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Climate Change – Arctic Shipping and possible future trends with reference to the various sectors of maritime transportation

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Maxakouli Kassiani, September 2022

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Abbreviations

IMO	International Maritime Organisation
PC	Polar Code
IACS	International Association of Classification Societies
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
SOLAS	International Convention for the Safety of Life at Sea
MARPOL	International Convention for the Prevention of Pollution from Ships
PWOM	Polar Water Operations Manual
IPS	Indigenous Peoples' Secretariat
PPs	Permanent Participants
ACAP	The Arctic Contaminants Action Program
AMAP	Arctic Monitoring and Assessment Programme
CAFF'S	Conservation of Arctic Flora Fauna
EPPR	Emergency Prevention, Preparedness and Response
PAME	Protection of the Arctic Marine Environment
SDWG	Sustainable Development Working Group
AC	Arctic Council
CRAP	Conference of Parliamentarians of the Arctic Region
NF	Northern Forum
AEC	Arctic Economic Council
EU	European Union
UNCLOS	United Nations Convention on the Law of the Sea
ND	Northern Dimension
UNFCCC	UN Framework Convention on Climate Change
AZRF	Arctic zone of the Russian Federation
NSR	Northern Sea Route
NWP	Northwest Passage
IPCC	Intergovernmental Panel on Climate Change
NEP	Northeast Passage
HFO	Heavy Fuel Oil
AWPPA	Arctic Waters Pollution Prevention Act
NAECA	National Appliance Energy Conservation Act
CANSR	Chief Administration of the Northern Sea Route
PSC	Port State Control
FSC	Flag State Control

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Abstract

Climate change is producing maritime navigation opportunities in the Arctic. Melting sea ice in the summer months is increasing shipping and other vessel traffic. The navigation in the Arctic depends on a number of factors: the trajectory of climate change, the level of cooperation among Arctic states, infrastructure investments, emergency management and advancements in technology.

The object of this dissertation is the analysis of the extension of ice caps that will be reduced considerably in the near future and this reduction will offer a wider window of usage of the Arctic Ocean through the NSR and the other Arctic routes.

The first chapter will analyze in more detail the problem of global warming. This will be followed by the Arctic geography and after that, will explain widespread changes in sea ice, sea-level rise and other physical features and characteristics of the Arctic environment. At the same time, explain the high concern of natural environment from direct human interference.

The second and third chapter presents the heightened interest of the world community, governance of shipping activities of international shipping in the Arctic and Intergovernmental organizations and politics.

The fourth chapter will analyze the significant early history of NSR, NWP and NEP and will explain the ship traffic of the Arctic.

The fifth chapter will describe the navigation of the NSR, also the challenges and opportunities to Russia's position. Finally, I will describe the environmental impacts of the increased use of the NSR.

Introduction

Global warming that refers to climate change has become a hot topic on the international agenda. One of the issues receiving much attention has been the Arctic, not only for regional states, but also for countries that are geographically remote from this part of the world. Over the past 49 years, the Arctic has warmed three times faster than the world as a whole, leading to rapid and widespread changes in sea ice, land ice, snow cover, and other physical features and characteristics of the Arctic environment.

Ship traffic is increasing in the Arctic, facilitated by reduction in sea ice cover and ice thickness as a result of global warming, resulting in greater marine access and longer navigation seasons. The future reduction in sea ice will bring with it a new set of challenges and risks.

The future is uncertain. If Arctic ice coverage continues to be reduced at the rates it has been, then it is highly likely that it will become an area of marine activity. Future development of Arctic shipping will depend on predictability and economy-of-scale, all of which are currently limited due to regulators and the governance of shipping activities that are characterized by efforts to promote maritime regulations, procedures, security and protection of the environment from damage by accidents, well as harmonization and uniformity in international maritime law and standards.

PART I CLIMATE CHANGE - PHYSICAL AND NATURAL ENVIRONMENT

Chapter 1 Global warming

It is widely known that the term global change refers to climate change, in particular, climate warming. However, this is but one aspect of global change. According to Will Steflen "global change' refers to the broad suite of human-caused changes to the biological world, the physical world (e.g., climate change, ice sheet change, sea level change, etc.), and the socioeconomic changes that are affecting Earth System functioning at the global scale.

Global change includes the transformations of global environments that have occurred over the past few centuries, including major changes in land use and land cover, the growth of cities, the growth of international travel, commerce, and increases in the pollution of the air, water and land. It also, includes human interference in natural cycles, such as the damming of rivers and streams, alterations to the nitrogen and carbon cycles, disruption of marine and terrestrial food chains and reduction of biological diversity (Elias, 2021).

Climate change is a global problem the impacts of which are more evident in the Arctic compared to other regions of the world. Over the past 49 years, the Arctic has warmed three times faster than the world as a whole, leading to rapid and widespread changes in sea ice, land ice, and snow cover, as well as in other physical features and characteristics of the Arctic environment. There are consequences, concerning the rapid loss of the Greenland Ice Sheet and other Arctic land ice that contributes more to global sea level rise than does the melting of ice in Antarctica. Climate change affects Arctic ecosystems that can induce feedback to the global climate system, although the future direction and magnitude of these feedbacks remain unclear. Along with the undeniable negative impacts these consequences bring opportunities for the new shipping routes, access to oil, gas, mineral resources and changes in Arctic fisheries that have economic consequences within and outside the Arctic. Finally, climate change also affects species that migrate between the Arctic and southern latitudes.

1.1 The Arctic Geography

The Arctic is the region surrounding the North Pole. There is no single correct definition of the region as the southern boundary varies. The Arctic Circle 66° (degrees) 33'' (minutes) delimits the Arctic in terms of solar radiation. In theory, areas north of the Arctic Circle have at least one day without daylight in the winter and at least one night-less night in the summer. In practice, this does not happen everywhere because the surface of the earth is uneven, and the light refracts in the

atmosphere. The monthly average temperature in the Arctic is below + 10 ° C throughout the year, even in summer.

Figure 1: The Arctic Ocean, this is a map over the Arctic region, containing regional name definitions.

It is true that the geography of the Arctic places some unique challenges to shipping. It is remote, very shallow in places, and presents several chokepoints that ships must pass through. Until quite recently, traversing the frozen Northwest Passage (NWP) was an extremely hazardous journey, requiring the avoidance of thousands of giant icebergs rising 100 m. However, this has now changed. Amplified warming of the Arctic is causing sea ice to melt, creating easier access to its waters. In the summer of 2007, the entire NWP route was ice-free for the first time in recorded history. The NWP, made up of straits through the Canadian Arctic Archipelago that are at times both narrow and shallow, these straits are easily clogged by free floating ice, and are still insufficiently surveyed, presenting the very real risks of grounding or becoming stuck in ice.

The Northeast Passage which Russians call the NSR presents a less complex situation. Because of the decrease of the Ice Sea along the Siberian coast average sailing times on NSR have decreased from 20 days in the 1990s to 11 days in 2013. The passing from the NSR eliminates the cost of using the Panama or Suez Canal. Sailing routes between Europe and East Asian ports through the Arctic Ocean along the NSR are about 11,100 km shorter than the routes around the Cape of Good Hope and are about 5000 km shorter than the Europe to East Asia routes via Suez Canal. Also, the NSR route is shorter than the Panama Canal route by about 10,000 km. However, the use of

NSR carries risks. The ship must be escorted by icebreakers, and if ice is sufficiently sparse that they can pass to the North of the islands. (Elias, 2021)

1.2 Loss of Sea Ice

According to the National Aeronautics and Space Administration (NASA), the arctic sea ice extent has declined significantly in all months since satellite measurements began in 1979. Arctic sea ice reaches its minimum each September and the rate of decline is 13% per decade, relative to the 1981 to 2010 average. The 2012 sea ice extent is the lowest in the satellite record. (Administration, 2022)

Due to the warming, snow and ice cover on land and sea ice cover over the Arctic Ocean and adjacent seas are currently diminishing. But, snow and ice cover are necessary to the maintenance of cold conditions in the Arctic. The white surface of the Arctic reflects solar energy back into space, this reflectivity is called albedo. Snow has an even higher albedo than sea ice. Thick sea ice supports a cover of snow and reflects as much as 90% of the incoming solar radiation. The snow cover of the Arctic is crucial because without it on the sea ice, the ice reflects from 50% to70% of the incoming energy. If the snow cover on sea ice melts, shallow melt ponds form.

Figure 2: Floating ice floes along one edge of Fram Strait. Photograph: Denis Sinyakov/Greenpeace, The Guardian https://www.theguardian.com/environment/2019/jun/07/oceans-demise-the-end-of-the-arctic-as-we-know-it

These ponds have an albedo of approximately 0.2 - 0.4, reducing the overall surface albedo to about 0.75. As melt ponds grow and deepen, the surface albedo drops to 0.15. So, the open ocean reflects only 6% of the incoming solar radiation and absorbs

the rest. Because this system forms a positive feedback loop both summer and winter sea ice cover are predicted to disappear from the Arctic Ocean in the coming decades. As sea ice extent has decreased, the exposed sea waters and adjacent atmosphere become warmer, since the dark surface of the water absorbs more solar energy. This oceanic warming spreads onto the adjacent Arctic lands, causing the ground surfaces to warm, contributing to the melting of permafrost. (Elias, 2021)

In recent years oceanographers and climatologists have come to realize the global importance of Arctic sea-ice cover. It is known that the presence of a largely white surface over the Arctic Ocean helps maintain cold temperatures over a wide region and that the replacement of white surfaces with dark, open ocean drastically lowers Arctic albedo, thereby contributing significantly to amplified warming in the Arctic.

The world community started paying attention to climate change in the 1990s, leading to the Rio Earth Summit (1992), the Kyoto Protocol (1997), the Copenhagen Accord (2009), the Cancun Agreements (2010), the Durban Platform for Enhanced Action (2011), and the Paris Agreement (2015). But these discoveries have taken place while Arctic sea ice is in the process of disappearing. According to the studies, only with the strictest adherence to reductions in GHG emissions can Arctic sea ice survive the next few decades. This would require the world to adopt GHG emission reductions to the level described in the RCP 2.6 scenario, which the Intergovernmental Panel on Climate Change considers its “best case” scenario. The RCP 2.6 scenario is a so-called "peak" scenario, which means the radiative forcing level reaches 3.1 W/m2 by mid-century but returns to 2.6 W/m2 by 2100. (Sphere, 2022)

The presence of sea ice in the Arctic is likely to drive increased human activity in the area resulting in greater transit and destination shipping activity and land-based resource extraction and processing. The future reduction in sea ice will bring with it a new set of challenges and risks.

1.2.1 Seasonality

The decline in the floating sea ice cover in the Arctic is one of the most striking manifestations of climate change, several studies have reported that the Arctic sea ice melt season has extended by 3 days per decade since 1979 due to earlier melt onset and 7 days per decade due to later freeze-up. This longer melt season is consistent with the observed loss of sea ice extent and thickness. While the melt onset trends are smaller, they play a large role in the earlier development of open water and melt pond development which enhances the sea ice albedo feedback. Observed reductions in the duration of seasonal sea ice cover are reflected in community-based observations of decreased length of time in which activities can safely take place on sea ice.

Changes in the duration of Antarctic Sea ice cover over 1979–2011 largely followed the spatial pattern of sea ice extent trends with reduced ice cover duration in the

Amundsen/Bellingshausen Sea region in summer and autumn owing to earlier retreat and later advance, and increases in the Ross Sea due to later ice retreat and earlier advance. (Notz, 2018)

1.3. Sea Level Rise

Sea-level rise is a major effect of climate change. High projected rates of future sea-level rise have captured the attention of the world because higher sea levels in the future would cause serious impacts in various parts. The ice sheets on Greenland and Antarctica contain most of the fresh water on the Earth's surface. As a consequence, they have the greatest potential to cause changes in sea level.

Ice sheets change sea level through the loss or gain of ice above flotation, defined as the ice thickness in exceedance of the smallest thickness that would remain in contact with the sea floor at hydrostatic equilibrium. Ice sheets gain or lose mass through changes in surface mass balance, the sum of accumulation and ablation controlled by atmospheric processes, the loss of ice to the ocean though melting of ice shelves, and by calving (breaking off of ice bergs). Ice shelves, the floating extensions of grounded ice flowing into the ocean do not directly contribute to sea level, but they play an important role in ice sheet dynamics by providing resistance to the seaward flow of the grounded ice upstream.

The latest scientific understanding has been assessed in a systematic way by the Intergovernmental Panel on Climate Change (IPCC). According to IPCC future rise in global mean on sea level caused by thermal expansion, melting of glaciers and ice sheets and land water storage changes, is strongly dependent on which Representative Concentration Pathway emission scenario is followed in the future. Sea level rise at the end of the century is projected to be faster under all scenarios, including those compatible with achieving the long-term temperature goal set out in the Paris Agreement. Global meal sea level will rise between 0.43 m (0.29–0.59 m, likely range) and 0.84 m (0.61–1.10 m, likely range) by 2100 (medium confidence) relative to 1986–2005. Beyond 2100, sea level will continue to rise for centuries due to continuing deep ocean heat uptake and mass loss of the Greenland Ice Sheet and Antarctica Ice Sheet and will remain elevated for thousands of years (high confidence). Antarctica could contribute up to 28 cm of sea level rise by the end of the century (medium confidence).

1.4 Natural Environment

The Arctic temperatures are predicted by the IPCC (2014) to rise dramatically in the coming decades. It is true that, temperatures are already rising throughout the northern high latitudes. According to National Center for Environmental Information the

average annual land surface air temperature north of 60N for October 2018 - August 2019 was the second warmest since 1900. The warming air temperatures are driving changes in the Arctic environment that affect ecosystems and communities on a regional and global scale.

There is a high concern about the Arctic environment and biota. The loss of sea ice cover means the loss of the principal habitat of both marine mammals in terrestrial mammals that make their living on the sea ice in winter. Moreover, the regional warming brought on by the loss of sea-ice cover is affecting trophic relationships of plants and animals on land, such as the increased threat to the eggs and chicks of shorebirds and polar bears and walruses that they need sea ice and not warm water.

There are two principal categories of threats. The principal threat comes from global warming. This is an extensive hazard, as its effects are being felt throughout the Arctic, in terrestrial, freshwater, and marine environments. The current intensified, rapid changes in thermal regime affect a wide range of environmental parameters, exerting various stresses on regional fauna and flora. Because of Arctic amplification, the biota of all Arctic landscapes is currently facing far greater climate changes than the lower latitudes. The second principal threat comes from direct human interference on the landscape. This includes the development of industrial sites for the extraction of resources and permafrost degradation due to the building of uninsulated or poorly insulated structures on frozen soils. Not to mention the increased risks due to shipping, such risks are: accidental discharge of oil and other pollutants, gaseous exhaust emissions and particulate matter, and discharge of waste into the sea.

1.4.1 The Regulation of Heavy Fuel Oil in Arctic Shipping

The human activities have accelerated the speed of global warming and increased sea ice melting in polar areas. The recent reports from the IPCC and an Arctic Council working group, have noted that the Arctic Ocean may become ice-free during the summer season by mid-century. On the one hand, climate change is having fundamental adverse impacts on polar environments, but on the other hand provide opportunities for destinational and transit shipping in the Arctic. Shipping economics and natural resources exploitation are drivers for the increase in Arctic shipping. (Lasserre, 2018)

Concern for the Arctic environment has raised the attention from regulators regarding the issue of the volume of maritime traffic in the Arctic that has increased the use and carriage for use of heavy fuel oil (HFO) and carriage as bulk cargo. The burning of HFO emits black carbon, sulphur oxides, nitrogen oxides, and greenhouse gases (GHGs), which could aggravate global warming. Another major contributor to climate warming, after carbon dioxide, is black carbon. Moreover, HFO spills could cause far-

reaching harm to the Arctic environment as stated in the arctic marine shipping assessment-report 2009. (Aldo Chircop, 2020)

The IMO is setting new mandatory measures in order to cut the carbon intensity of international shipping. The IMO's Marine Environment Protection Committee (MEPC 76), met from 10 to 17 June 2021, and adopted amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, that will require ships to reduce their greenhouse gas emissions. The MEPC 76 adopted the amendments to MARPOL Annex I (addition of a new regulation 43A) about the prohibition on the use and carriage of HFO in the Arctic waters on and after 1 July 2024. The prohibition will cover the use and carriage for use as fuel of oils having a density at 15°C higher than 900 kg/m3 or a kinematic viscosity at 50°C higher than 180 mm2/s. The ships that would be exempted are those who engaged in securing the safety of ships, or in search and rescue operations, and ships dedicated to oil spill preparedness and response. Ships which meet certain construction standards with regard to oil fuel tank protection would need to comply on and after 1 July 2029. (Sea, 2021)

The vision of IMO is to reduce GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century. The levels and the principles of the ambition are as follows:

1. Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships

2. Carbon intensity of international shipping to decline

3. GHG emissions from international shipping to peak and decline (Sea, 2021) (adopted)

Successful achievement of the HFO regulatory strategies relies on good implementation and coordination among flag states, coastal states, and port states. These regulatory plans of action reflect various environmental, economic, and social impacts. By such staged regulatory strategies, the Arctic will be conserved and sustainably used for the interests of Indigenous peoples and all the other stakeholders.

PART II GOVERNANCE OF ARCTIC SHIPPING

Chapter 2 Governance and regulation of International shipping in the Arctic

The governance of shipping activities in the Arctic is characterized by efforts to promote safety, security, protection of the environment from damage by accidents well as harmonization and uniformity in international maritime law and standards. The Law of the Sea, as reflected in the 1982 United Nations Convention on the Law of the Sea (UNCLOS), sets out the legal framework for the regulation of shipping according to maritime zones of jurisdiction. Other international agreements address specific elements of shipping such as marine pollution prevention standards, ship safety, seafarer rights and qualifications and liability and compensation for spills. A wide range of actors affect the law, policy and practice applicable to shipping in the Arctic. In addition to governments, shipowners, cargo owners, insurers, port authorities, trade and labor union associations, among others, are involved in determining when and where shipping in the Arctic should occur and under what conditions.

2.1 The United Nations Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS), also called the Law of the Sea Convention or the Law of the Sea Treaty is an international agreement that establishes a legal framework for all marine and maritime activities. Between 1973 and 1982, the Secretariat of IMO (formerly IMCO) actively contributed to the work of the Third United Nations Conference on the Law of the Sea in order to ensure that the elaboration of IMO instruments conformed with the basic principles guiding the elaboration of UNCLOS. (Sea, 2021)

In 1982 was adopted, the United Nations Convention on the Law of the Sea. It lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It embodies in one instrument traditional rules for the uses of the oceans and at the same time introduces new legal concepts and regimes and addresses new concerns. The Convention also provides the framework for further development of specific areas of the law of the sea. (Engtro, 2021)

UNCLOS relies on international cooperation between intergovernmental organizations as a mechanism for the development, establishment and implementation of new conventions and regulations. So, “the competent international organization”,

as referred to in UNCLOS – being the lead institution to address maritime matters – is interpreted to mean the IMO. (Engtro, 2021)

2.2 Flag State Control (FSC)

Flag states play a crucial role in the governance of shipping. UNCLOS permits a state to fix conditions for granting its nationality to ships so long as there exists a "genuine link." Ships can only sail under the flag of one state at a time, for that reason the domestic state laws, such as criminal law, apply to those aboard its ships. Also it is important that the flag state must ensure that its ships conform to international rules and standards concerning matters such as safety at sea, pollution control and communication regulations. Also, every state shall exercise its jurisdiction and control over ships flying its flag and take necessary measures to ensure safety at sea, regarding the construction, equipment, seaworthiness of ships, the manning and labour conditions, and the training of crew members, according to the applicable regulations and requirements in the operating areas. Moreover, on the high seas, the flag state is granted exclusive jurisdiction with only limited exceptions.

It should be noted that the provisions of UNCLOS regarding the protection and preservation of the marine environment do not apply to any warship or other vessel owned or operated by a state and used, for the time being, only on government non-commercial service. (Todorov, 2020)

2.3 Port State Control (PSC)

Under general international law, the port state has the authority to impose conditions for the entry of foreign ships into its ports, so PSC is essentially the rights and obligations that international conventions, domestic regulations, or both confer on a national maritime authority or its affiliates. More specifically, PSC refers to the port state authority, which, in compliance with the relevant international conventions, exercises supervision and control over foreign ships voluntarily harboring in its ports to ensure that the condition of those ships and their equipment conform to international standards and that they are manned and operated according to related rules.

According to the United Nations Convention on the Law of the Sea (LOSC) there is a legal basis for the application of PSC in relation to the protection of the marine environment. Under Article 218 of the LOSC, a port state may investigate any discharge by a vessel voluntarily within one of its ports or at any of its offshore terminals in violation of applicable international rules and standards. (Bai, 2019)

2.4 The International Maritime Organization (IMO)

In 1948 an international conference in Geneva adopted a convention formally establishing IMO, the original name was the Inter-Governmental Maritime Consultative Organization, or IMCO, but in 1982 the name was changed to IMO. The IMO Convention entered into force in 1958 and the new Organization met for the first time the following year.

The IMO plays an instrumental role in generating maritime regulations, rules, standards, procedures and recommended practices governing international shipping. The institutional structure of the IMO consists of the Assembly, Council, Secretariat and specialized committees and sub-committees, responsible for keeping the regulatory framework of the IMO developed and maintained on a continuous basis. National delegations drive committee work and formally make decisions, heavily influenced by the participation and involvement of other intergovernmental and NGOs, encompassing a wide range of associations for industry, maritime labour, environmental protection.

As summarized by Article 1(a) of the Convention, the main purposes of the Organization are to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade. Another purpose is to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships. The Organization is also empowered to deal with administrative and legal matters related to these purposes. (standards, 2022)

2.5 The International Convention for the Safety of Life at Sea (SOLAS)

The SOLAS Convention is the most important of all international treaties because of the safety of merchant ships. In 1914 was adopted the first version, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960.

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety.

Flag states are responsible for ensuring compliance of their ships with SOLAS requirements, and certificates are prescribed as proof that this has been done. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on, followed by an Annex divided into 14 Chapters.

- Chapter I - General Provisions
- Chapter II-1 – Construction, Subdivision and stability, machinery and electrical installations

- Chapter II -2 – Fire protection, fire detection and fire extinction
- Chapter III – Life- saving appliances and arrangements
- Chapter IV - Radiocommunications
- Chapter V – Safety of navigation
- Chapter VI – Carriage of Cargoes
- Chapter VII – Carriage of dangerous goods
- Chapter VIII – Nuclear ships
- Chapter IX – Management for the Safe Operation of Ships
- Chapter X – Safety measures for high-speed craft
- Chapter XI-1 Special measures to enhance maritime safety
- Chapter XI-2 Special measures to enhance maritime security
- Chapter XII – Additional safety measures for bulk carriers
- Chapter XIII – Verification of compliance
- Chapter XIV – Safety measures for ships operating in polar waters

2.6 Polar Code

On January 1, 2017, the International Maritime Organisation adopted the International Code for ships Operating in Polar Waters (Polar Code) and came into force, applicable to the Arctic and Antarctic Oceans. The aims for implementing the Polar Code *are to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the IMO (International Maritime Organization* (IMO), 2017, p. 5), in order to increase the safety of ships' operation and mitigate the impact on the people and environment in the remote, vulnerable and potentially harsh polar waters.

The Code recognizes that polar waters may impose additional demands on ships beyond those normally encountered. It provides a mandatory framework for ships operating in polar waters. The main demands are related to safety, protection of the environment, and seafarer competence, and it is implemented through amendments to SOLAS (Safety of Life at Sea) MARPOL and the STCW.

2.6.1. Structure and key principles of the Polar Code

The implementation of the Polar Code was the first international mandatory regulation addressing risks present in polar water. PC was a milestone set of regulations and guidelines for polar shipping and consists of two main parts: Part I (Ship Safety) contains provisions on safety measures, made mandatory under the SOLAS convention and Part II (Pollution) contains provisions on measures to prevent pollution, made mandatory under the MARPOL convention. Furthermore, Parts I and

II are divided into two parts, with part one (I-A) being mandatory and part two (I-B) consisting of guidelines and recommendations to the mandatory provisions.

In Part I, ten references are made to standards and guidelines for ice types, ship structure, machinery installations, voyage-planning and operational assessments. These guidelines are based on a mechanistic risk analysis process, estimated risk values that are compared with risk acceptance criteria. As no guidelines have been issued for cold climate, the analytical techniques must be adapted to the environmental conditions. The prescriptive standards for construction referred to in the regulations were developed over time, based on empirical models aligned with regular norms for construction (load, structural response and safety margins). These standards and guidelines have not been modified since the application of the Polar Code, although "Requirements regarding Polar Class", sections I1 and I2, were revised in 2016. The geographical area of application in the Arctic is shown in the following figure. (Gudmestad, 2020)

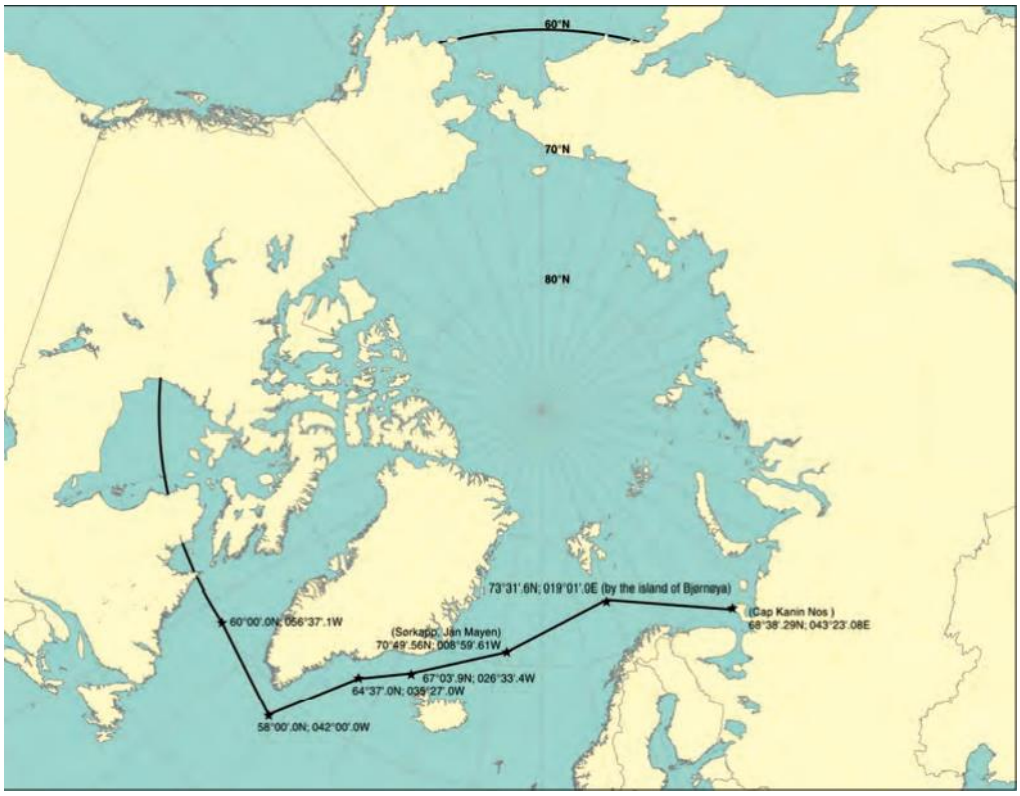

Figure 3: Maximum geographical extent of the Polar Code's area of application in the Arctic (International Maritime Organization, IMO, 2017)

Ships which comply with all requirements in the regulation are issued a Polar Ship Certificate on behalf of IMO. The certificate shall specify vessel type, ice class, polar service temperature, maximum expected time of rescue, vessel restrictions, operational limitations for ice conditions, temperature and high latitudes. The risk level may differ for this reason depending on the geographical location and time of

year, and mitigating measures required to address hazards may therefore vary within polar waters. Capabilities and limitations identified in the operational assessment performed for a vessel shall be documented in the Polar Water Operation Manual (PWOM), to be carried onboard when on voyage.

2.6.2. Goal-based standards (GBS) and Polar Ship Certificate

Goal-based standards are high-level standards and procedures that are to be met through regulations, rules and standards for ships. The GBS approach was used in the development of the Polar Code, regarding the design and construction of ships and equipment, operational conditions, training, and protection of the environment. GBS consist of at least one goal, functional requirements associated with that goal, and verification of conformity that rules/regulations meet the functional requirements including goals. In order to meet the goals and functional requirements, classification societies acting as recognized organizations and/or national Administrations will develop rules and regulations accordingly. These detailed requirements become a part of a GBS framework when they have been verified, by independent auditors and/or appropriate IMO organs, as conforming to the GBS. For example, one regulation for evacuation states that "Ships shall have means to ensure safe evacuation of persons, including safe deployment of survival equipment, when operating in ice-covered waters, or directly onto the ice, as applicable". The functional goals in the Polar Code facilitate interpretations and discretionary assessments, and those subject to the regulations must gain an extensive systemic understanding. The requirements in the Polar Code are distinctly functional, however descriptive guidelines for the analytical processes are provided. The regulations use specific definitions, in addition to definitions referred to in SOLAS and MARPOL, which are not rendered in the Polar Code. Those subject to the regulations must therefore be familiar with the existing IMO regulations. The Polar Code analytical approach specifies several explicit sources of hazards, such as icing, low temperatures and remoteness. (standards, 2022)

All ships that are constructed after the introduction of the Polar Code, 1 January 2017, entitled to operate in the application area of the regulations, are required to obtain a valid Polar Ship Certificate. Ships constructed before that date, operating in the same areas, was required to obtain the Polar Ship Certificate by the first intermediate or renewal survey, whichever occurs first, after 1 January 2018.

All SOLAS ships operating in polar waters will require a Polar Ship Certificate. This is a new statutory certificate issued by a vessel's flag administration or its authorized representatives. The Certificate attests that the ship complies with the ship safety requirements in Part I-A of the Polar Code. In order to obtain a Polar Ship Certificate, the owner must:

- *conduct an operational (risk) assessment of the ship and its intended operations in polar waters*
- *prepare a Polar Water Operational Manual (PWOM) specific to the ship, its arrangement and its intended operation in polar waters*
- *have the ship surveyed to verify its compliance with the relevant requirements of the Polar Code*
- *apply to its flag administration or authorized representative for the Polar Ship Certificate (DNV, The Polar Ship Certificate)* (Anon., 2022)

PART III INTERGOVERNMENTAL ORGANISATIONS AND POLITICS

Chapter 3 Intergovernmental Organisations and politics

Over the past several decades, the Arctic has become a hot topic on the international agenda, not only for regional states, but also for countries that are geographically remote from this part of the world. The heightened interest of the world community towards the Arctic could be explained by two factors: firstly, the Arctic coast, waters and shelf of its seas contain significant reserves of natural resources and secondly, the climatic transformations of the region have created favorable conditions for the use of sea lanes connecting the largest trade zones of America, Europe and Asia.

3.1 Intergovernmental organisations

There are many intergovernmental organizations that promote the development cooperation between Arctic States.

3.1.1 Arctic Council

The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, Arctic Indigenous peoples and other Arctic inhabitants on common Arctic issues, in particular on issues of sustainable development and environmental protection in the Arctic.

It was formally established in 1996.

The Arctic Council consists of eight Arctic states, so the founding document of the Council, the Ottawa Declaration, lists the following countries:

1. Canada
2. the Kingdom of Denmark, including Greenland and the Faroe Islands
3. Finland
4. Iceland
5. Norway
6. the Russian Federation
7. Sweden
8. the United States

These States have territories within the Arctic and thus carry the role of stewards of the region. Their national jurisdictions and international law govern the lands surrounding the Arctic Ocean and its waters. The Northern regions of the Arctic States are home to more than four million people, whose health and well-being is on the top of the Arctic Council's agenda.

It is important to mention that the Arctic Council is governed by Senior Arctic Official (SAO) meetings, which are held twice a year and biennial Ministerial

meetings. The chairmanship of the Council rotates between the eights states, each state holding the position for two years at a time. (ARCTIC COUNCIL, 2009)

Also, there is a category of Permanent Participants that is a unique feature of the Arctic Council. Six organizations representing Arctic Indigenous Peoples have status as Permanent Participants. This category was created to provide a means for active participation of the Arctic Indigenous Peoples within the Council.

The Permanent Participants have full consultation rights in connection with the Council's negotiations and decisions, and make valuable contributions to its activities in all areas. Their participation in the Council's projects and initiatives is facilitated by the Indigenous Peoples' Secretariat.

These are the six Arctic Indigenous organizations that hold Permanent Participant status in the Arctic Council:

Aleut International Association, Arctic Athabaskan Council, Gwich'in International Council, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, and the Saami Council.

Since the formation of the Arctic Council in 1996, the Indigenous peoples of the Arctic have played an important and vital role in shaping Arctic global policy for the past 20 years. With Permanent Participant status on the Arctic Council, the six Arctic Indigenous organizations sit alongside the eight member states to ensure the views of the approximate 500,000 Indigenous peoples of the Arctic are always considered and respected equally when decisions are being made. (ARCTIC COUNCIL, 2009)

There is the Indigenous Peoples' Secretariat (IPS) that supports all the Permanent Participants. They assist in creating opportunities for the Permanent Participants to present their causes, support the provision of necessary information and materials, and communicate information about their work in the Arctic Council and beyond. The IPS has announced Work Plan 2022-2023, which is inside the Senior Arctic Officials' Report.

The IPS work plan 2022-2023 is developed in consultation with the IPS Board, the six Permanent Participant organizations, and in light of Russia's Chairmanship program for 2021-2023. The IPS furthers planning and communication between the Permanent Participants (PPs) and Norway leading into Norway's Chairmanship commencing in 2023.

The IPS highlights the following themes the PPs' joint priorities for 2022-2023:

- Indigenous youth engagement;
- Arctic Indigenous languages; and
- Arctic Indigenous Peoples' cooperation

Since the IPS capacity may vary throughout the year, some work items may only be performed as time and resources permit. Work items that do not include a disclaimer referring to limited resources will be prioritized.

The Council's activities are primarily conducted in six Working Groups and one standalone Expert Group that cover a broad field of subjects, from climate change to emergency response, from mental health to sustainable development. (ARCTIC COUNCIL, 2009)

These are the six working groups:

The Arctic Contaminants Action Program (ACAP) works to prevent and reduce pollution and environmental risks in the Arctic. ACAP carries out demonstration projects to raise awareness and show possibilities to cut pollution in the Arctic and clean up. The Working Group encourages nations to strengthen policies and take actions to reduce pollutants and mitigate associated environmental, human health and socioeconomic risks. (ROUP, 2021)

The Arctic Monitoring and Assessment Programme (AMAP) aims to monitor and assess pollution and climate change issues in the Arctic. AMAP produces independent, science-based and peer-reviewed assessments of the status of pollution and climate change in the Arctic in order to provide the basis for sound policy- and decision-making – for the benefit of ecosystems and human health in the Arctic. (Council A. a., 2021)

The Conservation of Arctic Flora Fauna (CAFF's) mandate is to address the conservation of Arctic biodiversity, and to communicate its findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources. It provides a mechanism to develop common responses on issues of importance for the Arctic ecosystem such as development and economic pressures, conservation opportunities and political commitments. (Founa)

The Emergency Prevention, Preparedness and Response (EPPR) mandated to contribute to the prevention, preparedness and response to environmental and other emergencies, accidents and search and rescue. While not an operational response organization, EPPR conducts projects to address gaps, prepare strategies, share information, collect data, and collaborate with relevant partners on capabilities and research needs that exist in the Arctic.

The Protection of the Arctic Marine Environment (PAME) is the focal point of the Arctic Council's activities related to the protection and sustainable use of the Arctic marine environment. PAME addresses marine policy measures in response to environmental change from both land and sea-based activities. It develops and

coordinates strategic plans, programs, assessments and guidelines, complementing existing legal arrangements aimed at protection of the Arctic marine environment. (ENVIRONMENT, 2022)

The Sustainable Development Working Group (SDWG) focuses on the human dimensions of the Arctic. It works to protect and enhance the environment, economy, social conditions and health of Indigenous communities and Arctic inhabitants. The guiding tenet of SDWG's work is to pursue initiatives that provide practical knowledge and contribute to building the capacity of Indigenous Peoples and Arctic communities to respond to the challenges and benefits from the opportunities in the Arctic region.

Also, there is an expert group and its called Black Carbon and Methane, prompted by the climate impacts of black carbon and methane emissions in the Arctic, the Ministers of the Arctic Council adopted Enhanced Black Carbon and Methane Emissions Reductions: An Arctic Council Framework for Action in April 2015. To help implement the commitments outlined in this document, the Framework established an Expert Group on Black Carbon and Methane. The Expert Group was tasked with developing a biennial Summary of Progress and Recommendations based on the national reports and other relevant information.

So, the aim of Arctic Council is on a Strategic Plan 2021-2030 that guides its work towards the Arctic as a "region of peace, stability and constructive cooperation, that is a vibrant, prosperous, sustainable and secure home for all its inhabitants, including Indigenous Peoples, and where their rights and wellbeing are respected."

According to the Arctic Council: "There is no problem that we cannot solve together through our cooperative relationships on the basis of existing international law and good will." *Vision for the Arctic, 2013*

3.1.2 Arctic Ocean Conference

The initial Arctic Ocean Conference was held in Ilulissat (Greenland) on 27-29 May 2008.The Arctic Ocean standed at the threshold of significant changes. Climate change and the melting of ice had a potential impact on vulnerable ecosystems, the livelihoods of local inhabitants and indigenous communities, and the potential exploitation of natural resources.

Canada, Denmark, Norway, Russia and the United States discussed key issues relating to the Arctic Ocean. The meeting was significant because of its plans for environmental regulation, maritime security, mineral exploration, polar oil oversight, and transportation. Before the conclusion of the conference, the attendees announced the Ilulissat Declaration.

The conference was the first ever held at the ministerial level that included the five regional powers. It came at the invitation of Per Stig Møller, Denmark's Foreign Minister, and Hans Enoksen, Greenlands Premier in 2007 after several territorial disputes in the Arctic. States Møller, "We must continue to fulfill our obligations in the Arctic area until the UN decides who will have the right to the sea and the resources in the region. We must agree on the rules and what to do if climate changes make more shipping possible. We need to send a common political signal to both our own populations and the rest of the world that the five coastal states will address the opportunities and challenges in a responsible manner." (Conference, 2022)

These five coastal states cooperate closely in the Arctic Ocean with each other and with other interested parties. This cooperation includes the collection of scientific data concerning the continental shelf, the protection of the marine environment and other scientific research.

3.1.3 Conference of Parliamentarians of the Arctic Region

The Conference of Parliamentarians of the Arctic Region (CPAR), established in 1993, is a parliamentary body comprising delegations appointed by the national parliaments of the Arctic states (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the USA) and by the European Parliament. It also includes Permanent Participants representing indigenous peoples, and observers. The conference meets every two years.

The biennial conference is attended by representatives from the national parliaments of the Arctic states and the European Parliament. The Arctic indigenous peoples are permanent participants in the cooperation. Observers participate from governments and inter-parliamentary organizations as well as from observer states and relevant international organizations.

The Standing Committee of Parliamentarians of the Arctic Region, which is responsible for the work between conferences, started its activities in September 1994. The Standing Committee meets 3-4 times a year in the different Arctic countries to discuss current Arctic issues and the follow-up of the Conference Statement from the latest conference.

One of the major priorities of the Standing Committee was originally to support the establishment of the Arctic Council. Since then, the Standing Committee has worked actively to promote the work of the Council and participates in the meetings of the Arctic Council as an observer. Today the Committee is engaged in topics like: shipping possibilities, education and research, human development and climate change. (Council A. , 2022)

3.1.4. Northern Forum

The Northern Forum (NF) is a non-profit, international organization that was established on 8 November 1991 in Alaska USA and the North Forum Non-Profit Organization Certificate was issued on 29 November 1991.

The main aim of the NF is to improve the quality of life in the North and support regional sustainable development. The goals are to provide tools and opportunities for regional leaders in solving common problems, implementing joint socio-economic initiatives at the regional level, organizing events, ensuring active engagement in international forums and the implementation of projects of local and Global importance and supporting and enhancing active youth engagement.

The organization's development goal is to turn the NF into an effective, non-alternative structure for interregional and international cooperation of the regions of the North and the Arctic, which shapes world politics in this area and is an equal partner of international organizations with its own unique niche.

The NF is composed of fourteen sub-national or regional governments from five northern countries. The current NF regions are the following:

- Akureyri, is a town in northern Iceland.
- Alaska is a U.S. state located in the northwest extremity of North America.
- Chukotka Autonomous Okrug, Russia.
- Gangwon-do, Republic of South Korea.
- Kamchatka Krai, Russia.
- Khabarovski Krai, Russia.
- Khanty-Mansi Autonomous Oblast, Russia.
- Krasnoyarsk Krai, Russia.
- Lapland, Finland.
- Nenets Autonomous Okrug, Russia.
- Sakha Republic (Yakutia), Russia.
- Yamalo-Nenets Autonomous Okrug, Russia.

(Forum)

3.1.5 Arctic Economic Council (AEC)

The Arctic Economic Council is an independent organization that facilitates Arctic business-to-business activities and responsible economic development through the sharing of best practices. AEC was created by the Arctic Council during the 2013-2015 Canadian. Its membership includes more than 30 companies and organisations that all have interests in the High North. The main aim of AEC is to make the Arctic a favorable place to do business.

The purpose of the AEC is to facilitate Arctic business-to-business activities and responsible economic development. Based on the priorities set by the business forming the organization's membership, they focus on 5 themes:

The first overarching theme focuses on establishing strong market connections between Arctic states. Working to identify and remove trade obstacles at the circumpolar level is the key for AEC membership.

The second overarching theme is to promote stable and predictable regulatory frameworks. They support high standards of regulation, and support a predictable regulatory environment for all Arctic stakeholders where common standards make sense.

The third overarching theme encourages the use of public-private partnerships in infrastructure investments. There are 4 million people living north of the Arctic Circle. The need for infrastructure development is great and the cost is high, if not cost prohibitive for a single sector. Therefore, promoting public-private partnerships as a feasible option for pan-Arctic infrastructure development will go a long way in fostering responsible economic and business development in the North.

The fourth overarching theme focuses on creating closer ties between industry and academia. Exchange of information between academia and the business community will only strengthen the foundation for promotion of responsible economic growth. Industry and the academic world approach issues with a variety of perspectives, and through cooperation both industries can work to make the Arctic a favorable place to do business. Both sectors learn from each other in partnership.

The fifth overarching theme is a focus on traditional knowledge, stewardship and small and medium enterprise development. Traditional and local knowledge is a valuable resource that is a necessary de-risking agent to any Arctic project. Moreover, through this engagement process, businesses will learn what it means to be a good Arctic steward. It is of vital importance that they ensure that those interested in doing business in the Arctic are good stewards of their lands and environment.

The AEC is open to corporations, partnerships and indigenous groups that have an economic interest in the Arctic. The AEC Legacy membership includes three business representatives from each Arctic state and three representatives from each Permanent Participant organization. The AEC welcomes the participation of other stakeholders from across the globe as non-voting members.

Their members represent a wide range of businesses operating in the Arctic—from mining and shipping companies to reindeer herding and indigenous economic development corporations. This mix of interests across business sectors ensures that their work is carried out in an inclusive and sustainable manner. Representing the wide variety of Arctic businesses, it is important for the AEC to also be the voice of small and medium-sized enterprises. (Council A. E., 2022)

3.2 European Union (EU) member involvement

As a geopolitical power and a major economic player, the EU has strategic and day-to-day interests, both in the European Arctic as well as the broader Arctic region, and shares the responsibility for sustainable development there. The EU also has a fundamental interest in supporting multilateral cooperation in the Arctic and it is working to ensure that the Arctic remains safe, stable, sustainable, peaceful and prosperous.

The EU is a global leader in the fight against the climate and biodiversity crises, and is ready to play its full part and assume its global responsibility. Climate action is of particular importance to the Arctic, given the immense knock-on effects of Arctic warming. The consequences of this Arctic transition extend to the whole planet, and affect people in multiple ways.

The legislative proposals under the European Green Deal are at the heart of the EU's Arctic engagement, together with the EU's new approach for a sustainable blue economy, supported by science, innovation and regional investment.

While the EU has no direct coastline with the Arctic Ocean, it is inextricably linked to the Arctic, not only from historical, economic and geographical perspectives, but also as an importer of natural resources and through its wider concern and responsibility for the global environment. Furthermore, three Arctic countries are EU Member States Denmark, Sweden and Finland, while Iceland and Norway are members of the European Economic Area and the Scengen Area. (europa.eu.comission, 2022)

3.2.1. The Arctic footprint of the EU economy

According to the summary of the European Commission that was published in June 2021, the European Union influences the Arctic in a variety of ways. The footprint in the region is comparatively high because closest to the Arctic Circle are located some of the major industrialized regions of the EU. For this reason the emission of greenhouse gases leads to global warming, while pollutants such as persistent organic pollutants, black carbon, heavy metals like mercury, and micro- and macroplastics travel to the Arctic by air and ocean currents. Also, the global system of wind and ocean currents results in the Arctic becoming a sink for many of the pollutants, even though the northern local pollution sources are usually limited in scale.

The EU contributes to Arctic warming through an 8% share in global greenhouse gas emissions. In addition, the EU is responsible for around 36% of Arctic deposition of black carbon, which speeds up the warming of the Arctic, the melting of snow and ice surfaces, and is a harmful air pollutant. Black carbon is transported by air into the Arctic via wind patterns together with other pollutants. The European continent as a whole contributes 30-40% of persistent organic pollutants transported into the Arctic region. (Timo Koivurova, 2021)

The EU buys roughly one-fourth of Arctic hydrocarbon exports, including 87% of the liquified natural gas (LNG) produced in the Russian Arctic. Over 15% of vessels above 300 tones gross weight traversing Arctic waters fly EU Member States' flags or are owned by EU-based companies, being responsible for 31% of CO2 and 17% of black carbon emitted by Arctic shipping. Not to mention the fact that the EU has between 25% and 60% share in the imports of fish from North Atlantic countries.

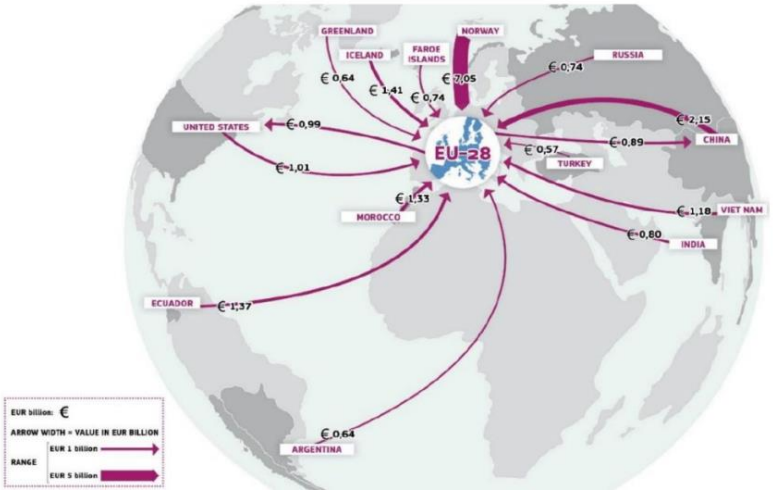

Figure 4: Most relevant extra-EU-28 (incl. UK) trade flows of seafood, 2019.

https://www.eumofa.eu/documents/20178/477018/EN_The+EU+fish+market_2021.pdf/27a6d912-a758-6065-c973-c1146ac93d30?t=1636964632989

Also, the EU imports raw materials, including critical minerals: 69% of gold, 51% of nickel and 48% of titanium exported by Arctic states find buyers within the EU. In 2019, EU-27 tourists constituted between 27% and 47% of visitors to the different regions of the European Arctic.

The EU contributes financially in a direct way to regional development, with the aim to make it sustainable. Arctic research is also strongly supported. Over EUR 200 million has been spent on Arctic research within the Horizon 2020 research and innovation program. In the 2014-2020 period, Greenland received EUR 217 million for education as a part of the overseas countries and territories partnership. During the same time, the EU spent over EUR 1 billion on mainstream (i.e. Investment for Growth and Jobs) cohesion policy programs in Arctic Finland and Sweden, as well as cross-border and transnational programs across the European Arctic. (Commission)

3.2.2 The enhancement of the EU role in the Arctic

The EU engagement for a peaceful, sustainable and prosperous Arctic is a geopolitical necessity. The Communication on the Arctic commits the EU to increased engagement in and around the Arctic region, in response to the geopolitical, environmental, economic, security and social challenges they face, and to working with others to manage new opportunities there. EU action according to Joint

Communication on a stronger EU engagement for the Arctic (Brussels, 13.10.2021), must be based on the United Nations Convention on the Law of the Sea (UNCLOS). Some of the actions are the following:

- The EU will increase its strategic foresight, particularly at the links between climate change and security. It will mainstream Arctic matters in its external diplomacy and build on regional cooperation. The EU will extend civil protection in order to decrease safety concerns. It will establish a permanent presence in Greenland to enhance our partnership and the visibility of EU actions on the ground.
- With the European Green Deal, including the new approach for a sustainable blue economy, and pursuing priorities at international level, the EU will seek to mitigate, adapt to and recover from climate change-related problems and offer European solutions to ensure a robust green and blue transition.
- The EU will invest in the future of people living in the Arctic with emphasis on education, to jobs including more involvement of young people, women and Indigenous Peoples in Arctic decision-making, on issues such as innovation and research, job creation, digital skills and education.
- The EU will prompt an innovative green transition, where the Arctic regions can showcase future-compatible job creation in innovative sectors, including: carbon-neutral energy, hydrogen, sustainable extractive industries, e-based learning, e-health, connectivity and infrastructure, sustainable tourism, green technologies, fisheries and agriculture. The EU will insist that oil, coal and gas stay in the ground, including in Arctic regions.

According to the Communication on the Arctic the EU will enhance its strategic foresight and its external diplomacy on regional cooperation, it will try to extend civil protection capacities and search and rescue cooperation and intensify research into permafrost thawing. The EU's policy is built upon the principles set out in UNCLOS, the United Nations 2030 Agenda and the Sustainable Development Goals, as well as its involvement in the work of the Arctic Council, the Barents Euro-Arctic Council and the Northern Dimension (ND) policy framework, the EU has built strong international networks on Arctic research as a diplomatic tool, including bilateral Science and Technology Cooperation Agreements with Canada, Russia and the US. Also, the EU has important ties with Greenland and the Faroe Islands. Both are part of the Kingdom of Denmark, and both are seeking closer relations with the EU. (Commission)

In order to make the Arctic more resilient to climate change the EU will act against major sources of pollution affecting the Arctic Regions in the air, on land and at sea, such as plastic/marine litter, black carbon, chemicals and transport emissions not to mention the unsustainable exploitation of natural resources. It is true that, Climate change and biodiversity are interdependent so the EU is a leading force in the negotiations under the UN Framework Convention on Climate Change (UNFCCC)

and the Convention on Biological Diversity. Moreover, the EU in order to be climate neutral by 2050, adopted a climate law, the "Fit for 55" is a package that aims to make the EU climate energy, land use, transport and taxation policies able to reduce net greenhouse gas emissions by at least 55% by 2030, and will be translated into sound policies and commitments that will benefit the Arctic. (Action, 2022)

3.3 Russian involvement

The most influential Arctic State with huge amounts of investments is Russia. The Northern Sea Route is controlled and administered entirely by Russia because it lies within Russian waters. There are also large oil, gas, and mineral deposits within the Russian Arctic. Russia sees the Arctic as not just of economic importance but also strategic importance. On June 8, 2015 the Russian government released their 'Integrated Development Plan for the Northern Sea Route 2015–2030', which stresses the importance of the NSR for maritime export of Russian natural resources and, importantly, for Russian national security.

3.3.1 Russia's key actors, economic interests and projects in the Arctic

Russia is located in the east of Europe and in the north of Asia, occupying about one-third of the territory of the Eurasian continent. However, the advantages of such a geographical position are quite contradictory. On the one hand, Russia remains the most extensive transcontinental state with a powerful belt of neighboring countries and with a transitional position between Europe and Asia, which allows it to fulfill the function of the Eurasian transit corridor. On the other hand, most of Russia's territory is located in a zone of low temperatures and severe climatic conditions, which makes it very difficult to conduct profitable economic activity there.

The advantage of the NSR is that it is the shortest waterway from North-West Europe to North-East Asia. As an example, the distance from Yokohama (Japan) to London (UK) is 11,400 nm through the Suez Canal and 12,580 nm through the Panama Canal. When passing through the NSR, these distances are reduced to 7200 nm, so the trip is shortened by 58% and 75%, respectively. (Halvor Schoyen, 2011)

On 5 March 2020, the Russian Government adopted Executive Order No 164 'Basic Principles of the Russian Federation State Policy in the Arctic to 2035'. This document defines goals, priorities, tasks and mechanisms for implementing Russia's state policy in the region, and demonstrates a high level of its continuity. The key Arctic actors in Russia are represented by two principal groups – governmental (the president administration, the government, federal executive agencies, regional and local governments, etc.) and non-governmental (interest groups/lobbies, business companies, political parties and associations, think tanks and mass media). For a long time, Russian companies – the largest of which are 'Novatek', 'VostokUgol', 'Norilsk

Nickel' and others – were successfully implementing their projects in the region related to extraction of the Arctic resources but as a result of the Ukraine crisis, in 2014 the US and EU begun to apply sanctions against Russia. For that reason sanctions stopped several important projects in the Arctic zone of the Russian Federation (AZRF). In order to resist the Western sanctions, Moscow launched a program of accelerated import substitution, and as a result they have only partially achieved their goals. (Kravchuk, 2020)

On 11 February 2020, the head of 'Rosneft' Igor Sechin presented to President Putin the plan to start a large-scale oil project in the Taymyr Peninsula – 'Vostok Oil'. According to Sechin, the resource base of the project is about 5 billion tons of oil, and the total amount of investments is expected to exceed 10 trillion rubles. (Kravchuk, 2020) It is reported that in summer of 2021, a total of 15 ships reportedly delivered 145,000 tons of construction materials to the remote coast. By late November, about 220 workers and 100 pieces of machinery were in production. So, 'Rosneft' restarted developing a huge energy cluster in the Arctic, while materials for its construction, as well as oil extraction and processing products will be transported through the NSR.

This project will have major consequences for the environment in the region. Within the framework of the Russian regional policy, the NSR had been assigned the role of a national transport artery so it could satisfy the transport needs of large companies engaged in resource extraction in the region. For that reason, in the last decade Moscow has taken a series of measures to improve the transport potential of the NSR. The first priority of Russia was to ensure the safety of navigation and provide the required level of emergency preparedness in the AZRF. In the Arctic, Russia has already deployed: two marine rescue coordination centers and three sub-centres under the Transport Ministry authority, and six search-and-rescue stations (SRS) under the Emergencies Ministry authority. Thus, the total number of rescuers in the Arctic has already exceeded 18 thousand people. (Kravchuk, 2020)

Another important focus of Russia's Arctic policy is the construction of new icebreakers. To implement future projects in the Eastern Arctic, where ice conditions are more severe than in the western part of the region, the country needs nuclear icebreakers. It is estimated that Russia has about 40 icebreakers of various types, only four of which are nuclear and all of them will be decommissioned between the years of 2023 and 2035. The only country that has built and operates nuclear-powered icebreakers as of 2022 is Russia.

3.3.2 The concept of shuttle transportation along the NSR

According to the NSR transit statistics the number of transit passages through the NSR was fluctuating and did not reach significant indicators – the highest number of trans-Arctic voyages on record was in 2013 (71 voyages), after which that figure has fallen sharply. This drop happened because of the fall in oil prices that made shipping

through the Suez and Panama Canals less costly. According to the statistical report for 2020, from the period 2016 to 2020 were recorded 617 different vessels, the total GRT amounted to 8 701 192 registered tons.

On the NSR, in 2020, 340 ships worked and 2905 voyages were completed. With the meaning "voyage", we comprehend the movement of a vessel from one port or water area to another port or water area.

VesselType	N Ships	N Voyages
General cargo	89	710
Tanker	49	750
Tug	32	108
Supply	29	154
Research	26	114
LNG Tanker	24	510
Bulk	18	49
Icebreaker	18	220
Dredger	14	33
SAR	9	26
Fishing	9	27
Container	8	171
Hopper	4	7
Drill rig	3	6
Heavy Load	3	5
Reefer	2	2
Drilling	1	2
Passenger	1	1
Pilot	1	7
Sailing	1	3
Total	**340**	**2905**

Figure 5: Analysis of shipping traffic in the NSR waters in 2020, Northern Sea Route Information Office.

Based on figure 2, 49 tankers made the largest number of voyages. The number of completed voyages for general cargo is 89 vessels and 710 voyages. There are LNG carriers with 510 voyages: all the voyages are for the export of LNG from the port of Sabetta, including return voyages.

According to the northern sea route information office, in 2010 the transit navigation on the NSR became more active. Over 11 years, they have recorded 378 transit voyages. This includes international transit, approximately 203 voyages and transit traffic between Russian ports about 175. Among all the transit traffic, 213 voyages were directed to the east and 165 to the west. There were actualized 54 international transits with the Russian flag, in second place 38 transits were ships under the flag of China and in third place were Norwegian vessels with 21 voyages. In 2020, transit traffic began on July 20 on the NSR waters and ended on November 17 leaving the NSR after the last transit voyage. During these incomplete 4 months, 64 voyages were made and the total volume of transported cargo amounted to 1 281010 tons. (Office)

The IMO Polar Code that entered into force in 2017 determines that only ce-class vessels, falling under one of the three established categories, can be used in the Arctic. But the total number of ice-class vessels in the world merchant fleet is limited,

as the world community has only recently begun to think seriously about the prospects of trans-Arctic shipping. The main trend in the world shipbuilding industry has been the production of large and super-large vessels of various types for transoceanic transportation, most of which are not capable of operating in the Arctic. For that reason, there are additional restrictions on trans-Arctic shipping, because the construction of ice-class vessels with technical characteristics meeting the requirements of the IMO Polar Code would require significant financial resources and time.

Given the shortage of vessels that can operate in ice-infested waters, it becomes clear that prolonged utilization of ice-class ships outside the Arctic Ocean is economically unprofitable. Taking this into account, the Russian Government has started searching ways for the most effective usage of ice-class vessels on the NSR. One of the ways became a plan to create two large logistics hubs at the entrances to the NSR (in its Western and Eastern parts) on the basis of 'non-freezing' ports of Murmansk and Petropavlovsk-Kamchatsky with year-round navigation.

All this period, the main problem in trans-Arctic shipping development along the NSR was related to the fact that Russia had not elaborated an attractive logistics model for effective use of the route. Today Russia offers foreign companies to use its territory- water area for cargo transportation and provides costly icebreaking services for that. But, according to many foreign experts the territory lacks the necessary infrastructure because some services that are provided and climatic conditions are quite dangerous for commercial navigation. (Jerome Verny, 2009)

3.4 Chinese involvement

3.4.1 China and the Arctic

It is common knowledge that China is an important stakeholder in Arctic affairs because, geographically, it is a "Near-Arctic State", one of the continental States that are closest to the Arctic Circle. The climate change in the Arctic has a direct impact on China's climate system and ecological environment, and, in turn, on its economic interests in agriculture, forestry, fishery, marine industry and other sectors. However, as a non-Arctic state, China has limited capacity to impact regional decision making directly. For that reason, China has engaged Arctic stakeholders in order to increase its participation and influence within northern regional affairs.

In January 2018, China published its first white paper edition on Arctic Policy. The concerns of China to the Arctic are mainly for the areas of climate change, resource and energy security (water and food security), and economic sustainability. China is highly interested about the impacts of climate change, both in the present and over the long term. It has already started working towards emissions reductions targets to mitigate the impacts of a changing global environment, as set by the Paris agreement.

In order to reduce the coal consumption, China has created approximately one-third of all wind turbines and solar panels in the world, mainly for export. Also, China has concerns with the long-term viability of water and food resources domestically. Climate change such as warming in the north of China, increased rainfall differentials between northeastern and southern China, and irregular patterns of drought and floods. China has linked increased days of haze pollution in Eastern China to Arctic warming patterns and loss of sea ice. Although there is more research to be done, scientists have noted a direct linkage between changes in the Arctic region and weather pattern changes within China. (Silog Piao, 2010)

The NSR is very important for China's motivation with Arctic development. This is evidenced by China's continued research and participation in dialogue, such as the Arctic Economic Council or Arctic Circle forum, regarding shipping and related infrastructure. This is because of several domestic factors, including increased pressure to identify shorter and faster shipping routes for exports, as China houses six of the ten busiest container ports in the World.

3.4.2 China's Policies and Positions on Participating in Arctic Affairs

According to China's Arctic Policy, 2018, the main policy goals on the Arctic are: to understand, protect, develop and participate in the governance of the Arctic, so as to safeguard the common interests of all countries and the international community in the Arctic, and promote sustainable development of the Arctic.

China Policies focuses on protection of the eco- environment of the Arctic, supports the Arctic coastal States in their efforts to reduce pollutants in the Arctic waters from land-based sources, in accordance with the relevant treaties, and commits itself to raising the environmental responsibility awareness of its citizens and enterprises. In order to effectively protect the marine environment of the Arctic, China works with other States to enhance control of the sources of marine pollution such as ship discharge, offshore dumping, and air pollution.

Secondly, China always gives priority to utilize arctic resources in a lawful and rational manner by encouraging its enterprises to engage in international cooperation on the exploration for and utilization of Arctic resources by making the best use of their advantages in capital, technology and domestic market. China supports that all activities to explore and utilize the Arctic should comply by treaties such as the UNCLOS and the Spitsbergen Treaty as well as general international law, respect the laws of the Arctic States. Due to global warming the Arctic shipping routes are likely to become significant routes for international trade. So separate to the Arctic Policy white paper China has described its plan to build a Polar Silk Road part of the Belt Road Initiative, an important cooperation initiative of China. This will bring opportunities for parties concerned to jointly build a "Polar Silk Road", and facilitate connectivity and sustainable economic and social development of the Arctic. It has

transacted studies on these routes and continuously strengthened hydrographic surveys with the aim to improve the navigation, security and logistical capacities in the Arctic. China hopes for stronger international cooperation on infrastructure construction and operation of the Arctic routes.

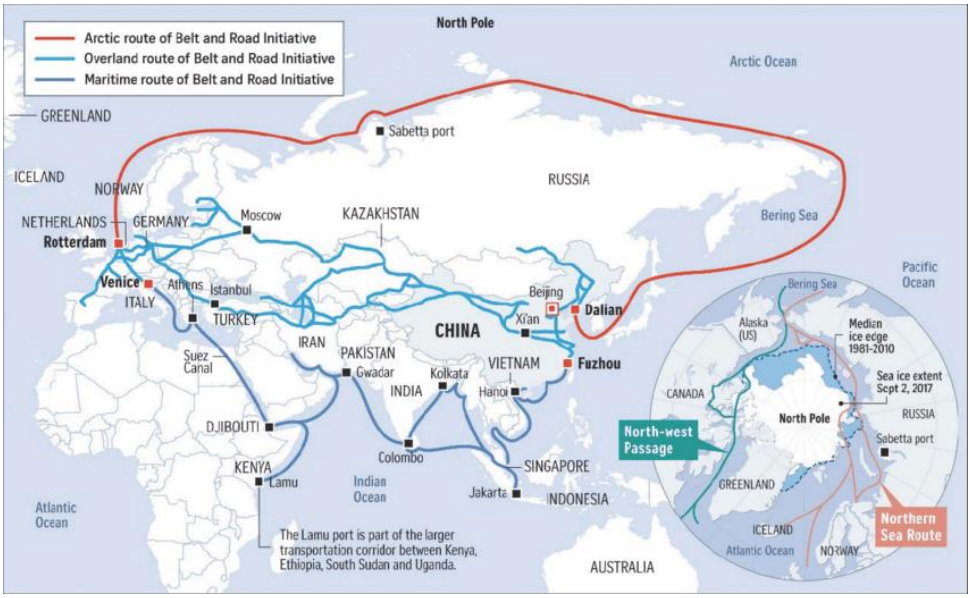

Figure 6: Map of existing and developing routes included in «Polar Silk Road»

Finally, according to China's Arctic Policy, China is committed to improve and to complement the Arctic Governance regime. It has worked to regulate and supervise the activities of legal persons or other organizations in the Arctic in accordance with the law to ensure that their activities accord with international law and respect the relevant national laws on environmental protection, resource conservation, and sustainable development. The Chinese desire is to improve international cooperation on the Arctic and try to strength such cooperation under the Belt and Road Initiative according to the principle of extensive consultation. These steps include coordinating development strategies with the Arctic States, encouraging joint efforts to build a blue economic passage linking China and Europe via the Arctic Ocean, enhancing Arctic digital connectivity, and building a global infrastructure network. China claims that it works for the common good of all parties and further common interests through the Arctic. (The State Council, The people's Republic of China, 2022)

3.5. Canadian Involvement

The effects of global warming in Arctic areas bring opportunities for increased shipping activities in the Canadian Arctic. However, it also causes concerns related to environmental pollution to vulnerable areas and impacts on ecosystems at local, regional, and global scales, which can further impact human health. Increased

maritime activities also create concern about safety risks associated with the navigation of vessels. Appropriate risk management strategies, tools, and equipment are essential to successfully mitigate these risks, with due consideration of concerns of rights-holders, stakeholders, and society at large.

3.5.1 Risks in the Canadian Arctic

The diminishing extent of sea ice in the Arctic led to an important decrease of ice coverage and this led to increased human activities such as hydrocarbon development, mining, shipping, fisheries, and tourism. Developments in offshore oil and gas extraction have attracted significant attention. The Canadian Northern Oil and Gas Annual Report, 2020, provides details on the exploration and development.

The message of the Minister was:

«Today, I am tabling before Parliament the annual report on the administration of the Canada Petroleum Resources Act in the Northwest Territories, Nunavut, and Northern offshore, for the year ending December 31, 2020. Taking into account the current state of oil and gas activity in the Arctic offshore, the Government of Canada continued its collaboration with Northern Indigenous partners, as well as territorial governments, to gather marine and climate change science in the Arctic offshore in regard to the moratorium on offshore oil and gas activities, which came into force in December 2016. The important work accomplished in 2020 is consistent with the Government's commitment to support a resilient and sustainable natural resources sector across Canada and in the North based on research and science, while respecting the rights and interests of Indigenous peoples and protecting the environment. » (Canada, 2020)

It is known that in December of 2016, the Government of Canada announced a moratorium on new oil and gas rights issuance in the Arctic offshore, subject to a five-year science-based review. The Government of Canada collaborates with Northern Partners to co-develop a science-based life-cycle assessment review in the Arctic offshore. So taking into account marine and climate change science, Canada is working with Northern Indigenous organizations and territorial governments in order to jointly administer the review with the science-based review committees that have commissioned new research which includes an Arctic offshore-wide resources assessment, an assessment of greenhouse gas emissions from potential offshore oil and gas development, and a survey of Arctic offshore well containment and control capabilities. The Northern Oil and Gas Annual Report 2020 objective of the collaborative review process is to assess the potential impact from Arctic offshore oil and gas exploration and development. The most existing licences clustered in the Beaufort Sea off Yukon and the Northwest Territories, and in the Arctic Islands Region in Nunavut. Currently, no production licences have been issued.

Region	Exploration Licence	Significant Discovery Licence	Production Licence	Former Rights[1]	Total
Arctic Islands of Nunavut	0	327,981	0	0	327,981
Eastern Arctic Offshore	0	11,184	0	0	11,184
Beaufort Sea	1,868,687	224,623	0	0	2,093,310
Norman Wells Proven Area	0	0	0	654	654
Total (in hectares)	1,868,687	563,788	0	654	2,433,129

By Interest Type (number of licences)

Region	Exploration Licence	Significant Discovery Licence	Production Licence	Former Rights[1]	Total
Arctic Islands of Nunavut	0	20	0	0	20
Eastern Arctic Offshore	0	1	0	0	1
Beaufort Sea	13	48	0	0	61
Norman Wells Proven Area	0	0	0	6	6
Total	13	69	0	6	88

Figure 7: Northern oil and gas annual report - Permits and/or leases issued under former legislative regimes and continued in force pursuant to subsection 112(2) of the Canada Petroleum Resources Act. https://www.rcaanc-cirnac.gc.ca/DAM/DAM-CIRNAC-RCAANC/DAM-NTHAFF/STAGING/texte-text/north_oil_gas_report_2020_1623700570699_eng.pdf

Focusing on shipping risks in the Canadian Arctic, various safety and environmental risks have been identified and studied, with possible effects on local, regional, or global scales in Council of Canadian Academies 2016.

As mentioned before, increased shipping in the Canadian Arctic brings various risks to the Arctic. There are risks to the vessel from the Arctic environment: for instance, hull damage can lead to loss of watertight integrity and loss of stability, and the harsh cold environments can lead to freezing of water spray and icing on deck, which can lead to accidents such as slips and falls. On the contrary, the ship can be considered as a hazard, which can cause opposite consequences to the environment. Moreover, vessel movements' lead to underwater noise, which can have harmful effects to marine biota because, can strike large marine mammals such as whales, leading to increased mortality in vulnerable populations. Accidental oil spills from damaged vessels can have disastrous consequences to entire ecosystems. Even the navigational presence of vessels in ice-covered waters may disrupt ice-bound transport or hunting routes used by Indigenous populations when navigation lanes are broken in sea ice fields and hence present a sociocultural risk. The adoption of the Polar Code has set new ship design and operational requirements for vessels operating in the Arctic according to Polar Code 2014/15. Under the supervision of the Arctic Council, agreements have been made between Arctic states addressing cooperation on marine oil pollution preparedness and response, aeronautical and maritime search and rescue in the Arctic. Within Canada, recent activities to mitigate Arctic shipping risks include the Low Impact Shipping Corridors Initiative, where voluntary shipping

corridors are proposed to enhance maritime safety and to minimize environmental impacts on ecologically delicate areas.

3.5.2. The international standards for ship emission

The International standards for ship emissions while navigating in the Arctic are lower than those in the National appliance energy conservation act (NAECA). Atmospheric emissions did not feature in the pollution prevention provisions of the International Code for Ships Operating in Polar Waters, 2014/2015 and amendments to MARPOL Annexes I, II, IV and V adopted by the MEPC in 2015. Canada implemented the Polar Code in 2017 through a new set of regulations, the Arctic Shipping Safety and Pollution Regulations, under the authority of the Arctic Waters Pollution Prevention (AWPPA) Act, 1970 and the Canada Shipping Act, 2001. The new regulations make no mention of ship emissions. All emissions in Canadian waters are regulated by the Vessel Pollution and Dangerous Chemicals Regulations under the Canada Shipping Act, 2001.

The Canadian Northwest Atlantic is an integral part of potential new navigation routes through the Northwest Passage, which ought to be subject to equivalent safety and environmental standards because the navigation occurs continuously through waters under Canadian sovereignty. The polar shipping standards should then extend to navigation in the Northwest Atlantic but in order to occur this, Canada would need to propose to the IMO the designation of its Northwest Atlantic waters as a special area under MARPOL Annexes I, II, IV and V. Hence, Canada should focus on equivalency of emissions to ensure that Canada's Indigenous peoples in the Arctic receive the same level of protection as their counterparts in the other Canadian coastal regions.

Canada has policy choices in terms of whether it should proceed with scaling up ship emission standards in Arctic waters to elevate them to the same level as those applicable in the NAECA. One route is to proceed unilaterally by invoking the power granted by Article 234 of the United Nations Convention on the Law of the Sea, 1982 (UNCLOS 1982). According to the article:

Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence. (Viatcheslav Gavrilov, 2019)

According to this provision, Canada has international legal authority to legislate and enforce pollution prevention standards for shipping in the 200-nautical mile EEZ (exclusive economic zone) in the Arctic as an ice-covered area for most of the year. This unique provision was specially negotiated at the order of Canada and is widely regarded as providing unilateral power to regulate vessel-source pollution prevention to a higher standard than the international norm and without a requirement to proceed through the IMO first. Such a move would apply only to Canadian Arctic waters as defined in the AWPPA in 1970. For this reason, Canadian Arctic waters, if not even the entirety of Arctic waters as defined for the purposes of the Polar Code, should receive protection from ship emissions at least equivalent to those applicable in the NAECA. This state is based on the need to protect the especially sensitive Arctic environment that is subject to multiple stressors and the imperative of protecting the health of Indigenous peoples.

3.5.3 Canadian Government - NWP

The NWP is debated issue between the Canadian government and the US. The Canadian government insists that the section of the route passing through its archipelago constitutes internal waters, and thus it claims it has full sovereignty over it. In opposition, the United States and others in the international community contend that the entire NWP is an international strait, subject to UNCLOS rules.

They have reached a settlement on the use of the route, while acknowledging their differences on sovereignty in the region. According to the Agreement between the Government of Canada and the Government of the United States of America on Arctic Cooperation, the United States “pledges that all navigation by U.S. icebreakers within waters claimed by Canada to be internal will be undertaken with the consent of the Government of Canada,” while Canada agrees to preemptively approve all requested U.S. transits. However, both countries acknowledge that the agreement does not influence their respective positions but instead allows them to move forward with continued NWP transits without controversy. (GOVERNMENT, 2022)

An increasing number of U.S. vessels could hazard various ecosystems in the Canadian archipelago and strain Canada’s search and rescue operations. And without an international resolution, or at least bilateral agreements in place, ships from other countries will be at a loss regarding whether to consider the route international or Canadian and the rules they should follow. (Boylan, 2021)

PART IV ARCTIC SHIPPING AND PORT DEVELOPMNET

Chapter 4 Shipping Routes

People have sailed in polar waters for decades, the Arctic Ocean and adjacent seas have been used by mariners since the beginning of time. There is significant early history with marine transport activities reflecting continuous indigenous marine use, expeditions and explorations, community supply/ re-supply and expanding use by the global shipping community. The first Arctic explorers were the indigenous people. With the passages discovered, the focus shifted from searching to improving marine routes. Many notable Arctic voyages occurred and the scope of Arctic marine shipping advanced such that vessels even ventured to the then elusive North Pole. A remarkable technological evolution has taken place bringing advances in ship design, construction and operation, coupled with advancements in infrastructure, crew training and governance.

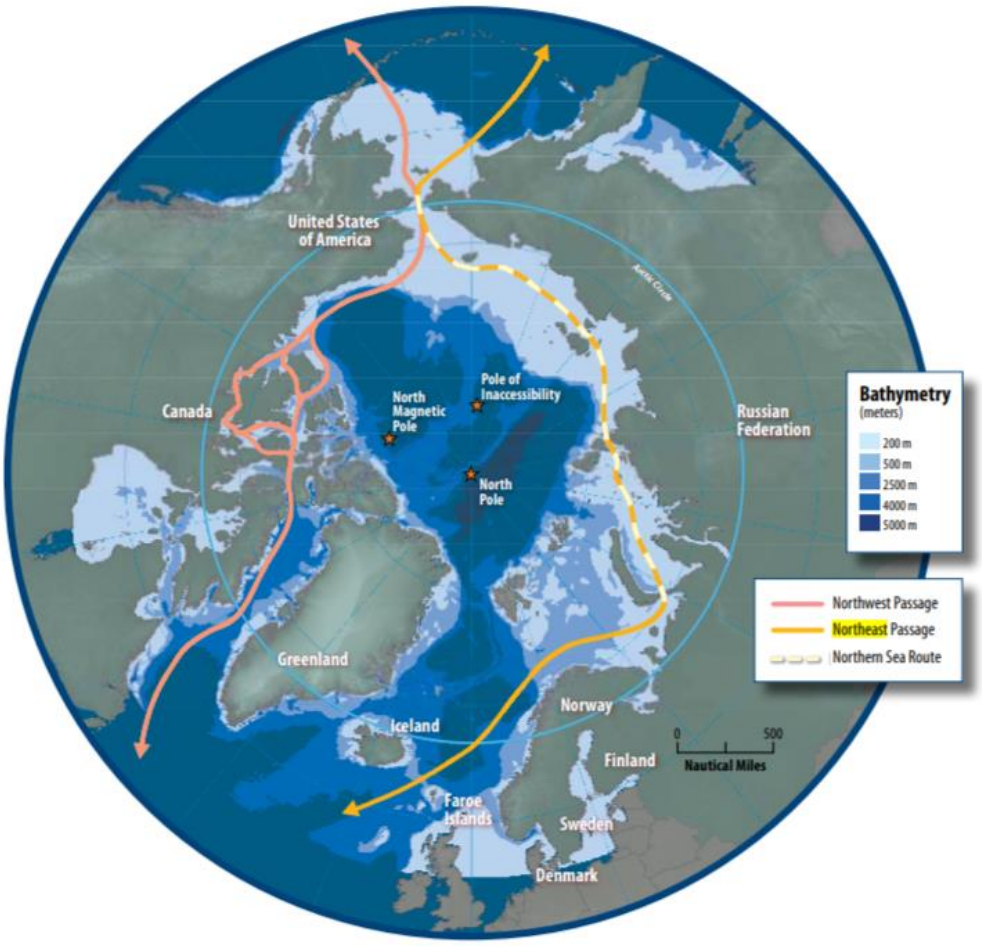

Figure 8: The Arctic Marine Area, (Arctic Marine Shipping Assessment, 2009)

4.1 The Northwest Passage

According to the Arctic Marine Shipping Assessment Report, 2009, in 325 B.C. the Greek navigator Pytheas was the first European Arctic explorer who sailed northward and is said that reached the vicinity of Iceland and perhaps even Greenland. In the late 9th century, the Norwegians found and colonized Iceland. After years, Icelandic explorers found and colonized Greenland, and explored the northeast coast of North America. It was not until the 1490s that Europeans began to investigate the possibility of a NWP in order to find a more direct route to the Orient and the lucrative trade with India, Southeast Asia and China. In 1497, John Cabot sailed from Bristol in Matthew in an unsuccessful search for the passage.

Historically it is mentioned that, in 1778, James Cook made the first attempt at locating the NWP from the west and in the 1800s, the Royal Navy explored the labyrinth of islands and channels that is now the Canadian Arctic Archipelago. Later, in 1845, Sir John Franklin's ships, the Erebus and Terror, sailed north into Baffin Bay and disappeared. The Royal Navy mounted a massive search during the following decade for Franklin and his 129 men and as a result, the entire archipelago was explored.

The first vessel that completed the NWP in 1906 was with the Norwegian explorer Roald Amundsen in the Pacific. Amundsen took three winters to complete the voyage and credit for his survival through the harsh Canadian winters goes to the Inuit. The first complete transit from west to east was completed in 1942 by the Canadian ship St. Roch. Captain Henry Larsen made the return trip from east to west in only 86 days and became the first vessel to transit the NWP in one season. Transits of the NWP after the St. Roch remained fairly sporadic until the 1970s.

- From 1945 to 1969, national security was the primary driver for navigation in the passage: the Canadian icebreaker HMCS Labrador became the first ship after the St. Roch, as well as the first armed Canadian ship to successfully complete transit of the NWP. Three years later, the Labrador escorted three U.S. Coast Guard icebreakers - Storis, Spar and Bramble - on part of the journey from west to east through the NWP.

- From the 1969 voyage of the American oil tanker Manhattan to the end of the 1980s, more than 30 complete transits of the passage were undertaken by a variety of vessels, as the focus shifted from national security to economic development. The bulk of the transits were Canadian vessels involved in the search for hydrocarbon resources offshore in the Canadian shelf in the Beaufort Sea. Also included in the period were tankers carrying fuel for the various explorations and bulk carriers transporting ore from the Nanisivik mine on Strathcona Sound. The year 1993 saw the Government of Canada spearhead an initiative bringing together various international shipping

companies and Arctic coastal states in an attempt to develop a shared set of international standards that could govern the operation and construction of vessels that would function in Arctic waters.

4.2 The Northern Sea Route

The Northern Sea Route extends from the Kara Gate in the west to the Bering Strait in the east. It was highly developed by the Soviet Union as an important national waterway, peaking in 1987 with 331 vessels on 1,306 voyages.

The history of the NSR can be distinguished by four stages:

1. Exploration and settlement, 1917-1932. In this period, the NSR was utilized for community re-supply, in addition to sporadic attempts at regional exploitation of resources such as furs, wood, fish, salt, coal, whaling and sealing. In 1932, a Soviet expedition led by Otto Yulievich Schmidt was the first to sail from Arkhangelsk to the Bering Strait in the same summer without wintering en route. The Northern Sea Route was officially open and exploitation began in 1935. Advanced Soviet navigational skills, technological capability and experience in ice navigation were unrivaled and traffic in the Arctic continued to grow. From 1917 to 1934 there were only two sinkings out of the 178 round-trip voyages across the Kara Sea to import finished goods to, and export timber from Igarka, along the Yenisei River in central Russia.
2. Organization of regular navigation coupled with the development of fleet and ports, 1932-early 1950. In this period administration of the Russian Arctic marine activity rested with the Chief Administration of the Northern Sea Route (CANSR), a direct arm of the Council of Peoples Commissars of the Soviet Union, with its goal *"to develop the NSR from the White Sea to the Bering Strait, to equip it, to keep it in good order, and to secure the safety of shipping along it."* Major additions were made to the Arctic fleet, which carried 100,000 to 300,000 tons of cargo annually and employed 40-150 ships per year.
3. Transformation of the newly developed NSR into a regular operating transportation line during the summer-autumn periods, early 1950s-late 1970s. In 1953 CANSR became a department under the Ministry of Merchant Marine in Moscow and for 17 years the infrastructure was improved to provide the capability for both summer and autumn shipping. In 1959, the Soviets launched the world's first nuclear powered surface ship, the icebreaker Lenin, extremely significant as it expanded the range of travel in isolated regions.
4. Efforts to establish year-round shipping, late 1970s-present. After CANSR became the Administration of the Northern Sea Route in 1970, the emphasis became year-round trafficability. By 1978-79, the western end of the NSR achieved year-round navigation with ships sailing between Murmansk and

Dudinka on a regular basis. Other landmark voyages during this era of Russian Arctic marine transport history include the 1977 voyage of the Arktika to the geographic North Pole and the first complete high latitude passage by the surface vessel Sibir in 1978. By the mid-80s, the total volume of traffic passages through the NSR amounted to 6.6 million tons annually.

Moreover, in the summer of 1991, the NSR was formally opened to non-Russian vessels only a few months before the Soviet Union was dissolved. Not to mention the several developments that has occurred during this modern period of Arctic marine transport history:

- the creation of the NSR Administration,
- the commissioning of the International Northern Sea Route Programme,
- the formation of the Noncommercial Partnership for the Cooperation of the Northern Sea Route Usages,
- leasing cargo space aboard Soviet SA-15 icebreaker cargo carriers,
- great strides in developing fleet and port infrastructure,
- and the establishment of year-round navigation in the western part of the Arctic.

The NSR is a substantially shorter passage (35-60 percent savings in distance) for shipping between northern European ports and those of the Far East and Alaska than routes through the Suez or Panama Canals.

4.3 The Northeast Passage

The Northeast Passage (NEP) is defined as the set of sea routes from northwest Europe around North Cape (Norway) and along the north coast of Eurasia and Siberia through the Bering Strait to the Pacific.

The search for a new route to reach China and India from the Atlantic via north of the Russian coastline spanned more than five centuries. The beginning in the 15th century with English, Dutch and Russian navigators sailing along the northern coast of Russia and far into the Arctic seas. The idea of a possible seaway connecting the Atlantic and the Pacific was first put forward by the diplomat Gerasimov in 1525, in Russia. However, Russian settlers and traders on the coasts of the White Sea, the Pomors, had been exploring parts of the route as early as the 11th century. By the 17th century they established a continuous sea route from Arkhangelsk as far east as the mouth of Yenise.

In 1648, the most famous expedition, led by Fedor Alekseev and Semyon Dezhnev, sailed east from the mouth of Kolyma to the Pacific and doubled the Chukchi Peninsula, thus proving that there was no land connection between Asia and North America. Another Russian explorer, in 1725 made a similar voyage in reverse,

starting in Kamchatka and going north to the strait that now bears his name. It was Bering who gave their current names to the Diomede Islands, discovered and first described by Dezhnev. In 1735, took place the second Great Northern Expedition.

The Northeast Passage (NEP) was not traversed by anyone until Baron Adolf Erik Nordenskjöld of Sweden accomplished the feat in 1878-79 aboard the Vega. Coupled with the ongoing search for a NEP, voyages using the Kara Sea route to Western Siberia played a pivotal role in Arctic marine transport. Two expeditions achieved transits of a substantial part of the NEP, including Fridjof Nansen's Fram (1893-1896) and the Baron Eduard Toll expedition on board Zarya (1900-1903). Maud, commanded by Roald Amundsen (1918-1920), was the fourth ship to complete a transit of the NEP and, as a result, Amundsen achieved the distinction of being the first person to circumnavigate the Arctic Ocean, since he had now linked up with the track of his voyage in the Gjoa. The first one-season transit route was not accomplished until 1934, when Glavsevmorput (Glavnoye Upravleniye Severnogo Morskogo Puti or GUSMP - Chief Administration of the NSR) mounted a successful attempt with the icebreaker Fedor Litke.

4.4. Ship traffic in the Arctic Region

As a result of global climate change the receding sea ice in the Arctic is enabling an increase in shipping across the northern polar region, connecting Asia and Europe by trans-Arctic routes along: the Northeast Passage and the Northern Sea Route, encompassing the route along the Norwegian and Russian Arctic coasts; the North West Passage, which follows Canada's northern coastline; and the Transpolar Sea Route, which bisects the Arctic Ocean through the North Pole.

Ship traffic in the Arctic can be divided into four main categories:

1. Oil tankers or Liquefied Natural Gas (LNG) tankers/condensate tankers and

tankers for refrigerated gas

2. Transport ships (with cargo other than oil or gas)

3. Passenger ships (including cruise ships)

4. Fishing vessels. (Engtro, 2021)

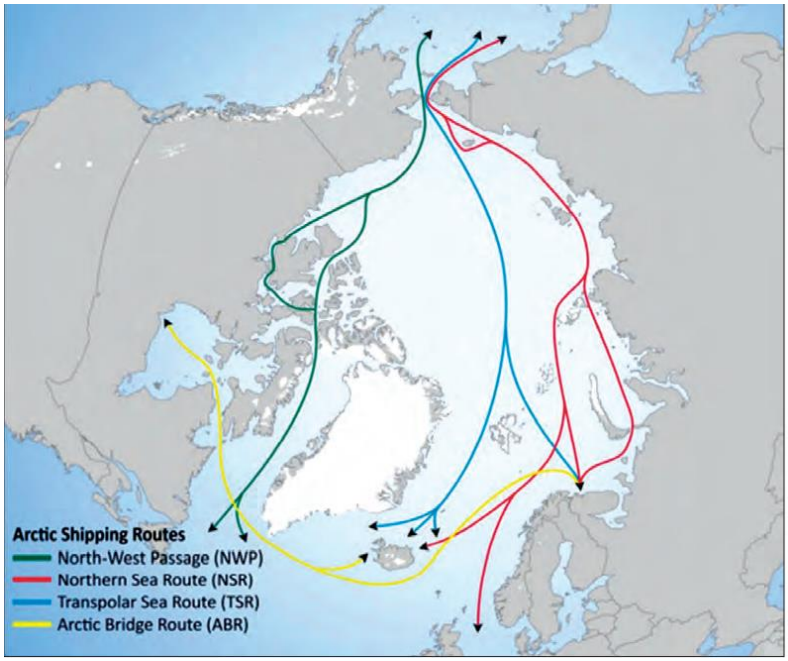

Figure 9: Shipping routes in the Arctic Region (The Arctic Institute)

According to the measurements of the volume of shipping within the Polar Code's geographical area of application in the Arctic, taken between 2013 and 2019, show a substantial increase in traffic, when counting both the number of individual ships (up 25 percent) and the total nautical distance sailed during the six-year period in the same area (up75 percent), thus Arctic navigation can no longer be considered a unilateral or bilateral issue but one that involves the larger community of states. (Anon., 2020)

Fishing vessels dominate both groups, representing more than 40 percent of all ships in the Arctic area, and, of the total distance sailed, fishing vessels account for 45 percent. However, fishing vessels are neither subject to the SOLAS Convention nor any other international safety regulations. According to a survey conducted by the IMO, more than 24,000 lives are lost in fishing operations around the world every year because of the harsh natural environment of polar waters. The IMO has worked to promote the international regime for the safety of fishing vessels. The 1977 Torremolinos International Convention for the Safety of Fishing Vessels is the first international convention on the safety of fishing vessels adopted by the IMO, but has yet to succeed in achieving ratification of the protocol by enough states with large numbers of fishing vessels. In addition to fishing vessels, cargo ships of less than 500 gross tonnage, ships not propelled by mechanical means, wooden ships of primitive build, and pleasure yachts not engaged in trade are exempt from the safety provisions of the Polar Code (Part I).

In 2016 and 2017, the passenger ship, Crystal Serenity, sailed through the NWP from Alaska to New York, with more than 1,000 passengers, on its first voyage so is expected an increase in passenger-ship traffic in the northern areas, especially due to

reduced sea ice enabling ship traffic in open waters between the Atlantic and the Pacific Oceans during short periods of the year. The cruise industry is profit driven and, to remain commercially competitive, costs related to safety equipment are often kept to a minimum.

Chapter 5 Developing shipping trends on the Northern Sea Route

5.1 Navigating the NSR

The Northern Sea Route (NSR) is a shipping route beginning from the Barents Sea in the West, near Russia's border with Norway, to the Bering Strait in the East between Siberia and Alaska. Voyages that take place in the NSR can be domestic voyages, destination voyages, transit voyages or international transit voyages. Domestic shipping is the dominant type of shipping activity on the NSR and a large majority of vessels are operated by Russian shipping companies. (Gunnarsson, 2021) Transit navigation on the NSR became more active in 2010. Noticeably, more voyages are currently taking place between NSR and European ports than between NSR and ports in North East Asia. This primarily explains the fact that the European shipping companies operating vessels on the NSR are more than Asian shipping companies.

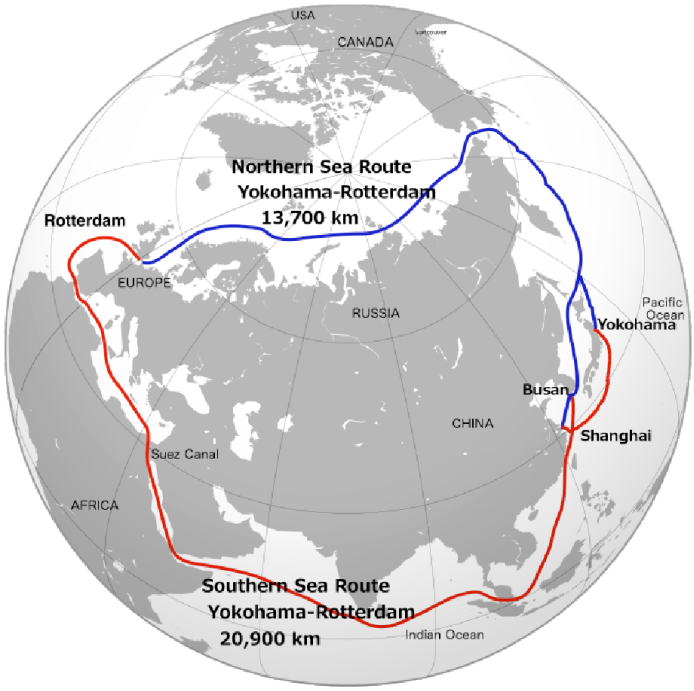

Figure 10: Northern Sea Route (Yokohama-Roterdam) Source: (Bekkers, 2016)

After years of operating for domestic voyages, in 1997, the Finnish oil tanker "Uikku" became the first non-Russian ship to use the NSR (P. Kujala, 2018). Since then, the route has been used by a variety of ships including tankers, dry cargo ships, heavy lift vessels and expedition cruise ships and Arctic Futures (PAME, n.d.). Ships use the route to supply remote communities and the traffic increase comes mainly from the shipping of Liquefied Natural Gas (LNG), crude oil, and coal, since 2014. Exploration of natural resources in Russia's Arctic has resulted in a large increase in cargo volume. (Humpert, 2018) Responding to these changes and after the NSR has begun to attract global attention, the Russian Government continues to expand and

modernize the permitting process under which ships of all flags can now enter or transit the region. Control of the waters is vested with the Northern Sea Route Administration (NSRA). (ABS, n.d.)

The NSR is now largely ice free for a limited time every year, as a result of global warming and is claimed to be an alternative shipping passage from Northern Europe to Asia, and at the same time (Sriram Rajagopal, 2021) (OPRI, 2021) a potential competitor to the conventional Suez canal route. By the end of the twenty-first century, the Northern Sea Route (NSR) should be ice free for three to six months per year (Vyacheslav C. Khon, 2010) and this leads to further significant opportunities, risks for commercial enterprises and coastal communities and at the same time pressure on states and international institutions to evolve governance systems to accommodate this new reality. The NSR is a large component of the Northeast Passage, which runs from the Atlantic to the Pacific Ocean. Some argue that using the NSR for a voyage from Northern Europe to China and vice versa can reduce the distance by almost 4,000 miles compared to the traditional route through the Suez Canal and it provides a competitive advantage in reducing overall transit time, implying greater vessel productivity over a calendar year and reducing bunker consumption with a reduction also in emissions. (ABS, n.d.). Commodity prices, ice-resistant ships, Russian regulations, and the need to modernize maritime infrastructure are among the influences on NSR usage (OPRI,2021). The American Bureau of Shipping (ABS) summarizes the advantages of the use of the NSR as follows:

- Distance from Northern Europe to China and vice versa, approx. 40% shorter than via the Suez Canal or 60% shorter via the Cape of Good Hope.
- Substantial reductions in transportation time, fuel consumption, environmental emission and eliminates piracy risk
- Further cost savings by generating return cargoes from the Far East
- Longer season-amount of ice reduced by 40% over the last 30 years
- Open for larger and a variety of vessels. (ABS, n.d.)

Despite these advantages, the climatic, technical, and economic conditions of the NSR, limits the number of transits. Moreover, some argue that the prospect of routinely using the NSR soon is low. Pruyn concludes that given increased time waiting and slow steaming and extra costs, ships will not find the NSR more attractive than the Suez Canal (Pruyn, 2016). After all, after the Suez Canal Obstruction in 2021 opportunities arise for the NSR. All in all there are a number of challenges and crucial details for navigating the NSR.

Yumashev et al. (2017) illustrates most of the physical and financial challenges of navigating NSR and his paper “Towards a balanced view of Arctic shipping: Estimating economic impacts of emissions from increased traffic on the Northern Sea Route”, is one of the more recent comprehensive assessments of economic and environmental benefits and costs of arctic shipping in scientific literature, with a

realistic shift towards the NSR within his modeling approach. (OECD/ITF, 2020). A variety of barriers that need to be mentioned are: the small number of ports and markets on the NSR, the limited navigability windows, year-on-year variations in season length, volatility of navigability within seasons and limited economies of scale. (Yumashev, 2017)

The huge unpredictability of the weather and sailing conditions along the NSR contribute significantly to the significantly low competitiveness of this route. This, despite a general decrease in sea-ice thickness and extent, facilitates increased vessel speeds and decreased costs. Another limitation of this route is its bathymetry. Areas of shallow water limit the size of vessels deployed on this route. (Aksenov, 2017)

The NSR can be divided into three principal climatic areas:

- Atlantic Area (Barents Sea, western part of the Kara Sea and part of the Arctic basin extending to the north of them). Frequent storms in winter and dull weather with frequent fogs and precipitation in summer are characteristic for this area
- Siberian Area (eastern part of the Kara Sea, Laptev Sea, western part of the East Siberian Sea). This area is influenced by the Siberian Low in winter. Air temperatures here tend to be lower than in surrounding areas in winter and higher in summer near the continental coast although the northern parts of the area remain cool even during summer.
- Pacific Area (eastern part of the East Siberian Sea, the Chukchi Sea). In winter it is strongly influenced by Pacific weather systems. Air temperature is higher and wind strength, and the amount of precipitation in this area are greater than in the surrounding areas. (team, n.d.)

Figure 11: Sailing along the NSR

5.2 Regulatory Context

According to the United Nations Convention on the Law of the Sea, coastal States have "the right to adopt and (Council, 2021) (GROUP, 2022)enforce non-discriminatory laws and regulations for the prevention, reduction and control of water pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly extreme climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the water environment could cause major polution to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence" (UN, 1982).

According to the Polar Code, nearly all ships with a gross tonnage over 500 tonnes that sail in the Arctic region should have at least a Polar Ship Certificate and a Polar Water Operational Manual and they have to include guidelines for lifeboats, vessel construction requirements, clothing, tools, survival packages, navigation devices, provisions, etc. The Code also addresses the anti-pollution rules, suggesting that any form of dumping chemicals is prohibited, as long as sewage water, chemicals, plastic material and food remains. (OECD/ITF, 2020)

The political management of the Northern Sea Route is disputatious. Although the route lies within Russia's EEZ, Russia claims that the NSR is a historically formed single national transportation route. There is no general agreement on the exact limit of the Arctic Ocean, and Canada and the Russian Federation claim part of these waters as internal, based on historic title and the drawing of straight baselines (Boone, 2013). Russia regulates all shipping on the NSR. Russia does this based on Article 234 of UNGLOS but also on historical grounds which defines the NSR as a national unified transport route of the Russian Federation (Sergunin, 2017). All shipping companies that are going to navigate through the NSR are allowed to ask for permission from the NSRA, the Russia's Northern Sea Route Administration.

5.3 Challenges and Opportunities of the NSR

The official requirements have been subject to significant change in the recent past and there are indications that the Russian Federation is contemplating introducing further changes in the near future in light of the increased traffic (ABS, n.d.). Laws and regulations must align to sustainable navigation and the protection and preservation of the marine environment based on the best available scientific evidence. Because of the sensitiveness and extreme environmental conditions in the arctic, such Russian regulation is a rational act and harmonizes with UNCLOS's article. (OPRI, 2021) Considering the extreme conditions in the Arctic the main problems that arise are crucial. Firstly, the absence of an emergency evacuation system and the provision of medical assistance to the crew of ships in the water area

of the Northern Sea Route need to be underlined. Additionally, delays in the development of the infrastructure of the NSR, the construction of icebreakers, rescue and auxiliary fleets in regard to the deadlines for the implementation of economic projects in the Arctic zone remain critical issues.

According to the "Strategy for Developing the Russian Arctic Zone and Ensuring National Security through 2035" the fulfillment of the main tasks in the field of social development of the NSR is ensured through the implementation of measures such as organization of medical support for navigation of ships, comprehensive development of the infrastructure of sea ports and shipping routes, the creation of a headquarters for maritime operations in shipping management, construction of hub ports and creation of a Russian container operator in order to ensure international and coastal shipping, the creation and development of a satellite constellation based on domestic equipment in highly elliptical orbits. (RF, 2020)

Shipping is the dominant way (in tones and value) of transporting goods all over the world. Globally, 90% of world trade in volume and 80% in value and the overwhelming majority of trade between non-neighbouring countries- is carried by ship. In 1869, the Suez Canal opened, allowing for direct passage from the Atlantic to the Indian Ocean, thus reducing shipping distances by 23% compared to passing the Cape of South Africa. However, due to the changing temperatures in the pole area, the Northern Sea Route (NSR) becomes more and more accessible. (OECD/ITF, 2020) The expected economic advantages that can be achieved in the Arctic creates a need to define who has the right to extract resources. International law allows for nations to claim ownership of up to 370 km of seabed off their coasts (known as the EEZ). Nations have the right to explore the waters and seabed within their EEZs but not the surface, which is considered international water. (OECD/ITF, 2020)

The extension of the ice caps will be reduced considerably in the near future and this reduction will offer a wider window of usage of the Arctic Ocean through the NSR, thereby allowing it to accommodate higher volumes of commercial traffic. Based on the above, the NSR is expected to remain a much targeted and desirable route, but much less used, in the next four decades.

Askenov et al. summarized the history and potential future of shipping via the NSR in their book called "Threats to the Arctic" (2017) in which they made detailed projections of ocean and sea ice conditions along the Siberian coast, forecasting conditions to the end of the 21st century. Their model used the worst-case IPCC emission scenario and the results show that in future time, large areas of open water will develop in the Arctic Ocean, in regions previously covered by pack ice. In this context they underlined that the savings, time and fuel for the NSR would be substantial less when compared with southern roots.

However, while projections have been made regarding the potential of NSR usage, there is a need for serious further study based on actual transits that have taken place

and empirical data that can be used to affirm, verify or doubt older projections and predictions. (Sriram Rajagopal, 2021)

5.4 Environmental Impact of the use of NSR

There are numerous hidden climatic and environmental costs that result from increased emissions in the Arctic region (Notz, 2018) (Yumashev, 2017). Gross gains from using the NSR in the RCP 8.5 scenario are USD 6.5 trillion in net present value (NPV). These gains are offset by climate losses (from CO2 emissions and short-lived pollutants) that account for USD 2.15 trillion (Yumashev, 2017).

The environmental impacts of the increased use of the NSR are not one dimensional:

- GHG-equivalent savings are offset by a higher environmental impact per unit of emissions in the Arctic context, despite a decrease in fuel consumption
- the reduced trade distances increase industrial productivity, leading to an increase in absolute GHG emissions
- Gains and losses are distributed unevenly over different regions. Regions that experience economic gains are not necessarily those that suffer from environmental losses.

The shipping industry has traditionally relied on heavy fuel oils (HFOs) that belong to some of the most polluting fossil fuels and generate a broad spectrum of emissions. The net effect is an increase in radiative forcing and thus global warming. Although there is decreasing fuel consumption, GHG-equivalent savings are offset by a higher environmental impact per unit of emissions in the Arctic context. Yumashev et al.'s (Yumashev, 2017) model run highlights the importance of SLCFs. It shows that 98.3% of the climate losses (USD 2.15 trillion) results from the SLCF shipping emissions. This underlines the importance of the impact of short-lived pollutants like black carbon and sulphate aerosols into climatically sensitive areas such as the Arctic.

Gains and losses are distributed in different and unequal ways over different regions. In this context countries that experience economic gains are not oftenly those that suffer environmental losses. At the same time, while net economic benefits are expected for global shipping, the local Arctic environment can be drastically negatively impacted. The remoteness of the NSR and its delicate ecology mean that the environment might be impacted disproportionally compared to other ecosystems. Due to its remoteness and infrastructure, environmental risks like oil spills are difficult to stop and can, therefore, have a significant impact on local ecosystems. Future shipping operations should consider these risks and should, where possible, mitigate them. For example, some of the main risks can be substantially reduced by the choice of fuel and the location of bunker tanks in the ship (OCIMF, 2017) However, from an environmental point of view, there is also an obvious link between the commercial shipping on the NSR, via the port, harbour and loading facilities, to

land-based development of harbour, ports, loading facilities, industry and infrastructure.

Currently, the NSR is only safely navigable for polar-class vessels during some summer months when the route is more or less ice-free. However, there is broad agreement that sea ice will continue to break apart and melt throughout this century. This trend implies that the extension of the ice caps will be reduced considerably in the near future. This reduction will offer a wider window of usage of the Arctic Ocean, thereby making it possible for the NSR to accommodate higher volumes of commercial traffic. (OCIMF, 2017)

All in all increased development of the NSR creates additional factors that inevitably will contribute to the current load in some way or another:

- Physical disturbance is generated by shipping operations, dredging of harbours and land-based developments such as oil and gas production.
- Contaminants like radionuclides from nuclear waste, petroleum hydrocarbons from extraction and transportation of oil and gas, and persistan organic pollutants from power stations, mining industry and landfills, are considered among the most pronounced threats to the NSR environment.
- Oil spills which may be the most serious impact. If this happens at the "wrong" place at the "wrong" time in the marine environment, the impact can be significant.
- The disturbance of the limnic and terrestrial environment.
- Chronic, long term-low level pollution may affect all ecosystem levels within a given area.
- Interaction between man-made noise and the environment.
- The adverse effects of contaminants that may be more severe in cold climate in the Arctic microorganisms.
- The bioaccumulation may reach the indigenous and local peoples if the natural resources within their main residence area and subsistence branches are affected.

Environmental damage in the Arctic may last for longer periods than in temperate regions. The transfer of damage in the food web is facilitated. In any ways however, the damage is a function of the fate of the impact factor, resources at risk and their ecological attributes. Consequently, the vulnerability of the Arctic organisms varies from species to species and between time periods and geographical regions.

The current environmental status of the NSR environment is a function of the load from NSR activities in the past as well as other factors that in some way or another have had or still have a significant influence on the NSR environment. Some of these factors are located within the Arctic, some are outside the Arctic. The basis for such comparisons however is vague. The resolution of the baseline data is in most cases

inappropriate for identification of temporal and spatial trends in key biochemical parameters (e.g. contaminant levels, population trends etc.). The corresponding comparison of sources and their importance, in terms of weighting the load from NSR activities vs. other loads within as well as outside the Arctic, cannot be measured quantitatively by scientific means. (J. Thomassen, 1999)

Chapter 6 Conclusion

The Arctic is an ocean surrounded by five coastal states and governed by the United Nations Convention on the Law of the Sea and associated instruments. Over the past decades the Arctic has witnessed a much faster than anticipated decline of sea ice and the continuation of this trend will transform the Arctic Ocean into a navigable seaway over the coming decades. As the governance regimes improve, this will attract more ships and other traffic.

The Polar Code is an IMO instrument that determines that only ice-class vessels can be used in the Arctic. The main trend in the world shipbuilding industry has been the production of large and super-large vessels of various types for transoceanic transportation, most of which are not capable of operating in the Arctic. For that reason, there are additional restrictions on trans-Arctic shipping, because the construction of ice-class vessels with technical characteristics meeting the requirements of the IMO Polar Code would require significant financial resources and time.

Of the Arctic routes, the NSR and NWP are most viable in the near future. Both routes connect the North Atlantic with the North Pacific, thus connecting Europe and Asia, east North America to Asia, and west North America to Europe. As traffic increase in the NWP and the rest of International Community (US, NATO) will need to resolve the routes legal status.

Given the shortage of vessels that can operate in ice-infested waters, it becomes clear that prolonged utilization of ice-class ships outside the Arctic Ocean is economically unprofitable. Taking this into account, the Russian Government has started searching ways for the most effective usage of ice-class vessels on the NSR. One of the ways became a plan to create two large logistics hubs at the entrances to the NSR (in its Western and Eastern parts) on the basis of ‘non-freezing’ ports of Murmansk and Petropavlovsk-Kamchatsky with year-round navigation. Russia might participate in the exchange of best practices related to shipping and port management, but it is unlikely to share the management of the Northern Sea Route with others states or the international community in the near future.

Considering the extreme conditions in the Arctic the main problems that arise are crucial. The extension of the ice caps will be reduced considerably in the near future

and this reduction will offer a wider window of usage of the Arctic Ocean through the NSR and the other routes.

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