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Research Article

Environmental Impact of Cruise Shipping in Arctic Region

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Abstract

The Arctic region has been gaining importance rapidly in recent years. Many parties and industries started to benefit from the region in different aspects. Gradually melting of glaciers and ice sheets due to global warming facilitated the growth of cruise tourism to be one of these aspects. The number of cruise ships and passengers in the Arctic has been increasing in the last decade, like growth in cruise industry globally. On the other hand, as the activities in the region increased, the possibility of environmental pollution that could occur in the region increased. The fact that the region has a sensitive and yet not fully explored ecosystem makes this environmental pollution potential even more important. In this paper, the impact of cruise tourism on environmental pollution in the Arctic region has been studied. Several factors were identified by reviewing the literature, reports, statistics, and legislation. These factors were clustered under main categories and possible impacts of each factor were discussed. Use of Heavy Fuel Oil (HFO) by cruise ships, amount of energy to operate cruise ships, waste generated onboard cruise ships and lack of infrastructure in the Arctic region were found as factors that have a crucial impact on the Arctic ecosystem.

Keywords: Arctic Region, Environmental Pollution, Cruise Ships, Cruise Tourism, Maritime Management..

Introduction

Until the pandemic crisis that broke out towards the end of 2019, especially in the last 10 years, the cruise tourism industry has shown a constantly growing trend. The number of cruise passengers increased to 29.7 million in 2019 while it was 17.8 million in 2009 (CLIA, 2019; Arlı and Bayırhan, 20201; Arlı and Ülker, 2021). During this growth, new cruise destinations became popular, as well as regions such as the Caribbean and the Mediterranean, which were very popular in the past.

The Arctic is one of these emerging cruise regions. As an inevitable result of global warming caused by increasing carbon dioxide and greenhouse gas emissions produced by burning fossil oils and deforestation, glaciers in the Arctic have been melting rapidly. Moreover, it is estimated that the region would be ice-free in the late summer months from the 2030s (Björk and Borennas, 2013; ACIA, 2004; AMAP, 2017; Acciaro, and Stemmler, 2018; AMAP, 2019; Acciaro, 2020). The changes in the region caused by the melting of the glaciers have an impact not only on the local climate, geography, and ecosystem but also on the global climate, ocean currents, weather patterns in mid-latitudes, and sea-level rise. (The Research Council of Norway, 2019) Hence, the sensitivity of the region can be accepted and the need for protection can be considered. On the other hand, previously inaccessible sea areas became navigable waters especially in summer and this created an attractive opportunity for many parties varying from governments to energy companies, shipping companies, or fishers because of commercial and governance interests. While cargo ships prefer Arctic routes for shorter distances, shorter voyage durations, and lower costs; cruise lines also started to benefit from the region by adding new destinations to their schedules. At this point, although Say's Law that the production of goods creates its own demand. In 1803, John Baptiste Say explained his theory (Economics, 2021), is not always true for today's money-based economy, it can be interpreted as supply created its own demand, and cruise passengers started to prefer these adventurous voyages.

Transatlantic ocean liners started carrying passengers from Europe to the United States after 1890. While these voyages were only for transportation purposes, the first ship built specifically for cruising made a voyage which was traveling from port to port with luxury design and leisure activities onboard. Cruise companies that realized that it is more lucrative, started to change their services to cruising instead of transporting. Industry experienced a regression when ships served to carry soldiers and ammunition. Also, development in intercontinental flights contributed to regression. During the 1980s, modern cruise ships set sail as floating luxury hotels with various entertainment activities, and the industry began a continuously growing journey. While there were only conventional ocean cruises in the past, the industry has been diversified and today river cruises and expedition cruises became much popular (Morgan and Power, 2011).

A vicious cycle may be the inevitable result in the future because changes in the region create a growing interest from many parties, but activities of these parties in the region can generate more carbon emission and other pollution resulting factors that cause melting of more glaciers. Although international organizations regulating the maritime sector have taken steps on the subject in recent years, the scope of existing maritime regulations may not be sufficient to protect the region since maritime activities in the region are relatively new.

Literature Review

Recent Literature on the Arctic

Due to considerable changes in the Arctic, studies regarding the region have been increasing in several fields. The fact that the blessings of the region have not been fully discovered yet enables studies in many different fields, while the potential damage to the region caused by the efforts to discover these blessings also creates research areas on their own. When recent studies about the region are examined, it is seen that marine biology and ecosystem, climate change, natural resources, economic activity, sovereignty, environmental pollution, and maritime transportation are emphasized topics. While both Arctic and non-Arctic governments have contributions to literature, it is noteworthy that publications about Arctic Canada are more than other countries. Biresselioğlu et. al. (2020) studied the increasing trends in Arctic literature and state that the first studies about the region started to appear in the 1980s and were generally in the field of natural sciences. Social sciences research such as international relations, economics, environmental studies, and transportation also started to take part in studies related to the region after the 1990s and there is a disciplinary shift from natural sciences to social sciences recently. Governance, energy, logistics, and security are prioritized themes of Arctic studies because of growing interest to benefit from future possibilities. Meng et. al. (2016) reviewed the literature on navigational feasibility and commercial viability of the Arctic and showed the increase in the number of publications. Meng also highlighted that these two topics are mainly segregated and emphasized the importance of merging these for future studies. Theocharis et. al. (2018) stressed the lack of systematic review of literature on economic feasibility and reviewed studies comparing Arctic routes and traditional routes from economic and environmental perspectives. It is highlighted that number of publications has grown significantly while Canada and China made the biggest contribution to literature. It is also emphasized that revenue and market factors, cost, navigational factors, and operational factors play vital roles in the decision-making process between the Arctic and traditional routes.

Geography of Arctic

In the scope of IMO Polar Code, the Arctic region is defined as waters which are located north of 60°N parallel for America and Asia shores and north of the line passing through the south of Greenland at 58°N parallel, north of Iceland, Island Jan Mayen, Island Bjornoya and Kanin Nos for the northern side of the Atlantic and Europe as shown in Figure 1 (IMO, 2017). Inland waters, territorial seas, and exclusive economic zones in the region are governed by eight countries: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and United States according to their geographic locations (URL 3, 2021).

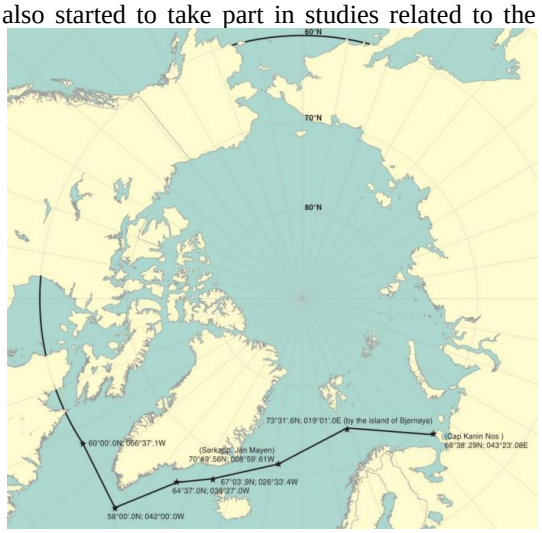

Fig. 1. Arctic Region in Polar Code (IMO, 2007).

Fig. 2. Major Passage Routes in Arctic Region (URL 1., 2009).

One of the various consequences of global climate change affecting the whole world is the alternative routes emerging in the Arctic Region (Lasserre, 2015; Bayırhan and Gazioğlu, 2021). Currently, there are two major passages located in the region. Northwest Passage is the route connecting the Pacific and Atlantic starting from Bering Strait and along the northern coasts of Alaska and Canada. It divides into various routes in Canadian Archipelago, converges again in the Baffin Bay between Greenland and Canada to reach the Atlantic by the Labrador Sea. Northeast Passage is the route connecting the Pacific and Atlantic from northwest Europe and along the North coast of Eurasia and Siberia through the Bering Strait (URL 1., 2009).

Svalbard Archipelago of Norway is the center of attraction for both cruise tourism and research activities. Location of the archipelago which is relatively in the

middle of Arctic countries and close to the North Pole can be considered as a reason for this. Warming of the Arctic is twice as high as in the rest of the world, and Svalbard has the fastest warming rate in the Arctic (The Research Council of Norway, 2019). Nyman et. al. (2020) stated that Svalbard has also the potential to be a development area for a new efficient route and is an exotic location with unique sightseeing activities for cruise tourists. Çetin and Büyüksağnak (2021) state that Svalbard has a unique geography, easy accessibility, and well-organized infrastructure that facilitates tourism, research, and education activities on polar disciplines.

The average air temperature on the surface of the Arctic reached the highest of all-time between October 2015 and September 2016. 2017-2018 was also the second highest and annual averages between 2014 and 2018 were higher than any other year in history. Warming in the Arctic is faster than the rest of the globe. Between 1971 and 2017, air temperatures experienced 2.4 times more increase than Northern Hemisphere. Ice sheets in Antarctic Sea retreats or sometimes disperses in summer while Arctic Sea ice can survive and create a remarkable amount of multi-year ice when compared to Antarctic (IMO, 2019). But, like temperatures, there have been significant changes in the ice sheet. The volume of Arctic ice sheets experienced a 75% decrease since 1979 and the lowest 12 average volumes of ice sheets were experienced in the last 12 years. (AMAP, 2019) Relation between increasing temperatures and melting ice sheets can be considered pessimistic for the future. Ice sheets protect Earth from warming by reflecting sunlight; therefore, the decrease in the ice sheets increases the warming, while the increasing warming causes more ice sheets to melt. Some models estimated that the Arctic may be ice-free in some months starting from the time between 2030 and 2050. Rising temperatures and melting ice not only affects the physical, chemical, and biological systems of the Arctic but also have direct and indirect effects on the rest of the Earth. Unusual behaviors of ocean streams, weather patterns, extreme temperatures, and rising sea level are the results found so far (URL 1, 2009; AMAP, 2019). Also, IMO (2019) defines marine environment of the Arctic as vulnerable. There are still inaccessible areas within the Arctic region and the physical structure and ecosystem of these areas have not yet been discovered. It can be predicted that the access to these areas and the completion of the researches in these areas may add emergent ones to the local and global results of the change in the region.

Modes of Arctic transport can be classified into four categories. Destination transport, the first one of them, refers to sailing to the Arctic Sea to perform activities in the region such as cruising, researching, etc. and then sailing outside of the region through the South. The second, Intra-Arctic transport means a voyage or marine activity that stays in the region and links two or more states of Arctic. The third, transport of ships from the Pacific Ocean to the Atlantic Ocean or Atlantic to Pacific by using Arctic region without any activity is called “Trans-Arctic Transportation” while the fourth, transportation activities of ships in coastal waters of only one Arctic State is called cabotage (URL 1., 2009). Cruising activities in the region generally fall under destination transport.

Cruising Activities in Arctic Region

Cruising activities in the Arctic and Antarctica started with expedition cruising which was a niche class of the cruise industry. Conventional ocean cruises and river cruises still cover the bigger portion of the industry, but expedition cruising is getting popular every year. The fastest-growing segment of the cruise industry has been the emergence of luxury expeditions, particularly in Arctic and Antarctic waters (Nikel, 2019). Owing to easier access, considerable growth was experienced in Arctic shipping activities and expedition cruising has been one of the fastest growing sectors (Dawson et. al., 2017). A shift in demand for cruise destinations has been experienced recently, and Polar Regions are expected to increase their popularity for cruise tourism besides Asia and Australia (Kolçak and Solmaz, 2018). Expedition cruising, indeed, have some requirements because of the rough conditions of the region, like ice-class hulls or smaller dimensions compared to conventional cruises. These ships generally do not only travel on a direct route or to a certain destination port but also, they sail to view landscapes at close range or seeking wildlife. Thanks to expedition ships that respond to the popularity of Arctic tourism and prove profitability, major cruise lines began to join this venture and deployed bigger conventional cruises on Arctic voyages (Bystrowska & Dawson, 2017). Water becoming more navigable especially in late summer also helped bigger ships of major cruise lines for safer voyages.

The number of ships sailed can be one of the indicators of increasing shipping traffic in Polar Code area. While 1298 ships sailed in the area in 2013, it reached 1494 in 2018 and 1628 in 2019 with a 25% increase in 6 years. While the majority of ships are fishing vessels, 65 of those in 2018 and 73 of those ships in 2019 were cruise ships. However, distance sailed in the region can be a more accurate indicator. Distance sailed by ships in Polar Code area grew by 75% between 2013 and 2019 increasing from 6.1 million nautical miles to 10.7 million nautical miles and 9.5 million of this was only in the Arctic (PAME, 2020). The fact that the increase in distance sailed is much more than the increase in the number of ships indicates that the time and activities of the ships in the region have increased considerably.

Perucic (2019) stated that 32 out of 125 cruise ships in the order book are expedition cruises and considered there is a growing demand for expedition cruises. Report of URL 6. (2020) showed that there are 84 expedition cruises with a capacity of 280.000 passengers except for larger cruises sailing to the Arctic region and 41 new expedition cruises would be launched between 2019 and 2023. The number of passengers visiting the Arctic region is also expected to grow in the next decade. A study projected that number of expedition passengers would reach nearly 600.000 while it was 242.000 in 2018 (Statista, 2020). According to a study compiling travel agency data, while 45% of them reported there

was no change in expedition cruise sales, 51% of them reported an increase. 16% of these agencies reported that the increase is more than 50%. Only 4% of agencies reported a decrease in expedition cruise sales. Also, 71% of them projected growth and 17% of them projected no change in sales in 2021 (Travel Market, 2020). Also, IMO (2019) emphasized that shipping activities will grow and diversify in polar seas, and tourist destinations are becoming increasingly popular. An important finding of Dawson et. al. (2014) was that cruise shipping in the Arctic region is developing faster than related regulations. Because of the nature of cruise tourism that requires passengers and crew to accommodate in an enclosed environment with many interactions to each other, cruise industry has become one of the maritime sectors which were highly affected by COVID-19 pandemic in 2020. Together with the number of people onboard, calling different ports on each day make cruise tourism vulnerable to effects of the pandemic. As a result, a global pause was experienced in the industry in March 2020 (UNCTAD, 2020). While some countries banned all cruise operations, some countries required quarantine for cruise passengers and crew (da Silva, 2021). It may be early to estimate full effect of pandemic on cruise industry, a drastic decrease in number of passengers was observed. The number of cruise passengers, which was 29.6 million in 2019, decreased by 80% to 5.8 million in 2020. The decrease in the regions hosting the most cruise passengers in 2019 is indicated in the Table 1. The Caribbean region experienced the greatest decrease in the number of passengers with 9 million passengers, while the Northern Europe region experienced the greatest decrease in terms of percentage with 97%. (CLIA, 2020; CLIA, 2021)

Table 1: Number of Cruise Passengers by Region in 2019 and 2020 (CLIA, 2020; CLIA, 2021)

	2019	2020	Decrease in Percentage
Caribbean	11,982	2,986	75%
Asia	3,977	643	83.8%
Mediterranean	3,211	224	93%
Northern Europe	1,707	51	97%
Australia/Pacific	1,177	366	68.9%

International Institutions and Regulations Related to Arctic Shipping

International Maritime Organization (IMO), which is the highest international regulating body of maritime industry, took a vital step for shipping activities in polar areas by issuing "International Code for Ships Operating in Polar Waters (Polar Code)". Polar Code aims to increase safety standards for ships, seafarers and passengers navigating, and to protect marine environment in polar waters. SOLAS amendments of Polar Code which are focusing on safety of life were adopted in 2014, MARPOL amendments which are focusing on protection of environmental pollution were adopted in 2015 and Polar Code entered into force in 2017. Coverage of Polar Code consists of design, construction, equipment, training, operational, search and rescue, and environmental protection standards of ships navigating in polar waters (IMO, 2017). When defining the aim of Polar Code, IMO states that other regulating instruments may not be adequate for full coverage of measures for polar seas and admits the unique conditions of polar waters. While the carriage in bulk as cargo or carriage and use as the fuel of heavy grade oils by ships in the Antarctic area has been banned since 2011 by Regulation 43 of MARPOL Annex I, there are no mandatory HFO rules for ships operating in the Arctic region. Currently, ships in Arctic Sea are only encouraged not to use or carry heavy grade fuels. A similar prohibition is expected to enter into force in MARPOL after 2024 for Arctic Sea. Due to the oceanographical and ecological conditions, MARPOL defines special areas and emission control areas for additional mandatory pollution prevention standards against oil, chemical substances, sewage, garbage, and air pollution. The Antarctic area is classified as a special area for oil, chemical, and garbage; but there is still no such specification for Arctic despite shipping activities that have increased significantly in recent years and are expected to increase in the future. In addition to special areas, IMO (2005) specified Particularly Sensitive Sea Area (PSSA) as an area that needs special protection through action by IMO because of its significance for recognized ecological, socio-economic, or scientific attributes where such attributes may be vulnerable to damage by international shipping activities. To be identified as a PSSA, the area should meet at least one of the main criteria classified as ecological criteria; social, cultural, and economic criteria; and scientific and educational criteria. These criteria have several sub-requirements. When these requirements are examined, it can be considered that the Arctic region meets some of them. However, both polar areas, Arctic and Antarctic are not classified as PSSA. Arctic Council (2009) emphasized that the need for designated areas to protect the Arctic environment should be explored by Arctic States and recommended that designation of special areas of PSSAs in the region can be a key factor for this.

Under Polar Code, ships navigating in polar waters must be certified with Polar Ship Certificate that classifies ships as "Category A" which includes ships designed for operation in polar waters in at least medium first-year ice, "Category B" which covers ship not included in category A, designed for operation in polar waters in at least thin first-year ice, and "Category C" which includes ships designed to navigate in open water or less severe ice conditions than Category A and B (IMO, 2017).

Another regulation of IMO affecting cruise ships in the Arctic is "Guidelines on Voyage Planning for Passenger

Ships Operating in Remote Areas". There is no exact definition of remote area under the guideline, but it can be defined as an area where sufficient designated Search and Rescue (SAR) units cannot reach the scene of an accident within survival times (International Maritime Rescue Federation, 2019). IMO (2007) addressed the need for such guidelines because of increasing number of passenger ships as a result of growing popularity of ocean travel, especially in exotic sea areas. According to guidelines, passenger ships operating in remote areas should give special consideration to environmental nature of the area, limited resources, and lack of navigational information. Sydnes et. al. (2017) stated that limited resources and infrastructures in Arctic make SAR operations a complex and dynamic cross-disciplinary activity that requires effort with specialized human and technical resources. According to IMO (2002) poor weather conditions, lack of navigational information, and communication systems are factors creating unique risks for ships operating in Arctic environment. It is safe to say that these risks would have severe impacts on possible SAR operations or operations to be performed in case of environmental pollution.

Arctic Council was established in 1996 as a leading intergovernmental forum to promote cooperation, coordination, and interaction among the Arctic States with the active involvement of Arctic Indigenous peoples and other Arctic inhabitants on common Arctic issues. Currently, Arctic Council consists of 8 Arctic States, permanent participants such as other related associations or councils, and observers including non-Arctic states and IMO. Council has 6 specialized working groups studying different aspects of the Arctic. Arctic Monitoring Assessment Program (AMAP) and Protection of Arctic Marine Environment (PAME) are the working groups that have serious contributions to shipping in the Arctic (URL 3-4., 2021). Arctic Council has prepared reports on environmental issues including toxic pollutants and their impact on people and wildlife and impact of climate change in the Arctic (Nilsson, 2012). Although the council does not have direct enforcement power, they influence the activities in the region. Kankapaa and Young (2012) measured the effectiveness of Arctic Council with a survey. They found a clear impact generally and reported that the Council is effective especially in international cooperation and raising general awareness about the Arctic. Impact on strategies adopted by Arctic states and changes on international agreements is found to be less but still positive. The effectiveness of AMAP and PAME was also evaluated to be relatively high. Nilsson (2012) stated that as the Arctic region is closer to be a center of commercial, scientific, and political center of globe; fragile environment of the region has led to demands for new governance structures. As a result, pressures on Arctic Council to change from being an only advisory body to a legal muscle increased.

On the other hand, contrary to the situation for environmental protection in Arctic Ocean, there are some agreements in Antarctic Ocean. Antarctic Treaty System (ATS) refers to whole agreements regulating the relations of states related to activities in Antarctica. The treaty was especially required by the increased interest to mineral exploring activities on the continent. The treaty, which was ratified by 54 states currently, establishes Antarctica as a scientific zone, ensures the freedom of scientific research and prohibits military activity on the continent. In 1988, Convention on the Regulation of Antarctic Mineral Resource Activities (CRAMRA) was signed by the parties as a part of ATS. CRAMRA defines and regulates the activities related to mineral resources in Antarctica and highlights the importance of the continent for global environment, and possible adverse effects of exploring activities to environment of the continent and associated ecosystems. While defining exploring activities, CRAMRA strictly excludes commercial production of mineral resources on the continent (Scientific Committee on Antarctic Research, 2021).

Later, Protocol on Environmental Protection to the Antarctic Treaty (PEPAT) emerged as an alternative to CRAMRA by being adopted in 1991 and entering into force in 1998. The Protocol expanded the scope of earlier regulations by providing a comprehensive protection to the environment of Antarctica. The most important point of this protocol is that it explicitly and indefinitely prohibits mining activities, and states that environmental principles will be the priority in any activity to be carried out in the region. With its annexes, the Protocol details the specific measures on environmental impact assessment, fauna and flora, waste disposal and waste management, prevention of marine pollution, area protection and management, and liabilities arising from environmental emergencies (URL 5. 2019). Both Arctic and Antarctic Regions are covered by Polar Code of IMO, but specific treaties such as PEPAT provide safer operations and cleaner environment in Antarctic Region.

Environmental Impact of Cruise Ships

Pollution to the marine environment caused by cruise ships can be classified as graywater, sewage, bilge water, garbage or solid wastes, toxic wastes, and hazardous gases such as SOx, NOx, and black carbon generated by main engine or power needed for hotel functions (Copeland, 2008; Tokuşlu et al.,2020; Mersin et al., 2019-2020). Despite the number of cruise ships represents a small portion of the global ship fleet, some types of wastes may have a greater impact due to the nature of them. Butt (2007) states that although the share of cruise ships in the global fleet is less than 1%, it is estimated that they generate 25% of all waste generated by the global fleet. The fact that these ships are constantly visiting the same ports with sensitive environments, as a necessity of tourism, increases this impact (Commoy, 2005).

Sewage, or black water, means wastewater including human body wastes and wastes from toilets. Most cruise ships have treatment systems for sewage before discharge. Graywater refers to wastewater from sinks, showers, laundry, and galley. Bilge water is generated by ship's main engines, powertrain systems, and auxiliary mechanical systems, and includes water, oily fluids,

lubricants, and cleaning agents. Bilge water can be stored onboard and discharged to a shore facility or can be discharged to sea after treatment according to related regulations of MARPOL. Solid waste is garbage, rubbish, trash, and any other discarded materials from individuals or many operations of the ship. Solid waste can be in a toxic or non-toxic form. Also, toxic waste can be in solid, liquid, or gas form that contains hazardous constituents (Johnson, 2008). According to the estimation of Commoy (2005) based on literature, an average of 27 lt. sewage, 246 lt. graywater and 2 kg solid waste are generated on a cruise ship per passenger per day. Also, 75 kg solid and 0.9 m3 liquid toxic waste is produced on a cruise ship with 5.000 passengers in a one-week voyage. Another report (US Department of Transportation, 2017) calculated waste amounts of a cruise ship with 3.000 passengers in a one-week voyage as 3.700 m3 graywater, 800 m3 sewage, 94 m3 bilge water, 16 tons solid waste, and 0.5 m3 toxic liquid. However, Johnson (2008) states that waste statistics gathered from cruise ships have too much variance and the accuracy of this kind of data is questionable.

Condino (2015) emphasized the key role of waste reception facilities in Arctic ports to protect the sensitive marine environment. Lack of these infrastructures is one challenge for the management of waste. Another challenge is that in case cruise ships cannot discharge waste to facilities or cannot enter ports due to adverse weather and sea conditions, waste must be kept onboard until a port call with a reception facility. Even if port facilities accept ship waste, managing that waste efficiently and sustainably on shore would be another problem for remote cruise ports of the Arctic.

Arctic Council (URL 2. 2017) stressed the importance of reception facilities and states that all Arctic port states must ensure sufficient reception facilities for ship wastes. The report identified challenges about reception facilities as capital cost and logistics cost to install and operate waste collection, storage, and treatment in remote areas of the Arctic; and the need for ability of operators to manage waste environment friendly on shore.

According to Comer et. al. (2017) operating hours of cruise ships in Arctic Sea represents only 1% of total operating hours and the total distance traveled by cruise ships represents only 2% of the total distance sailed. However, the fuel consumption of cruise ships which is 9.5%, and black carbon emission of cruise ships which is 9.9% are on top of the list above oil tankers and general cargo ships. High power demands of cruise ships besides main engines because of the number of passengers and onboard facilities of hotel department and entertaining department can be a key factor for such consumption. In contrast with cargo ships, cruise ships still need a huge amount of electricity in ports if the port facility cannot supply power. Considering that the ports in the region may not have the infrastructure to provide such a high amount of energy, it can be seen that the cruise ships will continue to pollute the Artic air even if they are at ports. Ballini and Bozzo (2015) highlighted that electricity supply to cruise ships at ports can effectively decrease emissions in the local environment of port and since power supply from shore can be inspected accurately, overall fuel emission can be reduced. However, the capital cost of these systems can be a discouraging disadvantage. Eckhardt et. al. (2013) studied emission generated by cruise ships in the Arctic by measuring SO2 and black carbon in Svalbard Archipelago. It is pointed out that cruise ships affected the mean concentration of these particles in the summer months at Svalbard cruise ports and there is a need for careful data screening for emissions. Report of Transport & Environment (2019) revealed a crucial fact that cruise ships visiting Barcelona generated almost 5 times more SOX per year than all passenger cars in the city during their port visits in 2017. The situation was same for many European cruise destinations. Another case study (Transport & Environment, 2018) on the cost impact of a possible HFO ban in Arctic Sea showed that an increase in the cost of fuel when cruise ships switch to a cleaner fuel which is more expensive could not have a significant impact on the overall profit of cruise operators since it would create an increase of just €7 per day in the price paid by passengers. Simonsen et. al. (2019) states that cruise tourism is one of the tourism segments most dependent on energy and claimed that there are no significant effects of international regulations to limit the environmental effects of cruises. One of the key findings of the study was that new cruise ships consume more energy at ports and probably more hotel functions of new ships are the reason. Celic et. al. (2014) states that although the number of cruise ships represents less than 1% of the world fleet, their impact on the environment is more considerable due to waste generated and energy demanded by the high number of passengers. Dragovic et. al. (2018) revealed that cruise ships at port or while maneuvering generates a great amount of emission, and insufficient berth space that leads ships to stay at anchor, and insufficient maneuvering space that leads ships to make complex and long maneuvering has a significant adverse effect on the port environment. Howitt et. al. (2010) estimated that the weighted mean energy use per passenger staying on cruise at night is 12 times more than a land-based hotel. Murena et. al. (2018), Poplawski et. al. (2011) and, Tzannatos (2010) showed a positive correlation between cruise ship traffic and emission at ports. While instantaneous emission increase is significant, impact to annual average is less but not negligible.

Methodology

The aim of this study is (1) to investigate the environmental pollution impact of increasing cruising activities in the Arctic region and (2) to review the scope of current international maritime regulations whether they are sufficient to protect the Arctic Sea from environmental pollution from cruise ships. Within the scope of the study, qualitative methods were used to meet the aims. Research started with reviewing academic studies and reports regarding cruising activities and environmental aspects of the Arctic region. It is followed by reviewing international codes, regulations, and

guidelines affecting shipping activities in the Arctic Sea. To better understand the importance of the subject, some information about international agreements for the protection of the environment in Antarctic Ocean was given for comparison. In the discussion part, firstly the types and causes of pollution and emergencies that may have more impact than other oceans due to the nature of cruise ships and the sensitive geographic structure of the region have been identified. Secondly, a comparison of the literature and legislation with the current cruise activities in the region has been made, and the scenarios that may be encountered in the future are evaluated. A Fishbone (Ishikawa) diagram was applied to demonstrate underlying factors and potential factors of environmental pollution in the Arctic region by cruise shipping.

Results and Discussion

Importance of the Arctic has been growing in many aspects. Several parties including governments, researchers, the tourism industry, the energy industry, maritime industry continue to work to benefit from the blessings offered by the region. Due to global warming, glaciers, and ice sheet regress consistently and this support these parties to intensify their activities in the Arctic. However, since the region has a sensitive and yet unexplored ecosystem, has still inaccessible waters, and has an effect on global climate; it can be considered that these activities may have an undesirable impact both locally and globally.

In this study, the environmental effects of cruise ships in the Arctic region were obtained from the literature and grouped as sub-factors under the main factors. Fishbone diagram was used for cause analysis and defined factors are indicated on the diagram as shown in Figure 3. Fishbone diagram was created by Ishikawa for quality control is a technique used for visualizing several causes and determinants of a specific event or phenomenon (Ishikawa, 1990; Coccia, 2017). The main factors that have an impact on environmental pollution in the Arctic Sea are classified as industry, infrastructure, legislation, and geography.

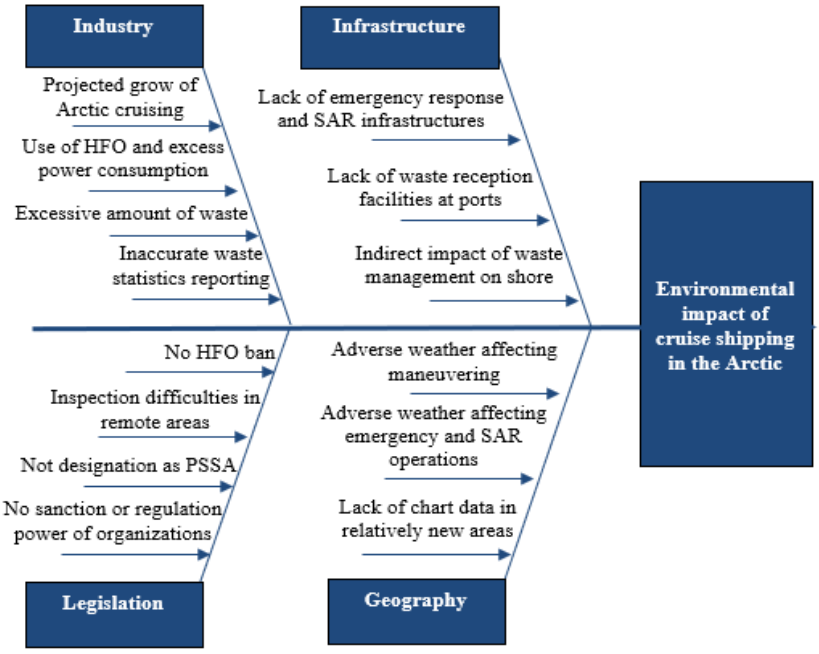

Fig. 3: Fishbone diagram of Factors Affecting Environmental Impact of Cruise Ships in the Arctic.

One sub-factor of the industry is the growth of cruise tourism in the Arctic. Projections and investments of cruise industry show an expectation of increasing trend and as the cruising activities increase; all possible environmental impacts can be multiplied. Cruise ships in the Arctic mostly continue to use HFO, and because of the number of passengers and hotel department; power consumption of these ships is considerably more than cargo ships in the Arctic Sea. HFO generated from routine operations of cruise ships has a direct impact on air pollution and global warming via emissions. Besides, in case of an oil spill, HFO can dispel a part of the marine ecosystem. The most harmful case of HFO spill can be considered as trapping under ice sheet which makes cleaning operations impossible. Also, because of the high number of passengers and crew onboard, cruise ships are the source of large amounts of solid and liquid waste which can be harmful to the marine ecosystem of the Arctic. The inaccuracy of waste statistics obtained from cruise ships makes the sanctions to be imposed on these ships and the studies on the subject more difficult.
Infrastructure is defined as another main factor. Lack of infrastructure for emergency response and SAR operations can cause severe destruction for the marine and shore ecosystem of the Arctic in case of an oil spill or other unintended spill of liquid waste from cruise ships. Lack of waste reception facilities at ports can be another factor because cruise ships generate an excessive amount of solid and liquid waste as mentioned in the industry factor. Some of these wastes can be discharged to sea after suitable treatment according to MARPOL but discharging to reception facilities is always a clean option for cruise ships especially in sensitive regions like the Arctic. Also, in case of any deviation from Schedule,

ships may have to carry large amounts of waste onboard creating potential pollution if there is no reception facility at the next port of call. Waste management on shore can create an indirect environmental impact. Even if waste is discharged to a reception facility, it is still must be stored or processed in a way that can cause pollution to both marine and land ecosystems of vulnerable areas.

Legislation is considered as a main factor affecting environmental pollution in the Arctic. Firstly, use of HFO which is the heaviest and most harmful form of marine fuels is not banned in the Arctic, unlike Antarctica. HFO ban in the Arctic is expected to enter into force after 2024, but currently, IMO can only advise ship owners not to use HFO. Difficulties in inspecting cruise ships at remote Arctic ports can be an effect for environmental pollution under the legislation. It can be interpreted that designation of the Arctic as PSSA can be an effective measure, but the Arctic does not have this title despite its vulnerable ecosystem and importance on global climate. The fact that intergovernmental organizations like Arctic Council have no official sanction power can be considered as an important effect. Although Arctic Council is very effective with working groups and consists of Arctic States as members, it has no direct power to regulate shipping activities.

Challenging geography of the Arctic making maritime activities more difficult can be considered as a factor in environmental pollution. Adverse weather and sea conditions that affect the maneuverability of ship can trigger an accident especially in berthing operations that can result in pollution to both sea and shore. However, the main impact of adverse weather can be experienced in emergency or SAR operations. While weather conditions can affect the pattern of oil or other spills, it also prevents emergency response, salvage, or SAR teams to reach within the area or operating efficiently that can multiply the impact of the incident. The increase in sea areas that can be navigated day by day in the region and the lack of or suspicious chart information about these unexplored waters would increase the accident probability of cruise ships and make the operations of emergency response or SAR teams more difficult and would increase the impact of a possible pollution.

Conclusion

Cruise industry, which has experienced significant growth in the last 20 years, is one of the parties trying to benefit from the Arctic. While cruise industry seeks new destinations, the Arctic became one of the new centers of attraction for cruise passengers. The number of cruise passengers visiting Arctic ports, especially ports in Svalbard, has been increasing in the last decade. Although the benefit of growth for the local economy is indisputable, it is vital to investigate and consider potential environmental pollution effects of cruise activities.

In this study, possible factors that lead cruise tourism in Arctic to an environmental pollution has been identified by reviewing literature, reports, statistics, and legislation related to shipping activities in Arctic. Identified factors were clustered under four main categories and demonstrated in a fishbone diagram. These main factors affecting environmental impact of cruise ships in Arctic are geography, industry, infrastructure, and legislation. There are both controllable factors such as regulations, infrastructure, operation of the ships, and uncontrollable factors such as weather and sea conditions. HFO is the most harmful fuel for both air and marine ecosystem. The use of HFO can be considered as one of the main factors affecting the Arctic environment.

Although the number of cruise ships in the Arctic region is much less than cargo ships, they generate much more emission which is very harmful to the sensitive climate of the Arctic. The excessive amount of waste generated on cruise ships is another important factor for possible pollution since there is a lack of inspection opportunities and a lack of waste reception facilities in remote ports of the Arctic. Lack of infrastructure can also be a key factor in the case of oil or other spills when considering adverse weather and sea conditions of the region that have the potential to multiply the effect of such incidents.

There are no mandatory HFO rules for ships operating in the Arctic region. Currently, ships in Arctic Sea are only encouraged not to use or carry heavy grade fuels. A similar prohibition is expected to enter into force in MARPOL after 2024 for Arctic Sea.
On the other hand, when the Antarctic Ocean is considered, there are some agreements for protection of the environment. CRAMRA and PEPAT are the significant agreements for Antarctic. Similar initiatives are needed for the Arctic Sea either. In this sense, it is considered that the Arctic Council may have more effective role.

It is safe to say that stopping cruise tourism in the Arctic region completely is impossible in a globalized world in which people always seek new and various forms of products and services. However, it can be said that reducing the possible environmental pollution impact of cruise tourism and being on guard against emergency cases are not so difficult. Regarding the factors identified, this can only be achieved through a multilateral collaboration of cruise companies, governing states in the Arctic, international regulatory bodies, and intergovernmental organizations.

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