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Maritime activity in the High North - current and estimated level up to 2025

MARPART Project Report 1

Odd Jarl Borch
Natalia Andreassen
Nataly Marchenko
Valur Ingimundarson
Halla Gunnarsdóttir
lurii ludin
Sergey Petrov
Uffe Jakobsen
Birita í Dali

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MARPART

INTERNATIONAL R&D PARTNERSHIP ON MARITIME SAFETY AND SECURITY IN THE HIGH NORTH

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Project partners:

- High North Center at Nord University Business School (Norway)
- Norwegian Defense University College (Norway)
- Norwegian Police University College (Norway)
- UIT-the Arctic University of Norway (Norway)
- University Center in Svalbard (Norway)
- University of Greenland (Greenland)
- University of Iceland (Iceland)
- Northern (Arctic) Federal University (Russia)
- Murmansk State Technical University (Russia)

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POLITIHØGSKOLEN

THE MARPART RESEARCH CONSORTIUM

The management, organization and governance of cross-border collaboration within maritime safety and security operations in the High North

The key purpose of this research consortium is to assess the risk of the increased maritime activity in the High North and the challenges this increase may represent for the preparedness institutions in this region. We focus on cross-institutional and cross-country partnerships between preparedness institutions and companies. We elaborate on the operational crisis management of joint emergency operations including several parts of the preparedness system and resources from several countries.

We emphasize the responsibility of the governments for preparedness as to safety, security and environmental protection in the High North. Maritime preparedness is defined as the system for damage avoidance and reduction related to unexpected and unwanted incidents at sea. We elaborate on the need for enhanced measures to respond to composite challenges including search and rescue (SAR), oil spill recovery, firefighting and salvage, and actions against terror or other forms of destructive action. To increase both effectiveness and efficiency within the preparedness system, we are in need of management tools for coordination and control making optimal use of the joint resources of several institutions both within and between countries.

In this project, we take as a starting point the increased commercial activity in the High North and the vulnerability related to human safety, environment, and physical installations/vessels. The commercial activity in the High North includes intra- / interregional transportation, search for and exploitation of petroleum and mineral resources, fisheries, and cruise tourism. Limited infrastructure, low temperatures with ice and icing, polar lows, and a vulnerable nature challenge maritime operations in this region.

MARPART project goals:

- To increase understanding of future tasks and the demands for a preparedness system in the High North including both search and rescue, oil spill recovery, firefighting and salvage, and actions against terror or other forms of destructive action;
- To provide analytical concepts for studying coordination challenges in cross-border, multi-tasking operations;
- To contribute with organizational concepts for inter-organizational partnership and management of joint operations.

Cross-disciplinary, international research network consists of twenty professors/researchers and PhD-students. 18 universities, police and naval academies and research institutes from eight countries (Norway, Russia, Iceland, Greenland, Denmark, Sweden, Canada, USA) are now part of the Marpart network. Advisory Board consists of the main preparedness authorities and industry representatives.

LIST OF AUTHORS

Odd Jarl Borch	Project Leader, Nord University
Natalia Andreassen	Nord University
Nataly Marchenko	The University Centre in Svalbard
Valur Ingimundarson	University of Iceland
Halla Gunnarsdóttir	University of Iceland
Iurii Iudin	Murmansk State Technical University
Sergey Petrov	Murmansk State Technical University
Uffe Jakobsen	University of Copenhagen
Birita í Dali	University of Greenland

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This report also relies upon the expertise of the different actors operating and analyzing the preparedness system in the participating countries. We are particularly thankful for input and support from: The Norwegian Coastal Administration; Resources and Competence Center for Safety and Preparedness in the Northern Region; High North Center at Nord University Business School; Salten Regional Police Department; Maritime Forum of Northern Norway; Joint Rescue Coordination Center Northern Norway; the Preparedness Department of the Nordland County Governor; Nordland County Administration; Norwegian Directorate for Civil Protection; The Petroleum Safety Authority Norway; Norwegian Coast Guard; Icelandic Coast Guard; the Environment Agency of Iceland; and the Department of Civil Protection and Emergency Management at the National Commissioner of the Icelandic Police.

EXECUTIVE SUMMARY

This report analyzes the current commercial and governmental activity in the sea regions north of the Polar Circle from the Northern Sea Route to the North West Passage. The study embraces sea and coastal areas of the North West of Russia, Northern Norway and around Svalbard, Iceland and Greenland. It includes an overview of types of vessels and other objects involved in different activities, and the volume of traffic connected to different types of activities, such as fisheries, petroleum, tourism, navy and research. Furthermore, this report estimates the maritime activity level in the area the next ten years, or until 2025, and the potential development of the regional preparedness system.

The data within this report is derived both from secondary and primary sources. The analysis of the current maritime activity is based on published analytical reports on maritime activity, facts and statistics published by different official sources in brochures and online; and direct interviews with local experts in the countries participating in the study - Russia, Norway, Iceland and Greenland. The report also uses data obtained during discussions on the MARPART conference held in Arkhangelsk, 23-25 September 2014, the 2015 High North Dialogue conference panels held in Bodø 17-19 March 2015, and the MARPART conference and Advisory Board meeting held in Murmansk, 7-11 April 2015.

In each country, the analysis focuses on six types of maritime activity: coastal transport, intercontinental transport, fisheries, petroleum activity, tourism and research/government activity. The last chapter is devoted to summarizing findings about the current developed activity level in the High North sea and coastal regions and the estimated activity level up to 2025. Possible implications for the preparedness system in the High North are also discussed.

Russia

The government in Russia has made much effort to facilitate inter-continental traffic through the North East Passage/Northern Sea Route. So far, the traffic has been limited to a handful of vessels due to short season, increased insurance costs, need for costly ice breaker escort and/or demand for ice strengthened vessels. The cruise traffic is limited, but includes some vessels moving to ice-free areas in the summer months. Less than ten cruise ships have visited Murmansk and Arkhangelsk during the last year. The modernization of fishing fleet results into

fewer vessels but with larger capacity. The main increase in maritime traffic comes from the outbound LNG, raw oil and hard mineral transport from shore terminals in the Northwestern Russia. This transport increases transit traffic through Norwegian and Icelandic waters. Also, a rise in the number of sailing hours for the North fleet of the Russian Navy indicates more traffic, involving a large number of nuclear submarines in transit to and from naval bases. The navy traffic also includes transport to and from the reopened military bases in the northwestern (Franz Josefs land) and the northeastern part of Russia. Thus, the high risk traffic will be increasing in the area.

An increase both in transit traffic through the Northern sea route and in oil and gas traffic depends on the international economy and the oil and gas prices. The Russian mineral transport and offshore oil and gas exploration may double or even triple, providing a significant increase in year round high risk activity, including offshore service vessels, drilling rigs, dry cargo ships and shuttle tankers in icy waters. Cruise ship industry also grows and may allow visiting areas close to the ice ridge in the Northern Russia.

Several preparedness institutions are responsible for the safety and security of the Northern Russia. A special attention should be paid to the development of crisis management solutions and strengthening cooperation between different actors involved in all fields of the emergency system. This includes the organizations EMERCOM, ROSMORPORT, State Maritime Rescue Service, Coast Guard Service, as well as companies involved in oil and gas, shipping and fisheries, which are operating in the region. It is necessary to ensure compatibility of emergency protocols of all actors operating in the region.

Russia is actively developing search-and-rescue and other emergency preparedness systems by upgrading the on-shore emergency facilities along the Northern Sea Route and building new ice-class rescue fleet. Also, stricter requirements are expected regarding compliance with IMO Polar Code to cover the full range of design, construction, equipment, operation, training, search and rescue and environmental protection matters.

Norway

In general, there is an increase in maritime activity in the High North mainly represented by the oil and gas industry and the cruise industry. So far, most of the activity is taking place in the

summer months. The exploration and construction activity is mostly close to the mainland. The 23rd licensing round for exploration of new oil and gas fields will, however, bring year round activity to the Northern and Eastern parts of the Barents sea closer to the ice ridge. This may cause significant logistics challenges both regarding air and sea traffic. Within the oil and gas production, the two main fields in the next decennary are Goliat and Johan Castberg fields. They will both influence the increase in traffic of oil shuttle tankers. These fields together with additional exploration with drilling rigs may lead to a significant increase in the number of activity units in the Barents Sea. For each drilling rig 3-4 offshore service vessels may operate. For remote operations with long distances and in icy waters, the need for vessels may be 10 vessels per rig.

The fishing fleet and cruise ships are operating close to the ice ridge, but with longer season including autumn months. The number of large fishing trawlers operating in the Svalbard area amounts to more than fifty vessels only in autumn. The fishing fleet represents more than 70% of the whole traffic in the Norwegian Arctic waters. Approximately 50 cruise vessels are visiting Norwegian mainland harbors during main season from May to October, some of them are visiting the harbors twice or three times per season. A few vessels operate in the winter months, however the number may increase as cruise tourism is gaining popularity. At Svalbard 25 different vessels operate during the main season from June to September. The number of conventional cruise vessels voyages is about 50, while more than twenty expedition cruise vessels operate in Svalbard for shorter or longer periods of the season. There are also up to 100 leisure vessels visiting Svalbard each year.

As for cargo transport, there are approximately 15 vessels per month along the Norwegian coast, in transit from Russia. More oil tankers is expected to pass through this area. There are currently about 25-35 calls by ships carrying coal from Svea, a mining settlement in the Norwegian archipelago of Svalbard during the period from July to December. However, the international market for coal and environment restrictions may reduce this number.

Iceland

In Iceland, the largest part of maritime activity is related to fisheries. Owing to improved technology, the fishing fleet has shrunk in the past decades and is likely to continue the decrease in the number of vessels. If sea temperatures continue to rise, fishing activity is likely to expand to the north of Iceland and at the east coast of Greenland.

Coastal sea traffic has increased in the past years, both in terms of coastal cargo vessels and passenger ferries. Cargo vessel and tanker traffic has also risen again after the economic recession. The previously forecasted sharp rise of oil tankers transit from Russia to North America has not happened, and is unlikely to occur in the near future.

Oil and gas exploration to the north of Iceland remains low and is unlikely to lead to large rise in vessel traffic within the next ten years.

Maritime tourism, on the other hand, has sharply increased the number of passengers rising from 9,000 up to 90,000 in roughly 20 years. Given the current popularity of Iceland as a tourist destination, the growth is expected to continue. Finally, despite a continuing interest in the Arctic, research and monitoring activity is still at a minimum and is not likely to increase in the next ten years.

Greenland

Sea area activity in the Greenlandic waters is limited to less than 600 arrivals annually on average during the last 10 years. Small population, limited fishing quotas, and therefore reduced fish export, the absence of international transit routes through the Greenlandic water explains the relatively low traffic compared to European areas.

At any given time, the estimated number of vessels in Greenlandic waters is around fifty, of which around 70% is estimated to be coastal fishing vessels and trawlers. In addition, there is a large amount of small fishing and hunting boats all along the coast. There may be an increase in the number of cruise ships in the summer months visiting the spectacular glacier and iceberg areas. Otherwise, there is no any increase in maritime traffic to expect.

New shipping routes through the Northwest Passage and the Central Arctic Route are discussed in governmental papers. However, it is not expected to get a significant increase in transit traffic in this area. Leisure vessels traffic may, however, increase in the summer months.

Oil and gas exploration has caused a peak in traffic in the period of 2012-2014. However, low oil and gas prices, less prosperous estimates of resources based on results from the drilling activities, and very costly operations have reduced interest of oil companies in this area.

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INTRODUCTION

This report gives a picture of the current commercial and government maritime activity in the sea areas north of the Arctic Circle from the Kara Sea, along the Northwest coast of Russia, the Northern coast of Norway, around Svalbard, Iceland and Greenland up to the Baffin Bay. Furthermore, the report offers estimation of the future maritime activity level in the area up to 2025.

There is a great variation in types of activities and operations that affects the number, size and frequency of ships and installations in the area. The range of vessels includes:

- tourism related vessels such as local sightseeing vessels, explorer cruise vessels and larger cruise vessels, leisure boats;
- transport vessel such as LNG tankers, oil tankers, bulk ships and container vessels;
- offshore service vessels including seismic vessels, construction vessels, platform supply, anchor handing and towing vessels, floating drilling rigs and drilling vessels;
- government research vessels and ice breakers, search and rescue and emergency towing vessels;
- a broad range of naval fleet vessels, including submarines.

In order to analyze the capability of the maritime preparedness system in the area it is useful to distinguish between passenger and cargo transport on the one hand, and between coastal and intercontinental traffic on the other hand.

Petroleum activity includes research, exploration, construction, production, storage and transportation of oil and gas with a broad range of offshore service and bulk vessels, as well as the floating and fixed installations. The fisheries can vary from small coastal boats with a few people on board to, intercontinental fresh fish trawlers and factory ships with crews of hundreds. Tourist and leisure vessels come in all different sizes and can have thousands of people on board — passengers and crew members. Research activities include land and sea-based research expeditions. Additionally, military vessels and submarines may have large crews.

The maritime activity varies in different seasons, as demonstrated in Table 1:

TABELL 1 THE VARIOUS COMMERCIAL AND GOVERNMENTAL ACTIVITIES IN THE HIGH NORTH

Maritime Activity in the High North	Types of vessels and installations	Time of year
1. Coastal sea traffic	Passengers and cargo vessels	Year round
2. Intercontinental transport	Transport of dry bulk cargo, containers and tank products	Summer
3. Fisheries	Local and sea going and international fishing fleet and transportation of fish	Year round
4. Petroleum activity	Exploration, construction and production of oil and gas, fields with a broad range of offshore service vessels, floating and fixed installations	Summer and year round, but more activity during the summer
5. Maritime tourism	Vessels for leisure and tourism, ranging from small boats to large cruise vessels Ships of all sizes as leisure crafts and within the cruise business	Mainly summer
6. Research and other governmental activity	Land and sea-based research expeditions and military vessels and submarines, both coastal and both locally and in high seas	Year round

The polar research vessels, the fishing fleet and the seal hunting fleet are the ones that are operating in the toughest environment close to or into the ice. The rest of the commercial activity in the High North is influenced by fluctuations related to climate, infrastructure, activity level in the remote settlements of the Arctic, access to natural resources, and the international price levels for natural resources.

PART I THE RUSSIAN SEA AREAS AND ACTIVITY LEVEL UP TO 2025 *BY IURII IUDIN AND SERGEY PETROV*

THE POLITICAL FRAMEWORK FOR THE FUTURE DEVELOPMENT IN RUSSIAN ARCTIC

The Russian Arctic represents a very important commercial area within the Russian Federation. It has been regarded by President Vladimir Putin as “the most powerful Arctic economy in the world”. About a third of the entire area of the Arctic belongs to Russia. It produces about 11% of Russia's national income with only one percent of the total population. The Arctic also accounts for 22% of the total Russian export (Kozmenko, 2010). The region contains the bulk of essential minerals reserves crucial for the development of Russia's economy.

There are, however, several challenges within the Russian Arctic with respect to maritime activity:

- Extreme climatic conditions, including the permanent ice cover or drifting ice in the Arctic seas
- Large distance between coastal centers with infrastructure such as harbors and airports
- Low population density

In spite of these challenges, the Russian government has high ambitions when it comes to the Arctic Russia. This is laid down in *“The principles of the State Policy of the Russian Federation in the Arctic for the period up to 2020 and beyond”*, adopted by the President of the Russian Federation, September 18, 2008. These define the main goals, key objectives, strategic priorities and mechanisms for the implementation of the state policy in the Russian Arctic.

This document also defines the system of measures for strategic forecasting and planning of the socio-economic development of the Arctic zone, and the national security of Russia. In order to ensure the continuity and efficiency of the priority tasks of the Russian Arctic policy, the Ministry of Regional Development of the Russian Federation developed a draft strategy of development of the Russian Arctic and national security for the period up to 2020. They also launched the State Program for the Russian Federation *"Economic and Social Development of the Russian Arctic*" for the same period.

These documents are based on three fundamental principles. The first one relates to the focus on strategic and policy decisions to enhance the role and effectiveness of the national Arctic position of Russia, and thus strengthening the foundations of the Russian state. This includes the implementation of the sovereignty and strategic interests of Russia in the Arctic. The second principle is to ensure the social dimension and the recognition of the social issues as well as the focus on innovation and economic development in general. This approach is primarily concerned with the improvement in the human capital and the transition towards a knowledge economy.

The third principle is covering the complex nature of decisions in order to harmonize the interests of all subjects of the national Arctic policy - government, civil society, business, science and the indigenous peoples of the North.

The government policies and ambitions for the Arctic Russia serve as a platform for the discussion of different types of maritime activity in the Arctic, both close to the coast line, offshore, and within transit traffic. The most important factors are, however, the international transport industry's willingness to use the Northern Sea Route and the growth of the commercial industries such as mining and oil and gas.

TRANSPORT INFRASTRUCTURE

Russia has the world's longest Arctic border, which stretches more than 16,000 kilometers. According to the maritime registry there are only 313 vessels registered in the area, 214 of them are fishing vessels, and the rest are cargo vessels. The coastal fleet consist of around 100 vessels (Russian Maritime Register of Shipping). After the fall of the Soviet Union the level of economic activity and coastal traffic density decreased dramatically, but has increased during the last few years.

Port infrastructure

The figure below shows the cargo transported to and from the main ports of the Northern Sea Route.

TABELL 2 CARGO TURNOVER IN THE RUSSIAN ARCTIC PORTS ALONG THE NSR

Arctic ports	Cargo turnover, thousand tons						
	1990	2003	2008	2009	2010	2011	2012
Amderma	100,0	59,3	-	-	-	-	-
Dixon	14,0	12,0	-	-	-	-	-
Dudinka	2500,0	1120,0	1100,0	988,9	828,0	1102,1	1132,4
Hatanga	230,0	15,6	-	-	51,0	-	-
Igarka	800,0	55,6	58,9	-	-	2,5	-
Tiksi	530,0	12,3	-	39,4	8,0	9,0	10,0
Pevek	730,0	136,9	60,7	54,8	67,0	189,0	208,8
Zeleny mys	185,0	90,4	-	-	-	-	-
Providenija	190,0	88,3	33,3	20,9	26,8	22,5	18,7
Total	5299,0	1590,4	1255,6	1104,0	980,0	1371,6	1718,3

Source: http://www.rostransport.com/themes/12476/

There was a dramatic decline in harbor activity after the fall of the Soviet Union. Some harbors have lost their position entirely and have very limited traffic today. There have been a slight increase in cargo volume during the last ten years, among others related to mining and oil and gas transport.

Russia has high ambitions when it comes to traffic through the Northern Sea Route and the use of its harbors. Russia's transport strategy up to 2030 implies a dramatic growth of cargo turnover within its Arctic ports. According to plans, Arctic ports and terminals shall process up to 100 million tons by 2020 and up to 150 million tons by 2030.

The most important ports for the Northern Sea Route are Murmansk, Arkhangelsk and Petropavlovsk-Kamchatsky. The harbor plans include further developed in order to develop centers that will contribute to growth of transit cargo flows, increase in container shipments, and contribute to economic development of the region.

The future goals are to implement a) the Transport Strategy of the Russian Federation up to 2030 b) the Development strategy for the Arctic zone of the Russian Federation and c) to ensure national security for the period up to 2020.

The plan is to merge the existing ports and to establish several transport and logistics hubs in Arctic region of the RF along the NSR. Referring to Rostransport, these hubs are:

- Kola hub (Murmansk, Teriberka);
- Urals-West-Siberian hub (Archangelsk, Indiga);
- Jamal oil and gas hub (Kharasavei, Sabetta, Novy Port);
- Norils-Turukhansk and Nizne-Jenisei hub (Igarka, Dudinka, Dikson);
- Lensky hub (Jakutsk, Tiksi);
- Chukotsko-Kamchatsky hub (Pevek, Providenija, Petropavlovsk Kamchatsky).

The plans include an increase of the harbor capacity from 58 till 97 million tons by 2030. The capacity of the new harbor in Murmansk is expected to increase to 53 million tons. The increase is related to both coal and oil transit terminals.

Icebreaker infrastructure

Ice classed vessels and ice breaking capacity is crucial to achieve this new strategy. Due to the Arctic climatic conditions it is required that all vessels operating in the area are ice-class certified. Icebreaker escort is necessary for cargo vessels carrying supplies.

There is a significant renewal process going on within the Russian ice breaker fleet. Russia has the largest fleet of icebreakers among other countries. At present, Rosatomflot owns 18 icebreakers, Six of them are nuclear-powered and are going to be decommissioned by 2020. In July 2012 Russia's state-owned corporation for nuclear energy Rosatom signed an agreement for construction of a multi-purpose new-generation nuclear icebreaker, with budget of 1.1 billion US dollars. The new icebreaker will be launched in 2017. In addition, in the next few years, Rosatom plans to build three third-generation icebreakers with 60MW engines to maintain the country’s potential in the Arctic (Kovalenko 2012). The Krylow Shipbuilding Research Institute is given the task by the government to plan a 110 MW icebreaker named “Leader”. Multipurpose diesel-engine icebreakers equipped for supporting oil and gas installations and cargo transportation are under construction at the Baltic shipyard and the PJSC Vyborg yard. The vessels at Vyborg are constructed by Finnish Aker Arctic Technology Inc.

on behalf of FSUE Atomflot, for Rosatom. One such vessel will operate at the Yamal LNG terminal in Sabetta, in temperatures as low as minus 50°C.

The functionality of the new fleet is especially related to the oil and gas fields and transportation of petroleum products. The fleet will also include smaller ice breakers for harbors with breaking capacity of up to 2m ice.

SAR infrastructure

Large passenger vessels and ambitions for more fishing and cargo vessels requires increased capacity within the rescue fleet. Special rescue hubs for the Northern Sea Route will be established in Murmansk and Arkhangelsk, with several sub-stations along the route. Rosmorrechflot (FGU "State Sea Rescue Service of Russia") has started to update its rescue fleet being responsible for the coordination and organization of search and rescue operations at sea. The implementation of a number of federal targeted programs (FTP) is done within the framework of the:

"Modernization of transport system in the Russian Federation (2002-2010)", from January 1, 2010;

The Federal Program "Development of transport system of the Russian Federation (2010-2015)";

FTP "Development of civil marine engineering for 2009-2016";

FTP "The world ocean" and subprogram "Development and use of the Arctic";

FTP "Nuclear and radiation safety in 2008 and for the period till 2015", FTP "Global Navigation System").

Special emphasis is laid on building of new multifunctional rescue ice-class vessels that can be used for search and rescue in the Arctic. The construction of the ships is launched within the federal program "Development of Transport System of Russia (2010-2015 years)". Within the framework of the federal targeted program it is planned to build 46 rescue ships and boats. This will represent a significant rescue infrastructure in the region.

INTRA- AND INTER-CONTINENTAL TRANSPORT

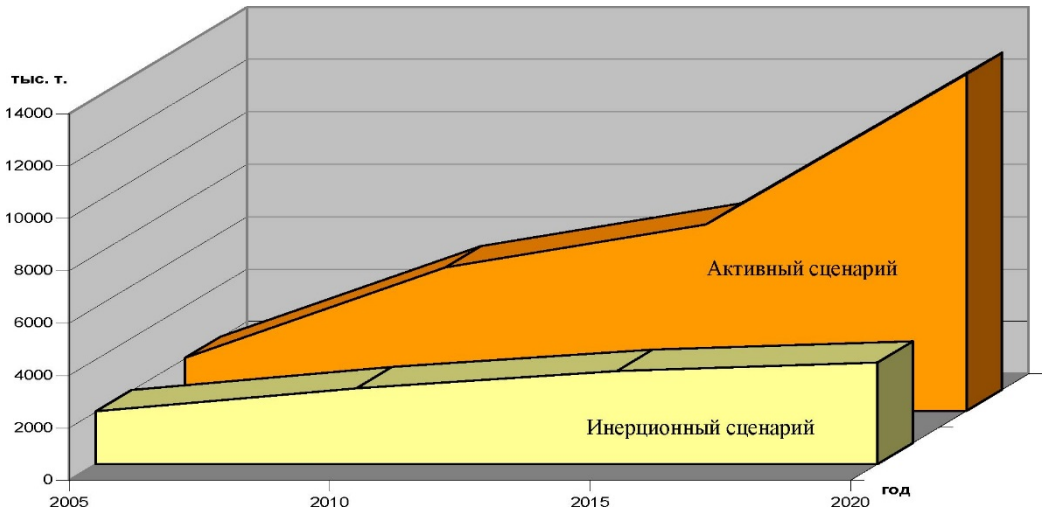
The high-latitude Northern Corridor (STC) - Russian national marine transarctic route includes the Northern Sea Route (NSR) with adjacent water and rail communications. The Northern Sea Route is a Russian ship route from the Kara Sea gate in the East to South of the Bering Strait. Its end points are the harbors Murmansk and Petropavlovsk-Kamchatsky that provide cargo handling on ice class vessels, icebreaking fleet maintenance, and support for transit routes.

The transit activity is defined as sailings through the Northern sea routes from one foreign harbor to another, or from a Russian harbor in the West to a foreign harbor in the East. The transit traffic is so far limited. The transit season is from late June until the beginning of December. In late August and September there is almost no ice, however, icebreaker support may be necessary for the rest of the season. In 2013, the inter-continental traffic reached its peak with 28 transit sailings. In 2014 the number was reduced to around 15, and in 2015 only approx. 10 sailings. The Russian statistics include transport through parts of the Northern sea route. In 2013 it was in total 71 sailings. The fluctuations in the number of vessels are related to international markets, the price of bunker oil, ice conditions, and the availability and price of ice breaker support.

The traffic level is much higher including the number of ships between harbors in the Northern Russia, and the traffic from the Northern harbors to Europe, to the American continent, and to Asia via the Southern sea route through the Suez Canal. All the national governmental decrees of recent years related to the socio-economic development of the Russian Arctic highlight the key role of industry development in the Russian Arctic and its export routes (Vilegzanin, 2008).

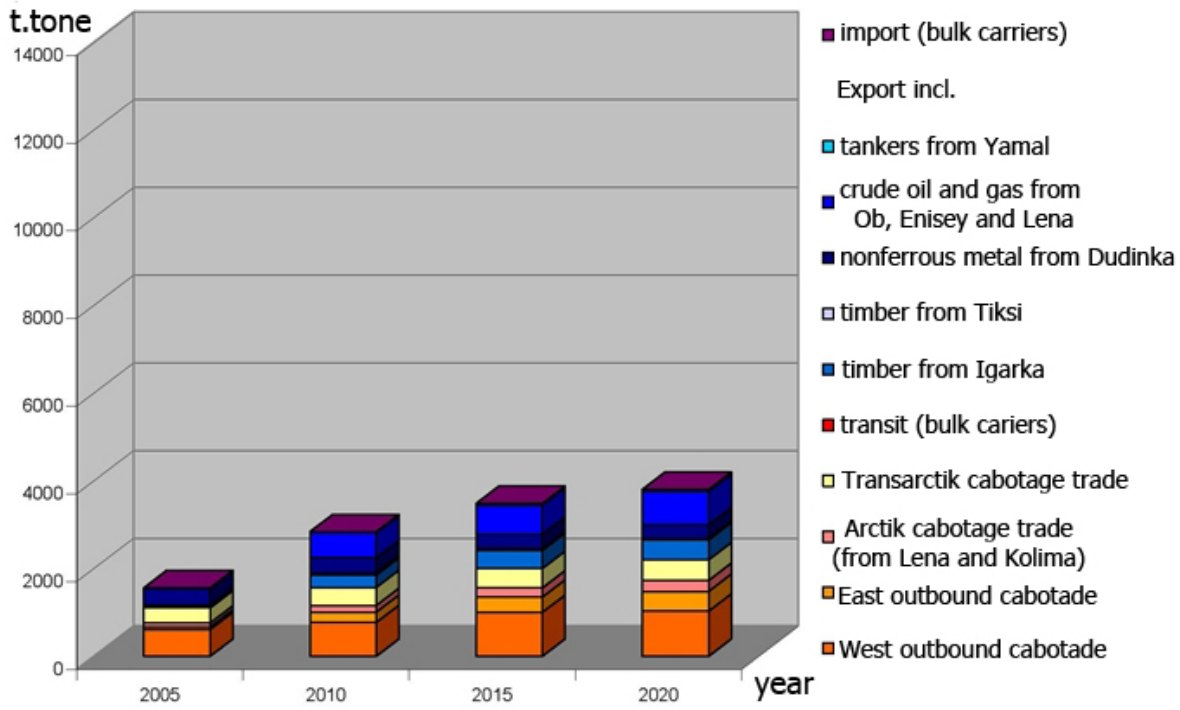
Cargo transport along the Northern Sea Route increased by 31,6 % in 2014 compared to 2013 and reached 3,7 million tons. During this period 2 500 tons of general cargo were transported via the Northern Sea Route. This is 54 % more than in 2013. The increase of ore transportation in 2014 was 140 % up to 80,8 thousand tons, oil transportation gained up 24,9 % to 757,1 thousand tons. At the same time coal transportation decreased with 45% to 230,2 thousand tons, and gas condensate decreased by 1,3% to 124,6 thousand tons. The share of general cargo from the total amount of transported cargo is 67,8%, petroleum products amount to 20,4%. There was a decline in transit transportation through the entire Northern Sea Route from 37 voyages in 2013 to 25 voyages in 2014. The total tonnage was reduced 4,3 times to 274 thousand tons. (http://morvesti.ru/detail.php?ID=31425). Cargo in transit along the Northern Sea Route was reduced from 1.3 million tons in 2013 to 300,000 tons in 2014. By October 1, 2015 less than 100,000 tons had been transported between Asia and Europe on the Northern Sea Route.

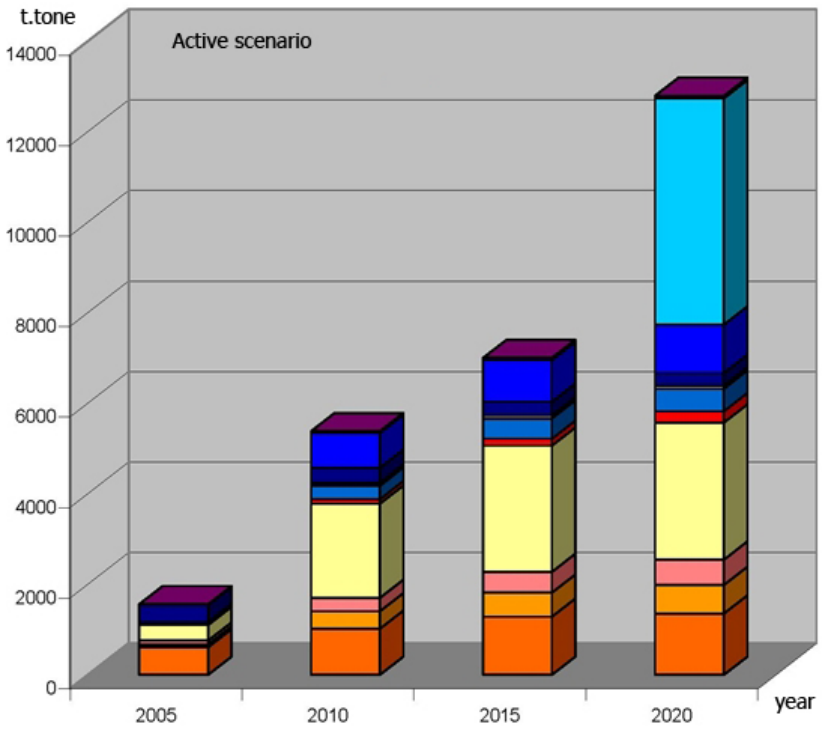
Cargo to and from Russian ports along NSR has gone up from 2.8 million tons in 2013 to 3.7 million tons in 2014, and 4.5 million tons in 2015. Most of this increase comes as a result of large oil and gas developments in the Russian Arctic, like the huge Yamal LNG project, and the Prirazlomnaya platform in the Pechora Sea (Barents Observer, October 17, 2015).



FIGUR 1 CARGO TRANSPORTATION FORECAST FOR THE NORTHERN SEA ROUTE BY 2020: INERTIAL AND ACTIVE SCENARIOS

Source: http://murmanskstat.gks.ru





FIGUR 2 TRANSPORT STRUCTURE ALONG THE NORTHERN SEA ROUTE BY 2020: INERTIAL AND ACTIVE SCENARIO

Source: Pilyasov, 2010

Figure 2 shows two scenarios of cargo transportation per year by the Northern Sea Route by 2020 reaching 14 mill tons according to the active scenario (orange figure) or 4 million tons according to the low scenario (light yellow figure). Figure 3 presents the transport structure of transportation along the Northern Sea Route by 2020.

Within the large-scale active scenario, the maritime transport may become the second largest export service of the Russian Arctic after oil and gas resources. Positioning itself as a Eurasian marine transport state, Russia may find a major source of income and will be largely immune to the risks associated with the outlook of unfavorable conditions of the world's hydrocarbons markets. However, full potential for maritime transport and transit may have powerful and complex effects (Stupakov, 2011). These effects include the increase of labor mobility and the standard of living of the population inhabiting the areas of international and regional marine transport routes adjacent to the Northern Sea Route, the revival of industrial and business activity in the Arctic regions of Russia, further impetus to the development of telecommunications, etc.

To facilitate inter-continental transport the plan is to upgrade and construct new ports and shipping terminals, build icebreakers and transport ships, create exploration fleet and offshore maintenance facilities. The load on the Northern Sea Route will increase due to new railway links to the White, Barents and Kara Seas, and the Laptev Sea (mixed rail-waterway through Yakutsk).

Climate change in the Arctic will have a growing impact on the technology of infrastructure development, modernization of the fleet, the forms of resettlement and environmental policy.

As for traffic pattern, the major traffic flows will be linked to the Dudinskiy area with year-round shipment of hydrocarbons from the Ob and Yenisei region, exports of timber from Igarka and Tiksi, and imports of goods from East and West. "River – Sea" vessel shipment will play a significant role on the transport of the Northern Sea Route.

The transportation of oil in the Barents Sea (including Varandej and Prirazlomnoe deposits in the Pechora Sea) will exceed 20 million tons by 2020. By extrapolating the values obtained for long-term (2030) in the inertial scenario and qualitative data of the active scenario, the forecast of marine cargo traffic along the Northern Sea Route will range from 10.6 million tons to 20.1 million tons (Kondratjev, 2002). When production starts at the LNG facility at the harbor Port Sabetta on the western shore of the Ob Bay in the Yamal Peninsula, there will be a gas tanker every six hours with 240 port calls a year, with up to 16 LNG tankers. The harbor of Novy Port supporting the Novy Port field, one of the largest oil and gas condensate deposits in Russia, will have year round operations with 6 ice classed tankers transporting approx. 36 000 ton petroleum products.

The development of a full-scale transport system will not only remove barriers in the use of transit potential and improve the accessibility of regions, but also it will help to eliminate the infrastructure constraints on the growth of mining industry in the Russian Arctic. The efficiency of the development of large and unique deposits of natural resources may increase traffic with different types of bulk cargo:

- oil (on the continental shelf and the continental part of the Arctic),
- coal (Pechora, Sosvino-Salekhard, Taimyr, Tunguska and its northern part - Norilsk coal district, Lena basin)

- platinum metals (Taimyr-Norilsk province), gold (Severnaya Zemlya, Taimyr and Yano-Chukotka province),
- chromium and titanium (Olenegorsk, Kirovogorskoe, Kovdorskoye and some other fields),
- lead and zinc (Khoi - Novozemelskaya province), nickel (Norilsk and Kola group of fields)

Summing up, Russia has ambitious plans for increasing volumes of minerals both from mining and from oil and gas fields. The transportation volumes of minerals will then very much depend on international prices of raw materials including the oil prices. The traffic may double or even become three times higher than today if new promising fields are discovered and the oil prices remain on a high level.

FISHERIES

As for fishing activity, approximately 25 % of all fish catches in Russia is caught in the coastal areas. According to the maritime registry there are 214 fishing vessels registered in the Northern Russia. The coastal fishing fleet has around 100 vessels (http://www.rs-class.org/ru/). Small coastal fishing vessels use diesel. Approx. 25 % or 17 thousand tons of fuel is consumed by the vessels in the coastal areas (http://murmanskstat.gks.ru). According to the statistics the fuel consumption by the fishing industry is rather high, approximately 68 thousand tons per year.

According to the Northern Fishermen Union the sea-going fleet is dealing with cod and pelagic fish species in the Barents and Norwegian Seas, bass fishing in the area of the Irminger, and Greenland halibut in North Atlantic areas and East Greenland (Zilanov, 2010).

Total catch brings 262,507 tons of fish and seafood products in 2015, which is more than the last year's 42,729 tons (56% of which belongs to the Murmansk region). The food production amounts 172,743 tons, canned - 693 tubes, fishmeal - 2023 tons. There is an increase in catch of key species: cod - over 44,701 tons, blue whiting - over 5916 tons, saithe - over 2811 tons, perch - over 2276 tons. Catch of haddock is decreased by 20,234 tons due to the significant reduction of the quota compared with 2012. All Russian catches of saithe in the Norwegian

EEZ amount 14300 tons with quota at 14250 tons. Union enterprises produced 9802 tons of saithe, which is equivalent of 84% of the total catch (http://murmanskstat.gks.ru).

Industrial quota of cod is used by 71% (quota 188498tons, catch 133104tons), haddock - 62% (quota 35904tons, catch 22117 tons). Ship owners presume that cod fishing is hampered by significant by-catch of haddock, which leads to a change in the position of vessels (http://murmanskstat.gks.ru).

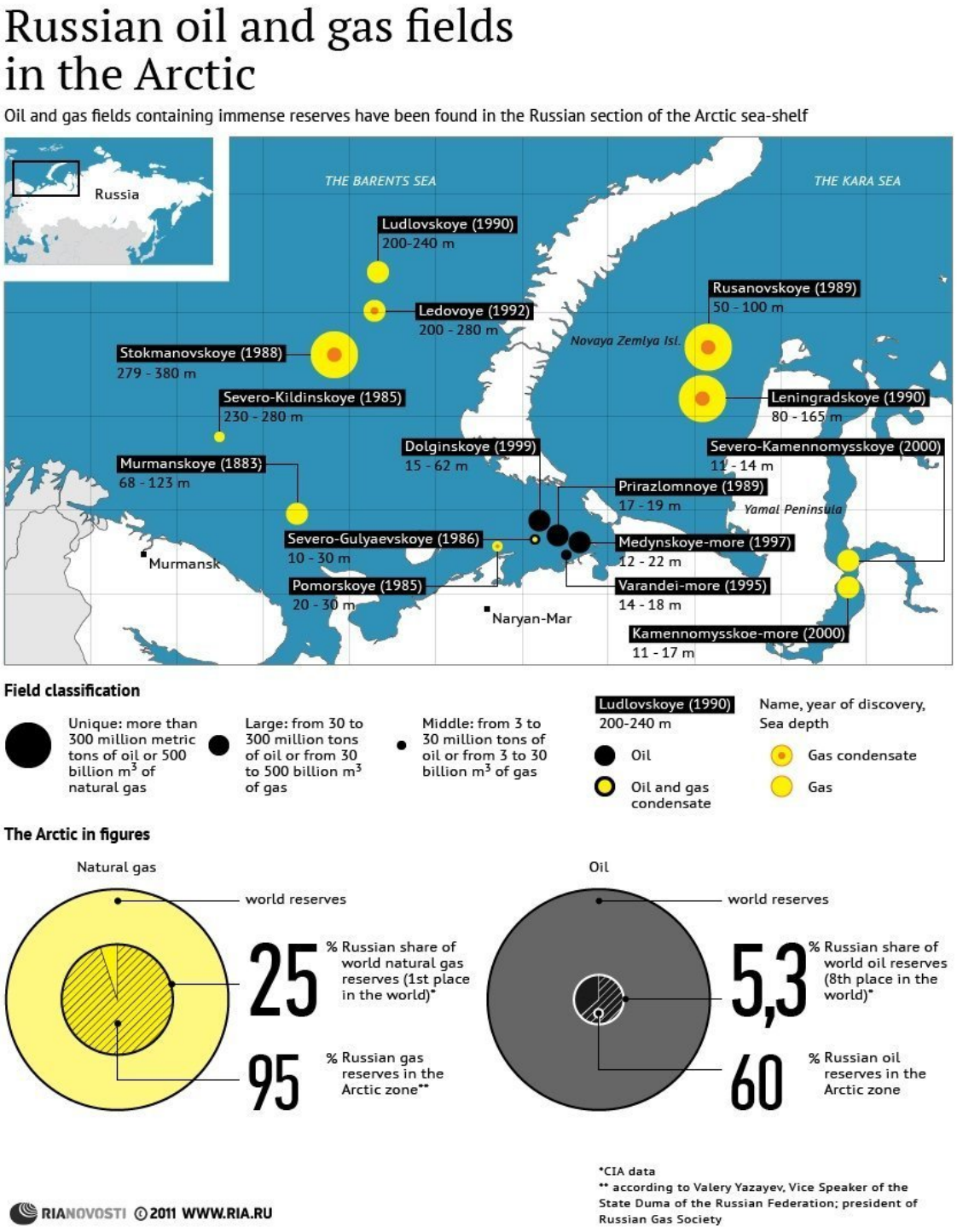
TABELL 3 BARENTS AND NORWEGIAN SEA FISH PRODUCTION AS PER 09 SEPTEMBER 2013 AND 2014

Species	Catch, thousand tons	Catch, thousand tons
	2013	January – September 2014
Catfish	8,4	8,5
Flounder	4,5	6,6
Perch	1,7	1,4
Hallibut	3,0	2,7
Saithe	12,4	14,3
Total	**30,1**	**33,5**

In order to reach the anticipated level of economic growth it is necessary to build new fishing vessels. There is limited information on the total number of planned new vessels. Many private fishing companies are already building or planning to build at least 2-3 new fishing vessels each within next 10-15 years. However, the number of the planned fishing vessels, which is reaching approx. 200, may in fact be smaller due to limitations in available resources. In addition, the new generation of fishing vessels have increased capacity, which means that less vessels will operate with given fish stocks and quotas.

PETROLEUM ACTIVITY

Currently, the northern areas play a key role in the national economy in ensuring energy security and geopolitical interests of the Russian Federation. More than 80 percent of oil and gas reserves of Russia are located on the shelf of the Russian northern seas.



FIGUR 3 RUSSIAN OIL AND GAS FIELDS IN THE ARCTIC

Source: www.ria.ru

Offshore oil and gas fields gradually include new areas offshore on the subarctic and arctic shelf. Development of oil and gas shelf deposits in the freezing seas is now regarded as one of the most promising sources of fuel and energy of the industrialized countries (Vasiljev, 2007)

- 70% of hydrocarbon resources of the continental shelf of Russian Federation are in the Barents and Kara Seas;

- 91% of the production of natural gas and 80% of Russia's proven gas reserves of commercial categories are concentrated in the Arctic region;

- Estimated reserves of hydrocarbons in the deep part of the North Arctic Ocean comprise 15-20 billion tons (In terms of conventional fuel).

The total cost of proven mineral reserves of mineral resources in the Arctic by approximate estimates is 1,5-2 trillion US dollars. The volume of offshore exploration has been rather low until 2010, however, during last few years there have been an increase in the activity (Andreev, 2010).

The Prirazlomnoye field is an Arctic offshore oil field located in the Pechora Sea, south of Novaya Zemlya, around 60 km from the shore. The field development is based on the single stationary Prirazlomnaya platform, which is the first Arctic-class, ice-resistant oil platform in the world. Commercial drilling began in late 2013. This is the first commercial offshore oil development in the Russian Arctic.

The next field in this region is the Dolginskoye field, which is located 110 kilometers out from the mainland. It may start production in the early 2020s. The depth in the field is up to 50 meters with distance to nearest supply base in Murmansk of about 1000 km.

The third area that may be developed in this region is the Victory field in the Kara sea. Rosneft launched projects in the Kara and Barents Seas in 2010 after obtaining four licenses to explore Russia's Arctic shelf. Three of the licenses relate to blocks in the Kara Sea (East Prinovozemelsky 1, 2 and 3) and the fourth one is for the South-Russky block in the Pechora Sea. The blocks are estimated to hold 21.5 billion tons of oil equivalent. After the first year of drilling the Kara sea field looked promising and was re-baptized as the Victory field. The logistics is, however, a challenging task because the supply base is located in Murmansk. This implies an 80-hour transit time and several platform supply vessels are needed. In the summer operation period in 2014 13 vessels in total were employed to serve this one drilling rig.

The Kara Sea is an extension of the West Siberian oil and gas province, which accounts for 60 percent of Russia's current oil production. The sea is approx. 80 meters deep. There are difficult

ice conditions (ice-bound for 270-300 days a year). Winter temperatures plunge to minus 46˚C. Ice ranges in thickness from 1.2 to 1.6 meters. The militarized zone of Novaya Zemlya makes base facilities a challenging task. Nearest supply base is in Murmansk - 1800 kilometer away, with an expected transport trip of up to 10 days both ways.

Exploration drilling in the Kara sea was launched in the Summer 2014 with mainly Norwegian vessels and a Norwegian drilling rig including 10-12 units. The Western countries' sanctions against Russia in the Autumn of 2014 stopped the drilling before the first year of the operation plan was fulfilled. It is uncertain when the drilling work will start again.

Exploration activity in the Kara sea illuminates the need for vessel capacity in areas of limited infrastructure and ice infested water. Between 10 and 15 vessels are employed in different phases of the exploration serving one or two rigs. There is a need for platform supply vessels, high ice class and ice-breaking vessels undertaking ice management, and also depot and hospital vessel capacity.

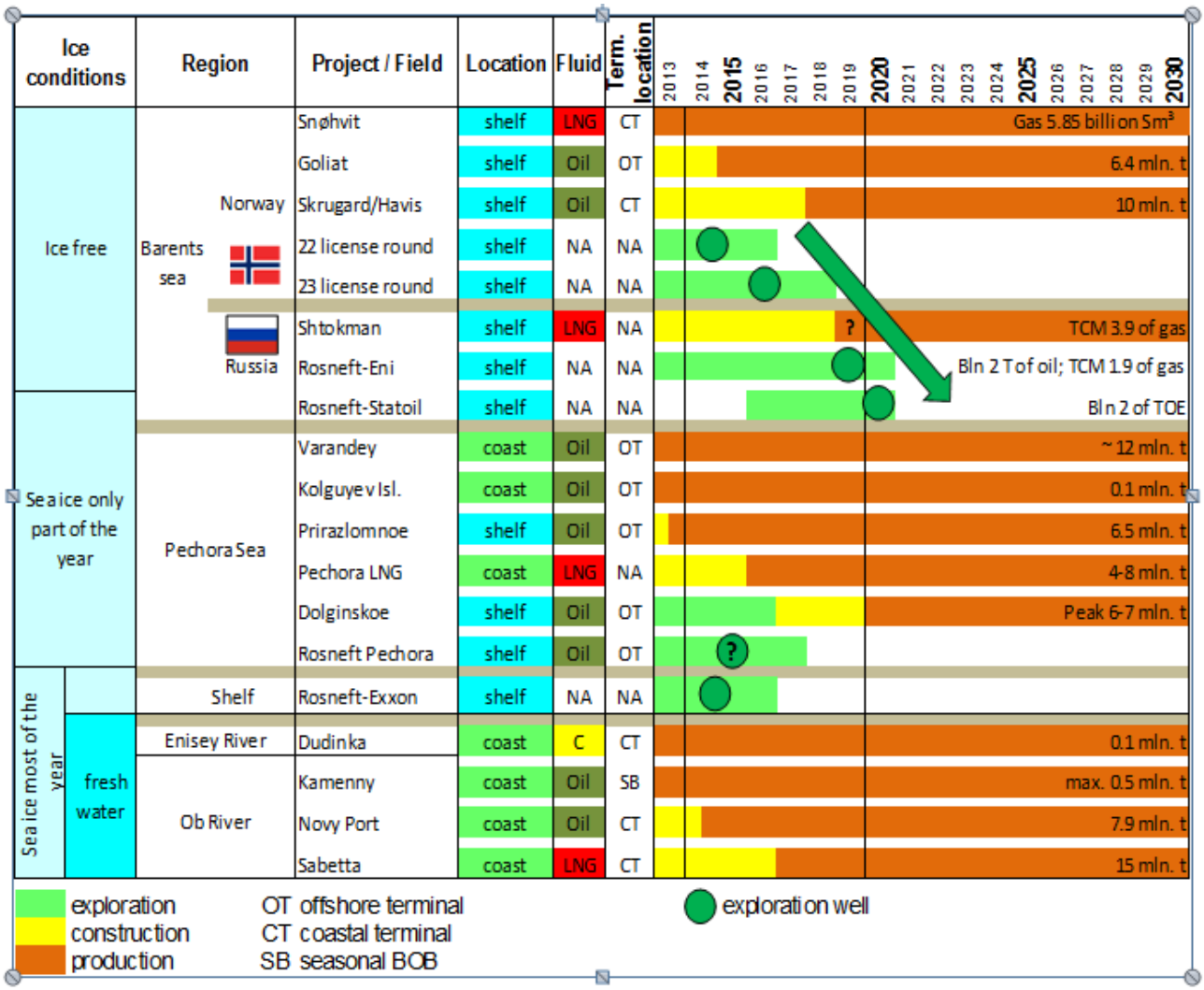
Rosneft and ExxonMobil has created an Arctic Research and Design Center for Offshore Developments (ARC) in St. Petersburg, which focuses on research and development. Its ambition is to become Russia's first competence center capable of solving all the tasks the companies will face when developing shelf deposits. It will unite global and Russian expertise, develop key competences needed to develop shelf deposits and create new underwater production technologies, including developing ice-class drilling platforms, ships and rigs and underwater systems for oil extraction and shipment. The development of this center was also stopped by the political sanctions in 2014. Rosneft has plans to start drilling again in 2017. Gazprom is going to continue drilling in the Kara Sea in 2018 and in the Barents Sea in 2019.

The basic principle of the shelf project implementation in Russia is open compliance with the tough requirements of Russia's environmental legislation and international agreements during all stages – from design to completion of the drilling and well abandonment afterwards. Rosneft's and ExxonMobil's experts intend to pay a special attention to environmental safety and interaction with the region's indigenous population. Environmental impact assessment will be one of the key tasks of the Arctic Research and Design Center for Offshore Developments.

The table below summarizes oil and gas activity in the different sea areas with ice challenges. The green arrow shows that there will be a gradual integration of activity in the Norwegian

Barents Sea and the Russian side. However, the suggested timeline will be delayed both in Russia and Norway. It is challenging to plan exploitation of natural resources in this region.

TABELL 4 THE MOST IMPORTANT OIL AND GAS EXPLORATION FIELDS IN THE BARENTS SEA AND NORTHWESTERN RUSSIA



Source: Gecon 2013[1]

As for new activity in the Western part of Arctic Russia, Rosneft and Eni plan to operate on both sides of the Norwegian-Russian border in the Barents Sea[1]. Rosneft and Statoil plan to run a joint project in the Perseyevsky field in the northern part of the Barents Sea. They are planning to perform seismic activities in 2016-2018 and drilling in 2020. The timeline of the development of exploration, exploitation and transport will very much depend on the international prices of oil and gas and development of political relations.

[1] Russian – Norwegian Oil & Gas industry cooperation in the High North, Logistics and Transport, 15. November 2013

The fields that have been under construction in Russia will, however, influence a significant increase in shipping activity. The table below shows the most important harbors and terminals and their role in transporting oil and gas in Northern Russia.

TABELL 5 OIL AND GAS DEPOSITS AND TERMINALS IN THE NORTHWEST OF RUSSIA

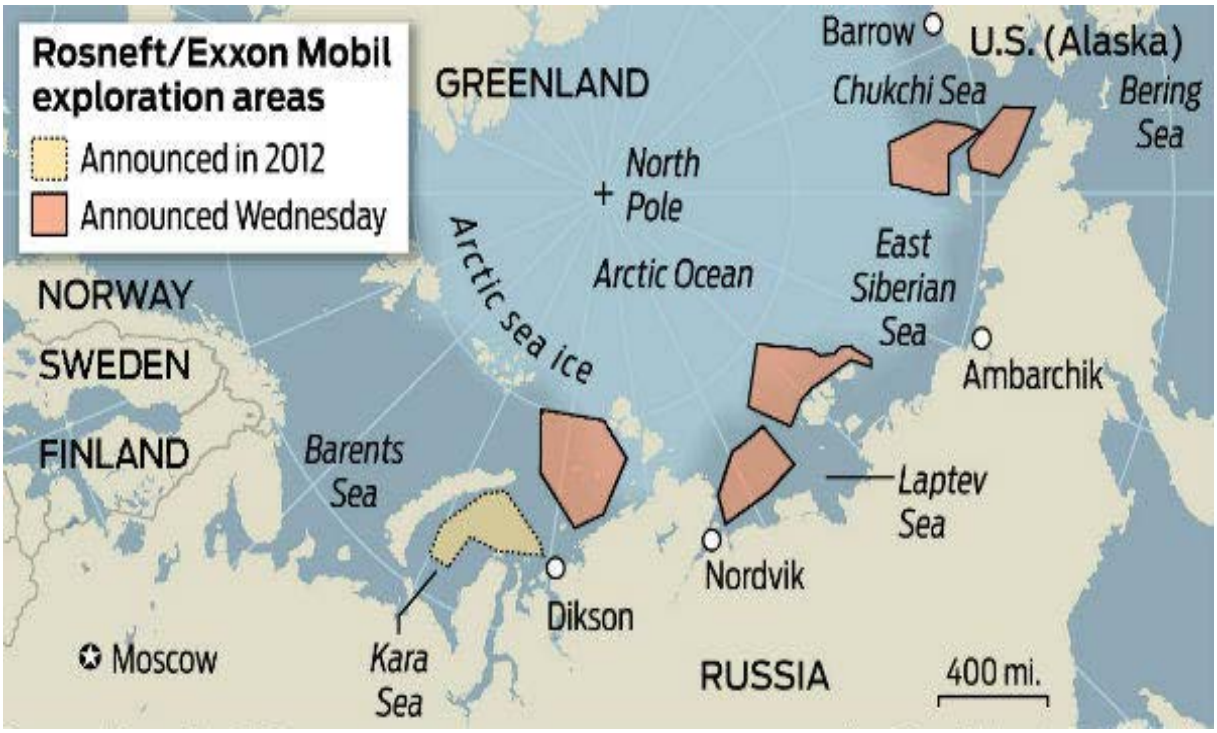
Oil loading operations		Volumes, thousand tons/year	
Place and routes	Characteristics	2005	2010
Murmansk	Oil loading from railway transport	2 000	6 000
Varandey terminal	Oil loading to tankers via sea pipelines and terminals	2 500	12 000
Pechora sea – Kola peninsula	Transportation of oil by tankers	2 500	14 700
Archangelsk	Loading of oil and diesel fuel to the tankers from onshore terminal	3 200	6 000
Port of Vitino	Loading of oil and gas condensate from onshore terminal	3 500	6 000
White sea – Kola peninsula	Transportation of oil by tankers	6 700	12 000
Kola peninsula	Loading of oil into export tankers	9 200	26 700
Obskaya bay – storage tanker Severomorsk	Transportation of oil by tankers	350	н.д.
Kolguev island - Kola bay	Transportation of oil by tankers	100	н.д.

Source: www.bellona.ru

The number of land-based and offshore terminals may increase in future, as well as the number of cargo supply bases for. Also, the production at the already established fields will be scaled up.

The construction of the oil transit shipment complex in Varandey gives an opportunity to export oil through the shortest sea route to European and North American markets at the lowest cost as well as to have an infrastructure that allows developing new fields in the Timan-Pechora province.

Eastwards Rosneft and ExxonMobil has several licenses all along the Russian coast towards the Bering Strait. We are here talking about five-six major exploration areas.



FIGUR 4 EXPLORATION AREAS OF ROSNEFT AND EXXONMOBIL

Source: Exxon Mobil Corp.

Rosneft and ExxonMobil conducted seismic shooting in the Laptev sea in summer in 2014. These areas have even more challenges related to lack of infrastructure and ice conditions. With the exploration drilling costs that Shell experienced in the Chukchi Sea spending more than 7 billion USD the exploration of the Northeastern part of Russia may take some time.

The risks of oil and gas development of the Arctic shelf are much higher than in other areas. In addition to reliable assessment of field and its environment, it is important to consider economic viability of deposits development, challenges regarding harsh climate conditions and construction of technologically complex shipping infrastructure and pipelines. Availability of unique technologies and equipment as well as accessibility of personnel capable of working with high-tech equipment in harsh arctic conditions are issues of high priority for the offshore

activity. The production is planned to increase to approx. 6 million tons per year in 2020. But it will very much depend on the speed of technology development. Environmental organizations criticize offshore oil production installations, especially the Prirazlomnaya rig 60 kilometers off the shore (Varandey settlement) at the water depth of 20 meters. The area risks are high ice loads with ice thickness of up to 1,7 meters and ice up to 250 days a year. The extreme low temperature is -50 degrees; wind is up to 40m/s and wave height is up to 12m.

Over the years, Gazprom has been the leading Russian company in production and transportation of hydrocarbons. It has emphasized efforts related to the establishment of emergency rescue capacity for personnel. A number of documents was drafted as a part of these activities, for example:
" The concept of rescue at sea of the objects of exploration, development and marine transportation of hydrocarbons by Gazprom",
"The concept of rescue of personnel from drilling and production facilities as well as support of offshore transport in natural and man-made emergency situations" (www.gazprom.ru).

Under the guidance of the Gazprom Technical Committee "Technology of Oil and Gas Production and Processing" (TK23) national standards are being developed on issues of rescue at sea, requirements for the safety of personnel and development of the continental shelf.

In sum, there is a large amount of licenses given in the Russian offshore areas. Improved technology for transportation of oil and gas through pipelines over longer distances as well as improved efficient technology on ice classed platforms and vessels will increase the rate of offshore exploration and exploitation. The number of offshore fields may increase significantly on the Russian shelf. For each field the number of vessels may increase with ten to fifteen units depending on transport solutions and infrastructure. Some of these vessels will contribute to transit traffic. The transport of oil and gas from each field may range from a few to twenty vessels depending on the size of installations, and the size of ships in use.

MARITIME TOURISM

There are a lot of possibilities for maritime tourism in the Arctic, including both sea voyages and visiting attractions on land. Two concepts appeared for tourism activity. Mass tourism uses larger cruise vessels and niche-oriented explorer tourism has cruises to more remote areas.

There is an increasing interest in niche-oriented cruises such as ecoturism, scientific, adventure, extreme, business, sports and health types. All the listed types of tourism generally correspond to the model of consumer behavior of the emerging middle class in Russia. The choice of these segments of the market are primarily happened due to competitive advantages and buying capacity of consumers, making the Arctic extremely attractive to a relatively narrow group of potential tourists. There are some restrictions in this area, regarding border crossings and area of navigation. Attractive cruises to the North Pole make it possible to visit Svalbard and travel along the Northern Sea Route. One example is a route between "Murmansk - Svalbard - Franz Josef Land - Severnaya Zemlya" and "Bolshevik Island - Wrangel Island". There are also other routes. Russian companies have long experience with cruises to the North Pole on "Rosatomflot" icebreakers. Over the years, thousands of tourists have taken an icebreaker and other cruise vessels to the Arctic part of Russia.

There have been plans for extension of the route of the Norwegian company Hurtigruten cruises to the ports of Murmansk and Archangelsk and to the Solovetsky islands; however, these plans have not developed further. During summer season up to 20 cruise ships have called at the port of Murmansk, but the numbers are fluctuating. The interest for Arctic tourism may be expected to grow, but it will also fluctuate with the Russian economy.

Despite the ambitious plans, the level of tourism activity in the Arctic remains quite low and can be regarded almost minimal in terms of number of vessels and potential damage. There are also discussions about the development of tourist transportation in the Arctic. No matter how low tourist activity probably be (up to 20 cruise ships per summer in Murmansk and approximately as much in Archangelsk) it shall also be taken into account. The number of cruise vessels to the Murmansk and Arkangelsk harbors during last couple of years have been around 10 vessels per summer. In addition, there is also some traffic with private yachts and sail boats.

As for explorer cruise tourism, more traffic is expected in the coming years. In late August 2014, the Hapag-Lloyd owned ***Hanseatic*** with ice class 1A Super was the first non-Russian ship to sail along the Russia's Northern Sea Route, travelling without ice breaker assistance and reaching 85.6 degrees North.

Summing up, there is a lot of uncertainty about the tourist traffic in the Russian Arctic. Larger cruise vessels reaches remote parts of the Northern Sea Route and explorer cruises focus on the areas close to the ice ridge, areas with limited infrastructure which may increase emergency

risks. The tourist industry aims to explore areas in the Northern regions and find areas where few people have travelled. This may increase traffic in the most Northern parts of Russia, north of the Wrangel and New Sibirian Islands, Severnaya Zemlya and Novaya Zemlya and up Franz Josefs land as close to ice areas as possible.

RESEARCH AND OTHER GOVERNMENTAL ACTIVITY

According to the Principles of the State Policy of the Russian Federation in the Arctic and Maritime Doctrine of the Russian Federation until 2020 among the main interests of the Russian Federation in the Arctic region are:

- Ensuring the sovereignty and territorial integrity of the Russian Federation and the inviolability of state borders;
- Establishment of the true boundaries of the Arctic continental shelf of the Russian Federation;
- Completion of the territorial demarcation of the Russian Federation and neighboring states and international legal registration of the state border;
- Strengthening the presence of the Russian Federation in the Arctic region;
- Preventing military escalation in the Arctic region from other states;

The Northern fleet has its base in for surface ship at Severomorsk and for submarines at Vidyayevo, Gadzhiyevo, and Polyarny. It has eight operational SSBN submarines and 18 general-purpose nuclear-powered submarines. It has fairly modern and well-maintained surface warships, including the aircraft carrier Admiral Kuznetsov, one nuclear cruiser Pyotr Veliky, and six destroyers[2]. Russia is opening new military bases at the New Siberian Island and Franz Josef Land.

Currently the Russian Navy has developed the "Concept of the Navy in the Arctic" which includes a chapter on construction and development of the search and rescue support in the Arctic zone. With increased international tension, the presence of military vessel may increase. With a more modern fleet, the Russian navy may be expected to increase the number of vessels

[2] Jane's World Navies. Russian Federation. 2-Oct-2015

present at all times. The Northern Navy fleet is building four icebreakers for ice up to 0,80m. The Russian military is creating a special group of Arctic Armed Forces provided by modern system-based and special ice class vessels for operation in the North.

Besides, the Navy plans to build maritime search and rescue long-range helicopters and aircraft systems capable of prompt search for people, as well as special collective and individual means of salvation for use in the Arctic conditions (Vasiljev, 2003).

In addition, work is being done on building two rescue vessels (one for Northern and Pacific Regions) ice class not lower AGS-7 (according to the classification of the Russian Maritime Register of Shipping) which are supposed to ensure independent navigation in drift ice; basing a search and rescue helicopter; search and rescue crew of emergency vessel. It is planned to create an ice-class rescue submersibles and specially designed for Arctic seas emergency aid complexes to be landed with parachutes.

Search and rescue capacities at sea in the Arctic affect the maintenance of the national interests of Russia based on the implementation of international instruments ratified by the Russian Federation and the expansion of its presence in the region. In this connection, one of the first tasks should be to build a modern system of search and rescue support in the Arctic. Four new Arctic SAR vessels are built.

As for research activity, this is an important part of government activity in the North. Icebreakers are used for this purpose. There have been discussions of using old nuclear icebreakers as research stations in the Arctic. At present four nuclear icebreakers are available for such purposes.

In sum, there more government vessels are going to present in the Russian Arctic. These include navy vessels, government research vessels, icebreakers and also SAR and towing vessels. This may increase risk for accidents, but also increase competence of the fleet in safety issues in the Arctic.

SUMMARY

Emerging maritime opportunities in Russia are related to increasing traffic through the Northern Sea Route and exploration of new oil and gas deposits of the Russian Arctic shelf. In addition, a growing interest for industrial fishing in the Russian economic zone and interest for Arctic wilderness tourism require sufficient measures to address natural and man-made emergencies.

There are ambitious plans for increasing volumes of minerals both from mining and from oil and gas fields. We may find that the traffic is doubled or even three times higher than today if new promising fields are discovered and the oil prices are kept on a high level.

The number of offshore fields may increase significantly on the Russian shelf. It will depend on improved technology on ice-class platforms, construction of pipelines for longer distances as well as improved technology on vessels used for offshore exploration and exploitation.

There may be an increase in the number of cruise vessels in the Northern Russia even though there is an uncertainty about the volume of tourism traffic in the Russian Arctic. Larger cruise vessels and explorer cruises close to ice and in areas with limited infrastructure may increase traffic even though this may demand higher ice-class vessels. The tourist industry development needs to be examined to define needs for search and rescue and other preparedness capacities for tourist vessels.

More government vessels are expected in the Russian Arctic. They include navy vessels, government research vessels, icebreakers and also SAR and towing vessels. This may increase risks for accidents, but also means presence of a fleet with very high competence in the Arctic as a resource in emergency situations.

Special attention should be paid to the development of crisis management solutions, strengthening cooperation between different actors involved in all fields – EMERCOM, ROSMORPORT, State Maritime Rescue Service, Coast Guard Service, but also companies operating in the region (both oil and gas companies, shipping companies, and fishing companies). It is necessary to ensure compatibility of emergency protocols of all actors operating in the region.

Russia is actively developing search, rescue, and emergency preparedness systems. Development is done through upgrading on-shore emergency facilities along the Northern Sea Route, building a new ice-class rescue fleet, introducing stricter requirements in compliance

with IMO Polar code to cover the full range of design, construction, equipment, operation, training, search and rescue and environmental protection matters, relevant to ships operating in the inhospitable Arctic waters. International cooperation, joining resources and acting by the same emergency protocol are vital to ensure emergency prevention and efficient emergency response.

PART II THE NORWEGIAN WATERS AND SVALBARD SEA AREAS AND ACTIVITY LEVEL UP TO 2025 *BY ODD JARL BORCH, NATALIA ANDREASSEN AND NATALY MARCHENKO*

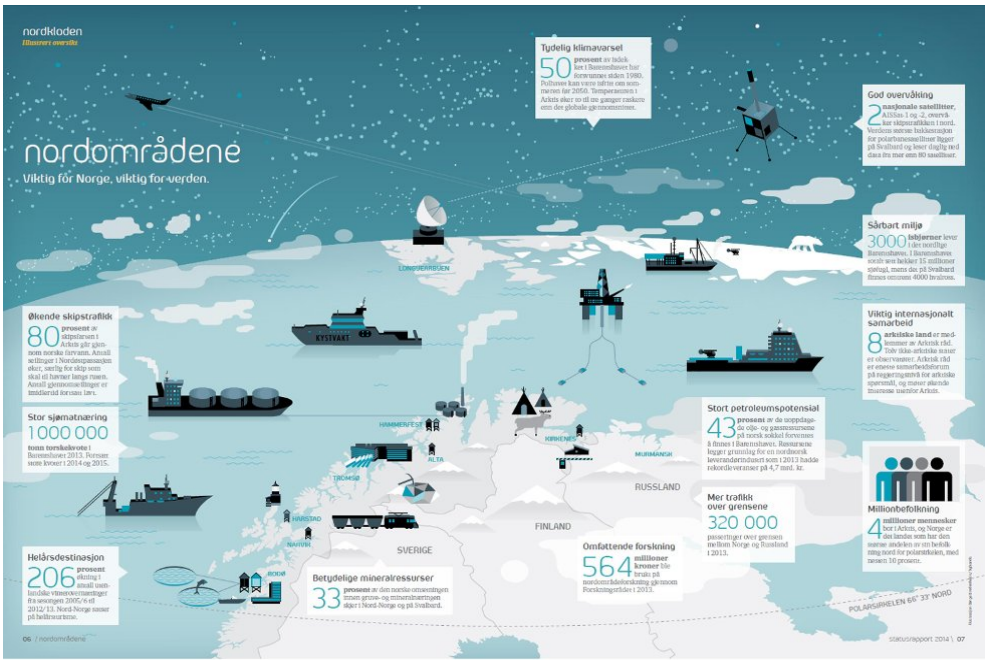
Commercial activity level in the Norwegian waters and Svalbard sea areas is growing and moving to the areas with severe conditions. There is a risk of ice, icing in the sea and extremely cold weather in winter months. Changes in maritime activity in the Norwegian North are related to the petroleum industry, which moves progressively farther north from the coast of mainland. There are also seasonal variations when fishing boats and cruise vessels that get farther to ice areas. The variation in activity level can be significant, so there is a need for a more detailed analysis of the activity in the High North and for a forecast up to 2025.

With the environmental vulnerability of the Northern Norway and general lack of infrastructure in the Arctic any emergency efforts become challenging. The activities in this region require a different emergency focus. The size of the sea areas and increasing commercial activities in some areas call for a careful reassessment of tasks and duties among emergency preparedness actors in the region. This is especially important because the risk of extensive unwanted events increases and the need for integrated operations emerges.

This chapter focuses on key types of activity and their characteristics in the Norwegian and Barents Sea areas including Svalbard and coastal areas of Norway. The first section discusses coastal sea traffic of passengers and cargo transport routes in the areas of mainland Norway and Svalbard. The next section overviews intercontinental routes and their traffic level. Fishing industry is one of the main industries in Norway. The chapter proceeds with overviewing of fishing activity and fishing fleet in the area. Another industry significantly important for the Norwegian economy is petroleum industry. The section discusses oil and gas industry activity related to exploration, development and production and engaged maritime traffic. The last section is devoted to the sea traffic engaged in research and monitoring activity.

POLITICAL STRATEGY

Norwegian Government has outlined new priorities for foreign policy development in the Arctic region (Figure 6).



FIGUR 5 PRIORITY AREAS FOR THE HIGH NORTH

(Norwegian Ministry of Foreign Affairs, 2014)

There is a need for more discoveries, robust solutions, detailed policies, solid understanding of the Arctic ecosystem, academic knowledge and expertise in different areas, and close dialogues between various parties. Norway will strengthen international cooperation through multilateral initiatives such as Arctic Council, cooperation between research communities and private and public sectors at national and international level. There will be focus on further development of research activities, development the transport system in the north and promotion of sustainable economic activity in the north for better emergency preparedness and environmental protection (Norwegian Ministry of Foreign Affairs, 2014).

The Norwegian government recognizes the need to strengthen preparedness and capacity in the High North due to increasing traffic and activity level. 150 million NOK are the planned investments in initiatives through project Arctic 2030. Preparedness and environment is one of the five priority areas, announced in the latest Status Report by the Ministry of Foreign Affairs (Norwegian Ministry of Foreign Affairs, 2014).

COASTAL SEA TRAFFIC

Mainland coastal traffic

In general, there is an increase in internal destination traffic of Norway, which stand for the shipping between ports in the Arctic region and for all types of shipping to and from the Arctic (Sander et al., 2014). The coastal sea traffic includes passenger and cargo transport along the coast of mainland Norway, and from neighboring countries, with use of smaller and medium-sized vessels. The volume of internal transport in coastal regions is relatively stable. Traffic statistics for routes with compulsory pilotage between Norway and abroad and between Norwegian ports presented by the Norwegian Coastal Administration, counts for 16942 sailings in Northern Norway for 2013. In addition to those, there are many smaller routes that are not obliged for compulsory pilotage (9688 sailings in 2013) and vessels exempted from the obligation (293 sailings in 2013) (kystverket.no).

Passenger ships are defined by the Australian Maritime Safety Authority (AMSA) report as ships that carry passengers, whether for transport purposes only or where the voyage itself and the ship's amenities are part of the experience (Arctic Council, 2009). In Norway, a fine grained net of ferry and fast boat routes are established along the coast. The coastal steamer Hurtigruten has up to 1,100 people on board and represents the largest and most frequent actor visiting 34 harbors on the coast on a daily basis with 12 ships.

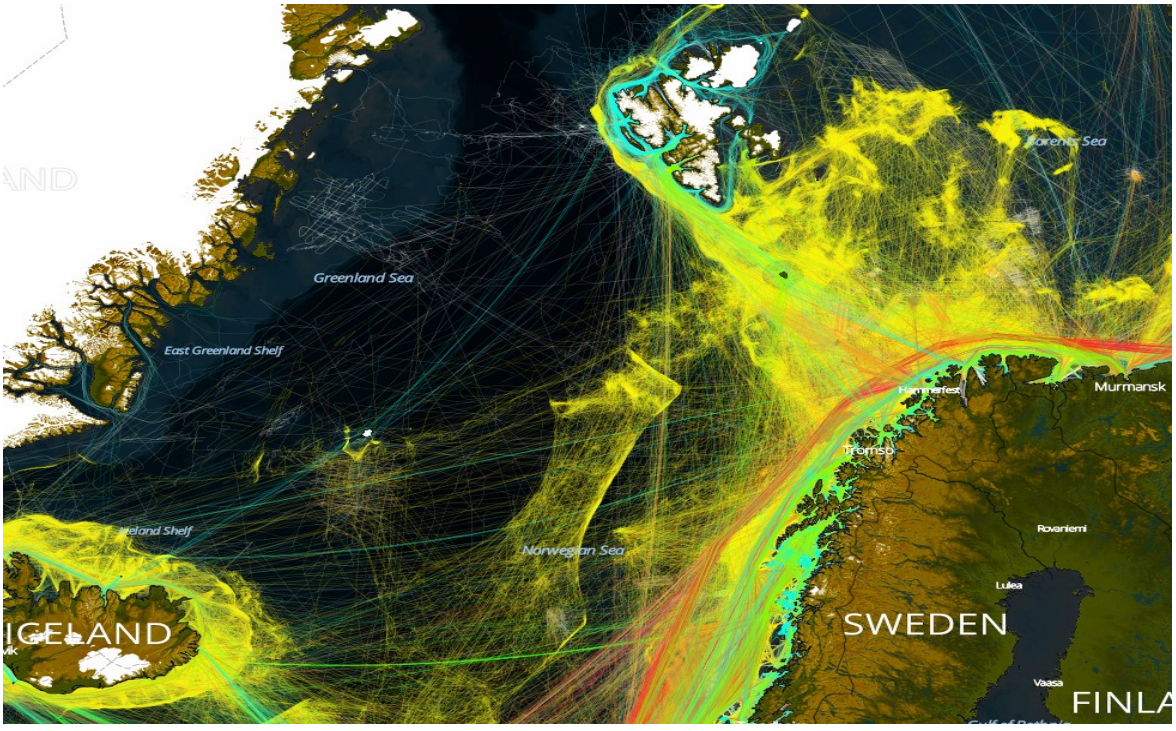
Some part of the coastal traffic is routes between Russia and mainland Norway, and Svalbard. General cargo ships are designed for the carriage of various types and forms of cargo and the combined carriages of general cargo and passengers with 12 or less fare paying passengers. Tanker ships are propelled ships designed and constructed for the bulk carriage of liquids or compressed gas, as in the case of natural gas (Arctic Council, 2009). Tankers travelling from Russia along the Norwegian coast represent almost 300 transports, with the largest shipping ports located in Murmansk and Arkhangelsk. The Norwegian Coastal Administration's Vessel Traffic Service (VTS) in Vardø coordinates the traffic separation system off the coast.

A significant increase in traffic is coming through shipping of goods between supply bases and installations on land and floating offshore platforms, initially out of Sandnessjøen and Hammerfest. A potential increase will come from the planned Johan Castberg field in the Barents Sea and exploration and production of other oil and gas fields in the coming years. The activity level here will very much depend on the oil prices.

The petroleum related traffic includes transportation of liquefied natural gas (LNG) on larger vessels, from the Statoil terminal on Melkøya near Hammerfest. These ships go farther out to the sea in the outer traffic lanes.

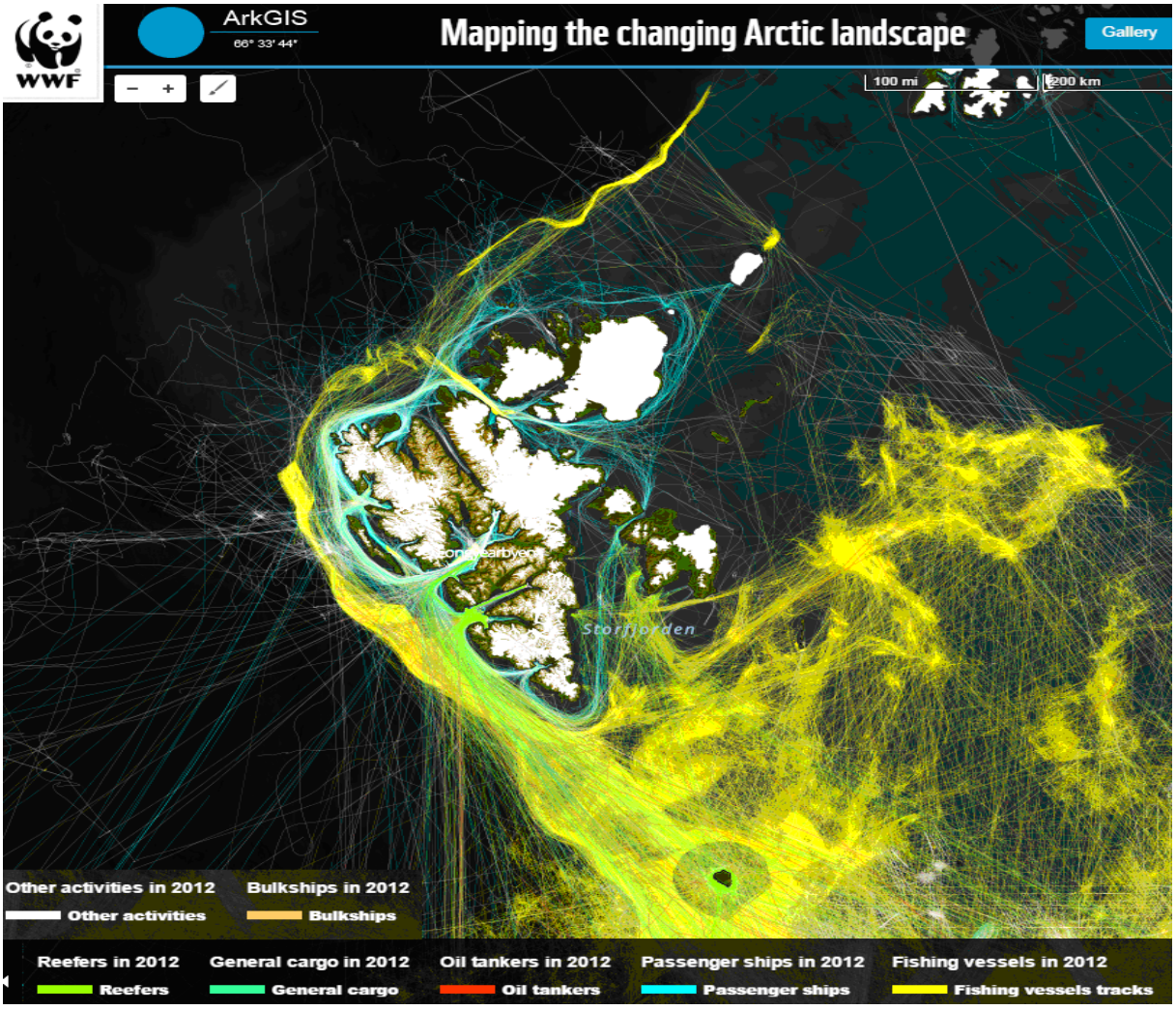
Many involved cargo routes belong to the special category of risk vessels. Risk vessels are defined by the Norwegian Coastal Administration as 1) tankers and vessels carrying hazardous and / or toxic cargo, 2) all vessels over 5,000 gross tons and 3) vessels containing radioactive materials. The Norwegian Coastal Administrations data system reports about 132 risk vessels per month on average for the region (www.kystverket.no). The Norwegian Coastal Administration's towing emergency preparedness capacity along the coast is particularly motivated by this risk group.

Special online service ArkGIS (Arctic Geographical Information System - http://arkgis.org/) is an interactive mapping platform that combines and integrates existing data about the environment and human activity in the Arctic. ArkGIS has been used to make an image of ship traffic along the Norwegian coast in the North (Figure 7) and in Svalbard area (Figure 8).



FIGUR 6 SHIPPING TRAFFIC ALONG NORWEGIAN COAST IN THE HIGH NORTH IN 2012 FOR DIFFERENT TYPE OF SHIPS

Source: http://arkgis.org/



FIGUR 7 SHIPPING TRAFFIC IN SVALBARD AREA IN 2012 FOR DIFFERENT TYPE OF SHIPS

Source: http://arkgis.org/

Coastal traffic in the Svalbard region

Ship traffic in the Svalbard area has large seasonal variation due to ice and weather conditions. Data from Vardø Vessel Traffic Service Center (VTS) shows that traffic around Svalbard is rather stable, largely the same from year to year with the same seasonality and the same number and type of boats.

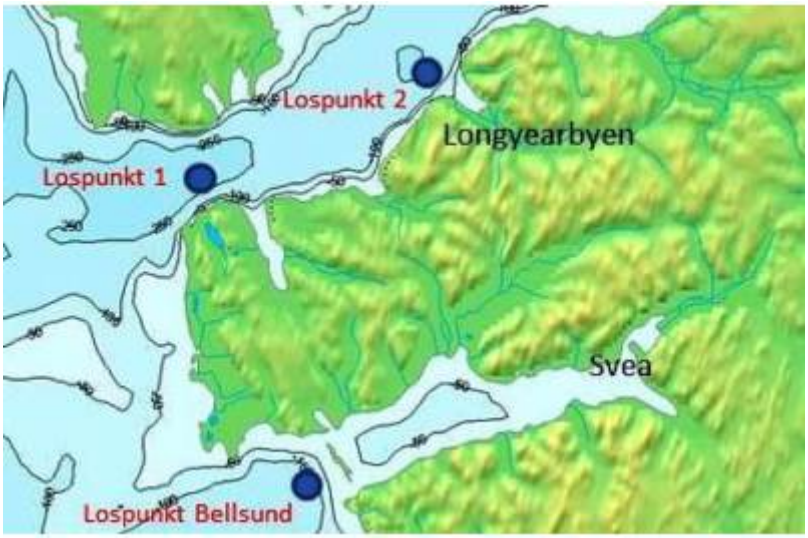
Local regulations in Svalbard include traffic restrictions in some areas. Ships sailing within nature reserves and national parks, which cover the vast majority of Svalbard waters, are not permitted to use fuel other than quality DMA in accordance with ISO 8217 Fuel Standard. Ships sailing within Eastern Svalbard nature reserves are not allowed to carry more than 200

passengers. Other restrictions includes bird sanctuaries with security zones where sailing is prohibited, cultural heritage sites where visits are prohibited or restricted, and areas where site specific guidelines are required before landing passengers from cruise vessels.

The Governor of Svalbard, in consultation with the Ministry of Environment, may regulate or prohibit traffic in all or parts of protected areas if it is deemed necessary to preserve flora and fauna.

Compulsory pilotage was introduced in 2011 by the Government by a national Act for all types of shipping. It is valid in the waters around Svalbard as well as near the mainland, with adjustments for local conditions. The aim of the Act is to reduce the risk of adverse events by maritime transport on Svalbard and avoid damage to life, health and the environment.

Cruising in Svalbard poses particular challenges in relation to the mainland emergency capacity. The navigation conditions of the archipelago are demanding. A national pilot can thus be an important for reducing risk of maritime accidents.



FIGUR 8 PILOT BOARDING POINTS

(source: Multiconsult, 2014)

Estimated Activity

The AMSA report in 2009 projected that the main increase in maritime transport in the next decade would be destinational (Arctic Council, 2009). The SADA report agrees with the projections (Sandler et al., 2014). Future Arctic transport activity, including the one in the

coastal areas, depends highly on ships involved to oil and gas, fishing, tourism industries and research. These issues are discussed in the following sections.

The Norwegian Government will further develop the transport system in the north, to ensure that it is able to cope with goods flows and everyday transport and can provide good connections between the countries of the north and the global markets. The maritime surveillance and information system Barents Watch will support government agencies in their operational responsibility at sea. The Norwegian Space Centre is developing concepts for satellite communication north of 75°N (Norwegian Ministry of Foreign Affairs, 2014).

The increased shipping traffic in the Arctic brings to stricter requirements for traffic and more governmental contributions to develop maritime infrastructure. As *Barentsobserver* reports, the harbor in Longyearbyen will become better prepared for the expected shipping boom. The National Transport Plan for the period 2014-2023, Norwegian Government has decided to allocate NOK 200 million (appx €26,7 million) to development of new harbor infrastructure in Longyearbyen (Pettersen, 2013).

INTERCONTINENTAL TRANSPORT

The intercontinental transport in the Arctic for Norwegian Sea areas is primarily related to the Northeast Passage. The Northeast Passage (NEP) follows the coasts of Norway, Russia and Alaska. It is used for transportation of oil, gas, various types of ore and fish from Norway, Iceland and Greenland. Along the coasts of Norway and Iceland, and near Murmansk (northwest Russian Federation) the route is ice-free year-round.

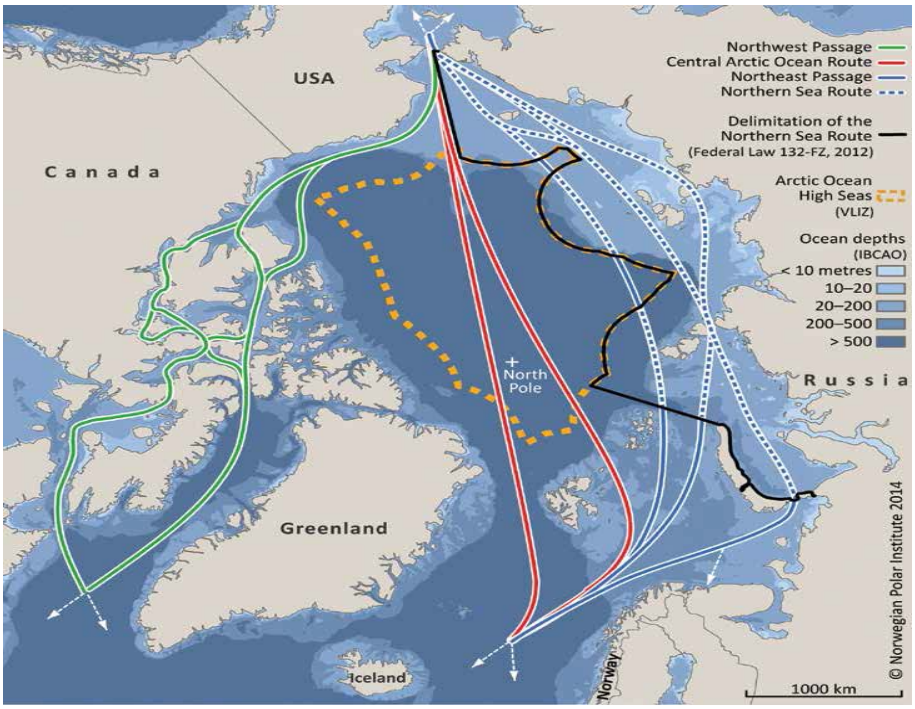
The major part of its Russian section is called the Northern Sea Route (NSR). Along the NSR there are ports for normal cargo handling in small ports and deep-water port facilities to handle volumes of cargo from global shipping (Arctic Council, 2009). The Northern Sea Route can actually provide up to 40% reduction in transport time and a significant reduction in emissions and costs on the route between Europe and Asia.

However, there is still an uncertainty about the transport capacity on this route. The numbers of ships using it as a transport corridor between Europe and Asia are still small as shown in the previous chapter. The time window each year when the transportation is possible is limited to the season from June until late autumn. There have also been few vessels so far and few ships

with ice-strengthened hulls (icebreakers). The reduced availability and long time on route results for bunkers and vessels into additional costs of insurance, icebreakers fees and vessels reinforcement for ice waters. Icebreakers fees are high and obtaining the right to ship on the Northern Sea Route is time consuming. There is a need for receiving official permissions at least 4 months before a route and obligatory inspections of ships (High North Dialogue, 2015).

In 2013, the navigation season lasted from 28.June until 28.November. Only two oil tankers under Norwegian flag passed through the Northern Sea Route carrying 58721 tons of gas condensate to South Korea and 62115 tons of liquid hydrocarbon to Taiwan (the Northern Sea Route site, http://www.arctic-lio.com/docs/nsr/transits/Transits_2013_final.pdf).

Compared with the 18 000-20 000 ships that pass through the Suez Canal each year, Arctic shipping today holds a minor global significance (Arctic Council, 2009). However, The Central Arctic Ocean Route in international waters is sparking interest as a future trans-Arctic transport corridor (Sander et al., 2014). It crosses the Arctic through the North Pole. It remains a mostly unused as ships going through it must traverse a permanent sea ice sheet, which requires the advanced ice breaking capabilities. The Figure 10 below illustrates maritime traffic activity in the High North.



FIGUR 9 ARCTIC MARITIME TRANSPORT ROUTES

(Source: G. Sander/A. Skoglund, SADA report, 2014).

Cargo ships run on fixed routes to and from Svalbard. The vessels are 80-150 meters length and call to Svea, Barentsburg, Longyearbyen and Ny Ålesund. There are two ships in regular service and 5-6 other dry bulk ships random arrivals by about 15 to 20 trips a year combined (Figure 11).

FIGUR 10 GRØNN FROST. TYPICAL CARGO SHIP IN LONGYEARBYEN HARBOR

(Photo: Longyearbyen harbor)

There are other types of vessels operating in Svalbard area. A freezer vessel of about 100-150 meters receives fish from Russian trawlers operating in the fjords west of Svalbard and around Bjørnøya. There are 2-4 such boats mostly throughout the year in these waters. The size of ships is 50-150 m. During the autumn months also Barentsburg and Longyearbyen calls by 2 to 3 bulk carriers. There are tankers supplying fishing vessels, cruise ships, Svea, Longyearbyen, Barentsburg and Ny Ålesund with fuel. These boats are from 90-150 meters long and operates in the Svalbard zone from April to December. Number one is about 10 vessels throughout the year.

FIGUR 11 TRANSEEAGLE. TYPICAL CARGO SHIP IN LONGYEARBYEN HARBOR

(Photo: Nataly Marchenko)

The challenges connected to operations near the ice edge call for a monthly examination of ice zones and the production of ice maps (Winther, 2014). Norsk Polarinstitutt calculates the probability for areas covered with ice. This information is used for mechanical and operational risks estimates.

The main challenge of intercontinental transport in the High North is the increase in traffic with tanker cargo and vessels with heavy oil. Fuel provides high pollution risk in vulnerable areas. Along the Arctic sea routes, the infrastructure and service is very much limited. A significant portion of this traffic transits outside the Norwegian coast, but the risk accident are present. The Norwegian Coastal Administration therefore emphasizes a strict report scheme and also the availability of dedicated tug boat capacity.

There are also areas with extra restrictions. In the Svalbard area, the Heavy Oil and Traffic ban restricts use of heavy fuel oil on ships in the three largest national parks in Svalbard (Norwegian Hydrographic Service, 2012). The purpose of the ban is to avoid spills of heavy fuel oil in connection with maritime accidents, thereby reducing the risk of any possible discharge. The ban on heavy fuel oil has been applied to protected areas on the east side of Svalbard since 2007. Heavy bunker oil has been banned from most of Svalbard's territorial waters since 1.1.2010.

Intercontinental navigation in the High North is challenged by environmental factors: presence and movement of sea ice, icebergs, cold air and water temperatures, variable and often unpredictable severe weather, magnetic variation, solar flare activity and extended daylight or nighttime conditions. These environmental conditions, combined with the remoteness of the region from commercial shipping centers and shipping lanes, highlight the need for improved systems to support safe navigation in the Arctic region (Arctic Council, 2009). In spite of the major constraints to its rapid expansion, the trans-Arctic shipping is slowly developing (Sander et al., 2014).

Estimated Activity

The changing climate is resulting in increased accessibility and a longer shipping season for intercontinental shipping. This will affect the activity level in future. Sea-ice has also become younger and thinner (Sander et al., 2014). The high-end scenario on traffic can be pictured in 15-20 years with a new world map for intercontinental shipping where the Arctic region is the road for 50% of transportation between Asia, Europe, and north and west of USA (Finne, 2014). The use of the Northern Sea Route may increase by 2025 because of the expanded open water shipping and moderately ice-strengthened ships (Smith and Stephenson, 2013).

At the same time, the ease of future shipping capacity can be overestimated. Firstly, sea ice conditions are highly variable and there will still be summers of occasional heavy ice conditions. By 2025, the navigation ice-free season is expected to be the same, about 4-5 months. Traffic system therefore should consider the conditions of waters with no ice, with ice part of the year, permanent ice cover and shallow ice-covered waters. The strategy will remain the same for now - managing the ice on shallow waters and avoiding the ice on deep-water. Secondly, getting shipped something on the Northern Sea Route is costly and time consuming. The high cost depends on the increased fuel consumption in the iced waters, ice-class ships costs or icebreakers expenses, high insurance rate and a shipping fee. Russia is now considering a more differentiated fee and less requirements for ice reinforcement during time of year when there is no ice in order to attract transit traffic through the Route. The insurance rate can become lower as the ice in the area melts. Thirdly, limited infrastructure does not allow to stop in multiple hubs for oil or cargo loading and the total shipping in ballast counts to around 25%. There are also maximum size and draft restrictions for vessels on the route. Therefore, new solutions for transport systems and vessels are needed considering size and draft restrictions,

combining multiple hubs and destinations on route, reduced predictability and seasonality (High North Dialogue, 2015).

Another future uncertainty is expressed towards container ships models operating in the Arctic. The DNV GL has estimated that the number of transit voyages with container ships will amount to 450 in 2030 and 850 in 2050 (DNV, 2010). Future Arctic transit traffic crucially depends on its attractiveness to container ships, which account for the largest share of global marine shipments (Sander et al., 2014). Therefore, new sustainable solutions for ships design are needed considering demand for ice-classed ships, icebreakers and related technology and ways to reduce fuel consumption.

The number of tanker vessels along the Norwegian coast fluctuates between 15 and 35 per month. The number of sailings from Melkøya amounts to 7-9 per month[3]. This provides a picture of the major risk traffic in transit through Norwegian Arctic waters. The number of commercial ships in and out of Norwegian harbors and transiting through Norwegian Sea areas is likely to increase because of the commercial activity in Northern Russia, and more transit traffic through the Northern Sea Route, even though the growth may be slow. The first oil field in the Norwegian Barents Sea, the Goliat field will represent increased shuttle tanker traffic in the region with around four tours a month.

FISHERIES

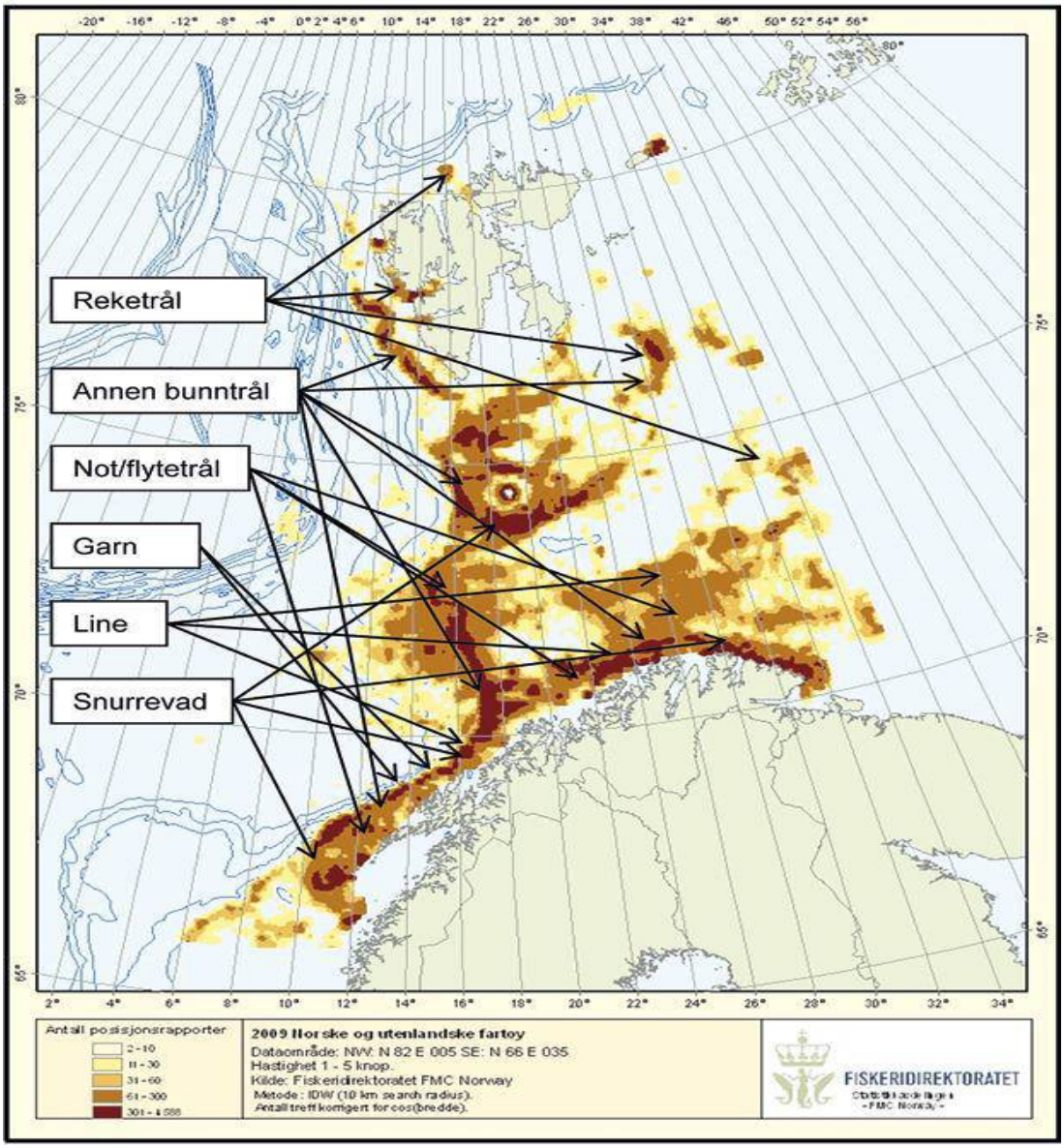
Fisheries continue to be a key industry across the Arctic (Arnarsson, 2014). Norway has a long tradition of fishing and fish farming, which has played a crucial role for Norwegian economy and export connections.

In the sea areas of Norway, fishing activity is currently maintained by smaller number of large sea-going vessels. Further north and west cod and shrimp trawlers are used. In summer, some of them operate on a latitude 81 degrees north from Svalbard. With a factory on board, a sea-going fishing, fleet can operate for long periods of time and over large distances. For fishing in coastal waters there are available small boats operating year-round. A great number of them represents around 50% of all coastal traffic in the north. This category demands good towing

[3] Norwegian Coastal Administration. NOR VTS, Vardo, July 2014.

capacity in the national preparedness system. In total, 3427 fishing vessels were registered in 2013 in the Northern Norway (Fiskeridirektoratet, 2014).

The Figure 13 demonstrates how the fishing activity is allocated in the Northern Norway sea areas with different types of trawls and coastal fishing fleet. Fishing vessels stand for 58% from the total transport distance in this region (the Norwegian Coastal Administration's website, www.kystverket.no).



FIGUR 12 FISHERIES IN THE BARENTS SEA

(Source: Directorate of fisheries, www.fiskeridir.no)

Vardø Vessel Traffic Service (VTS) shows that in the Svalbard zone fishing takes place throughout the year and around the archipelago with a peak from August to December. Typical

vessel size is between 25 and 60 meters (Figure 8). The fishing takes place mainly in the cod and shrimp areas south and west of Svalbard. The Fishing vessels usually do not visit Longyearbyen. Trawlers, going far north, following fish/shrimps and occasionally are caught by ice and need icebreaker assistance almost each second year. Since 2003 the number of port calls from fishing boats to Longyearbyen ranged between 15 and 30 per year. Since 1981 fishing vessels have accounted for over 60% of events in the waters around Svalbard. Fishing vessels over the vessel limits will be subject to polar pilot requirements. The Norwegian Coastal Administration expects that most fishing vessels will be eligible for Pilot Exemption Certificate (PEC). The number of fishing vessels in Svalbard changes from 10 -20 in January-May to 30-40 vessels in June-August and 50-60 vessels in September-December.

FIGUR 13 REVAL VIKING. TYPICAL FISHING SHIP IN LONGYEARBYEN AREA

(Photo http://www.marinetraffic.com/)

Sea hunting is the most limited type of hunting. There is a small activity related to the hunting of Minke whale. Modern whaling is conducted by many small to medium sized fishing boats in spring and summer seasons.

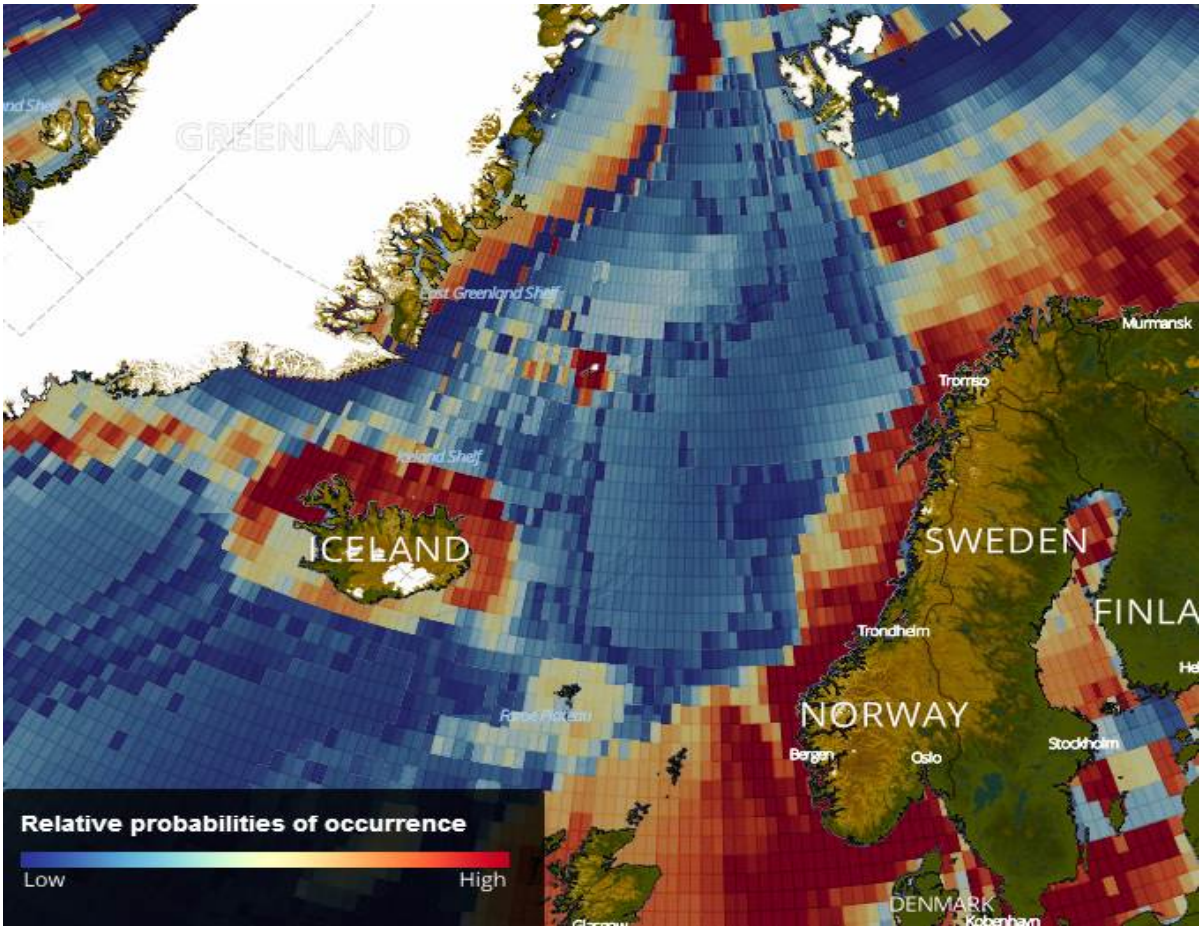
Challenges related to fishing fleet, which can influence the national preparedness system, are particularly the large numbers of vessels that operate the most part of the year. The great

challenge in the far North is limited communication. This applies to both emergency communication (GMDSS) related to VHF, MF, HF channels, and Inmarsat satellite communications. The connection drops away rapidly above the 75 degrees north. The Iridium satellite phone provides better coverage, but is unstable.

Estimated activity

Fisheries will continue to be an important industry across the Arctic. The efficiency of the vessels imply that there will be fewer but larger vessels present. The fast growing aquaculture production is a crucial part of the economy in many Northern communities, and will result in an increased coastal cargo traffic.

The maritime traffic engaged depends on the fishing areas and movement of fish resources. The vessels are constantly searching for new areas for their catches. Some species are migrating such as the pelagic fisheries moving North and westwards. The ArkGIS (Arctic Geographical Information System) demonstrates the relative probabilities of fish occurrence (Figure 15).



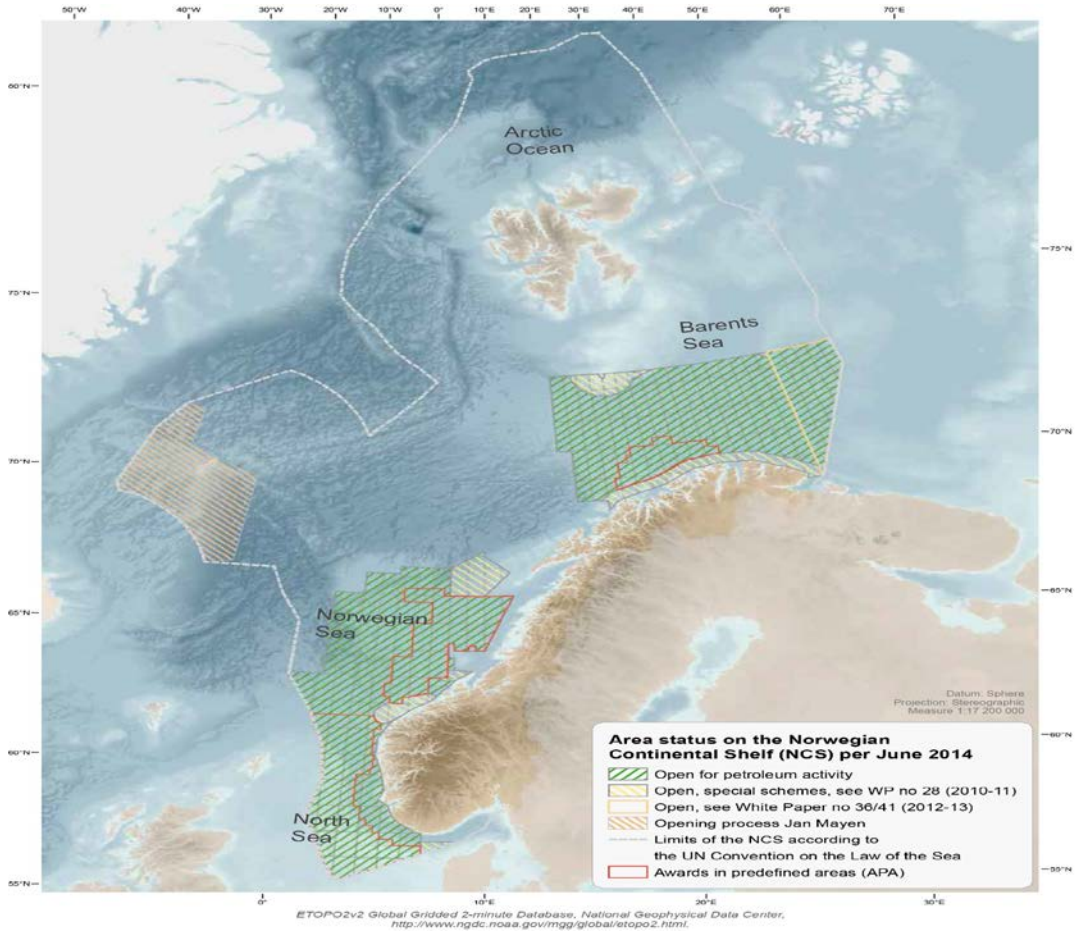
FIGUR 14 RELATIVE PROBABILITIES OF FISH SPICES OCCURRENCE

(Source: http://arkgis.org/, accessed 2015)

Changes in fish stock migration patterns are expected into peripheral areas. Various international frameworks for managing fisheries have been adopted. They resulted into regulation of catch quotas for highly migration species. There is an indication that the choice of management regimes may have a greater impact on Arctic fisheries than the potential environmental changes caused by climate change. Therefore, it is important to develop robust approaches for fishing management and institutions framework (Arnarsson et al., 2014).

PETROLEUM ACTIVITY

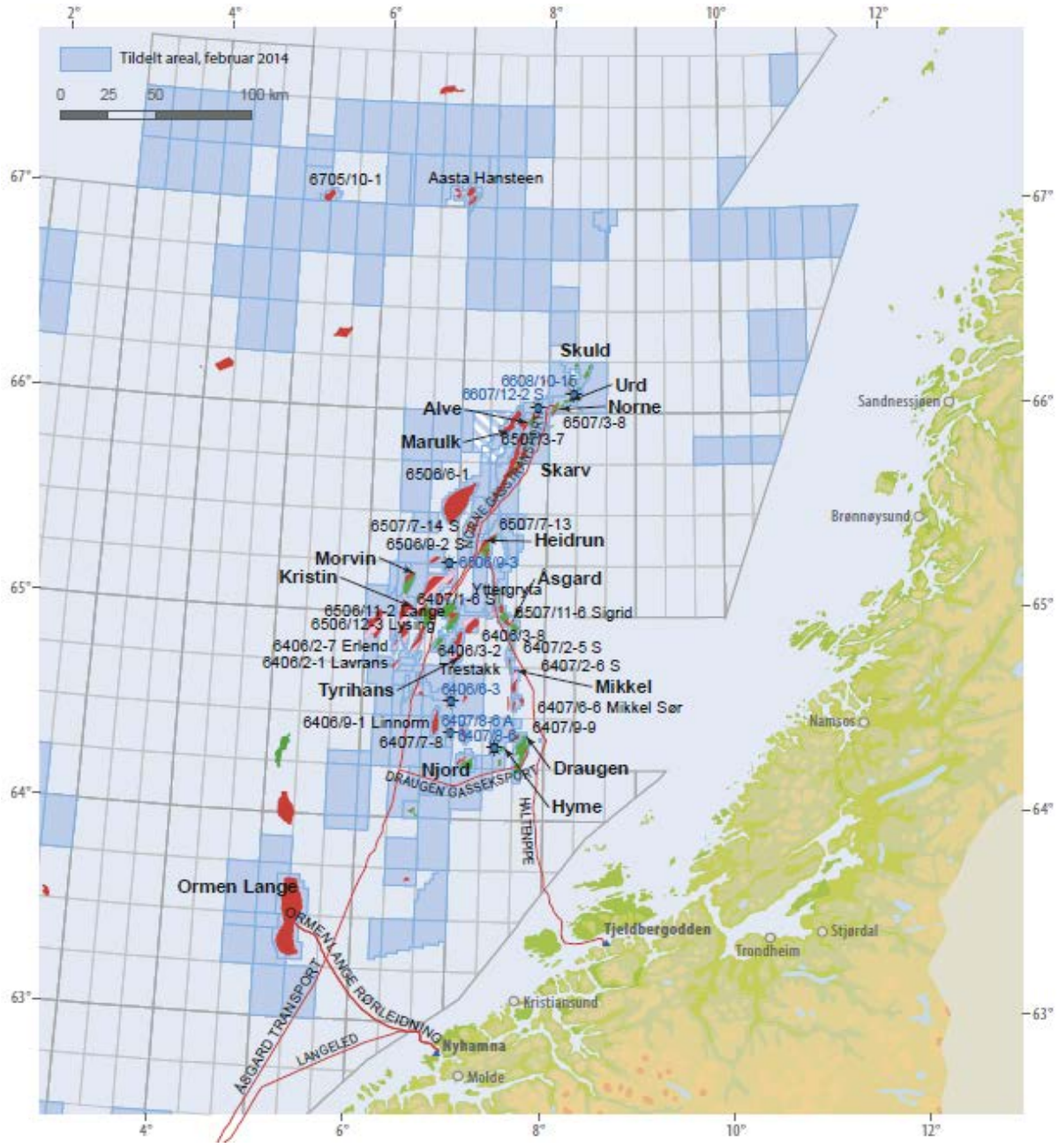
Oil and gas activity in the High North is primarily related to exploration, development and production in the coastal areas of the Norwegian Sea and exploration in the southern part of the Barents Sea. The activity is moving further north in the Norwegian Sea and further east and west in the Barents Sea in the 23rd license round (Figure 16).



FIGUR 15 PETROLEUM ACTIVITY ON THE NORWEGIAN CONTINENTAL SHELF

(source: Norwegian Petroleum Directorate, npd.no)

The Norwegian Sea has 16 producing oil and gas fields, which are mostly outside the High North region, and substantial gas reserves. Above the Arctic Circle, the Aasta Hansteen gas field is under development (Figure 17). The Polarled gas pipeline is planned to extend the Norwegian gas transport system north of the Arctic Circle. The pipeline with a record depth up to 1,3km will ensure gas transport capacity for gas volumes from planned and future field developments, such as the field developments of Aasta Hansteen, Linnorm and Zidane. Tanker ships transport oil from the fields in the Norwegian Sea (Tormodsgard, 2014).



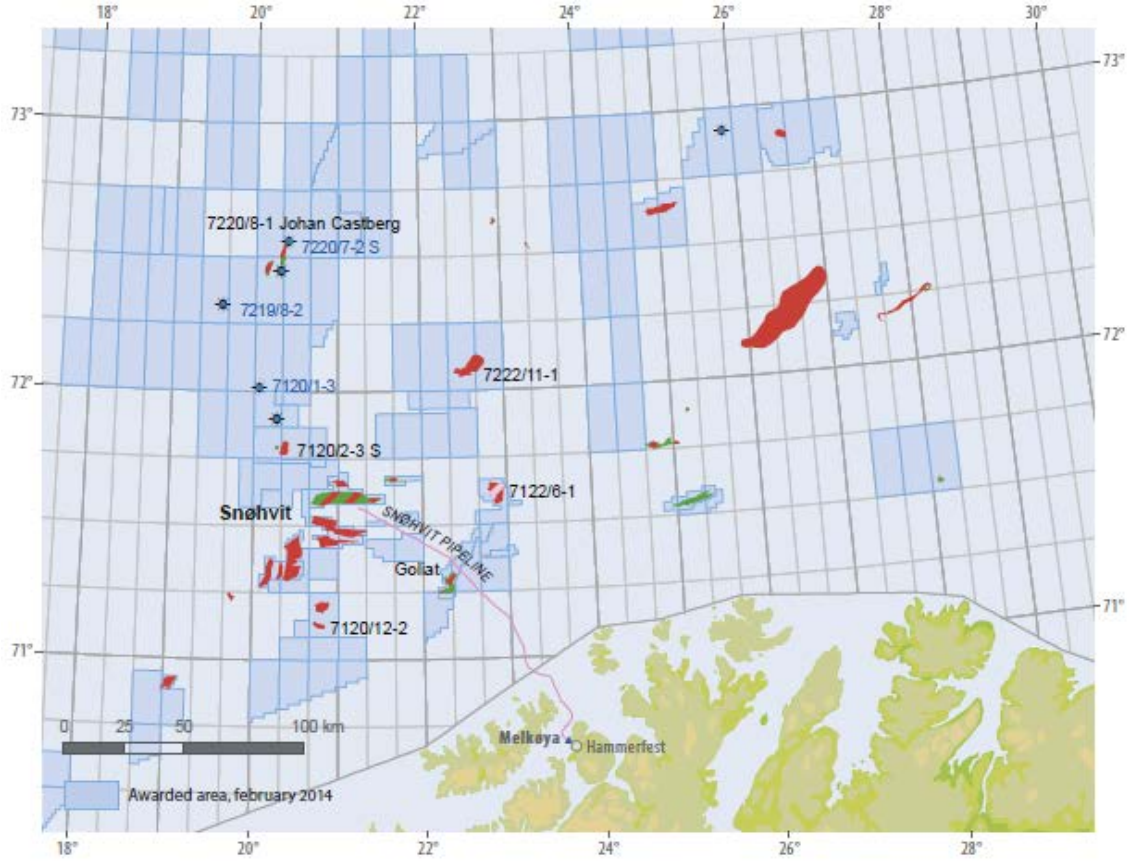
FIGUR 16 FIELDS AND DISCOVERIES IN THE NORWEGIAN SEA

Source: Fakta 2014)

The Barents Sea is seen as a perspective petroleum province in the coming years, although there has been exploration in the area for more than 30 years (Figure 12). The first offshore gas development in the Barents Sea, Snøhvit, came on stream in 2007 and became a milestone in developing the hydrocarbon province (Łuszczuk et al., 2014). The gas from Snøhvit is transported via pipeline to Melkøya, where it is processed and cooled into LNG, which is transported to the market using special vessels (Tormodsgard, 2014).

The Johan Castberg field (earlier called Skrugard) is located 230 km (125nm) north of Norway's northern coastal islands and 100 km north of the Snøhvit gas field. For now, it is the biggest oil discovery in the Barents Sea.

The first Norwegian oil and gas field closer to the coast of Barents Sea, the Goliat field, is under development. The start initially planned for 2013 was postponed due to the lack of experience and knowledge on operating in the coastal areas. There are many challenges there, which are associated with cold climate, icing, fog and polar lows. The closeness to the fishing grounds sets additional requirements for oil spill response.



FIGUR 17 FIELDS AND DISCOVERIES IN THE BARENTS SEA

(Source: Fakta 2014)

Gas production in Norwegian waters north of the Arctic Circle in 2014 amounted to 7,46 billion cubic meters which is the biggest volume from the region so far. The biggest share of this production, 5,22 billion cubic meters in 2014, comes from the Snøhvit gas field (Staalesen, 2015).

The petroleum activity is rapidly increasing in the northern areas. More and more oil and shipping companies are being involved. The oil and gas fields have additional requirements for helicopters, vessels and equipment, which can handle ice and icing. Unfortunately, many of them have a lack of experience in the northern areas.

The challenges of petroleum activity in the waters of High North relate to time of response within underdeveloped infrastructure, production near ice edge, rigs for unloading drilling, great vulnerability of nature, especially in winter, working environment, atmosphere icing and sea spray icing, polar lows, fog and reduced visibility, sea ice and iceberg (Endresen, 2014).

Estimated Activity

The main expectations regarding petroleum activity in the Norway sea areas are an increase in planning and exploration activity, and limited development activities throughout the Arctic, although with greater development of the Barents Sea as a petroleum-producing region (Łuszczuk et al., 2014; EY, 2013). The increase in production activity is also estimated (Rystad Energy, 2013). According to the European Union's outlook to 2030, the expected increase is to be driven by growing global demand, shifting market conditions, increased physical access and geopolitics (Łuszczuk et al., 2014).

Barents Sea is one of the most important areas for Norway when it comes to oil production development. According to the analysis of Rystad Energy "Petro Foresight 2030", the biggest increase in the activity level may come in Barents Sea. Northern Norway has a potential to start 6 new oil fields within 2030 (Rystad Energy, 2013). The basic scenario is demonstrated in Figure 19.

FIGUR 18 A BASIC SCENARIO FOR OIL INDUSTRY DEVELOPMENT WITHIN 2030 IN THE NORTHERN NORWAY

(Source: Rystad Energy, 2013)

The Goliat field is starting production drilling in Barents Sea in 2015. The Goliat field is expected to be in production for at least 15 years and produce 174 million barrels oil and around 8 billion sm3 gas (Bjørsvik, 2014). Its lifetime may be extended if new discoveries are made in the vicinity (ENI Norge).

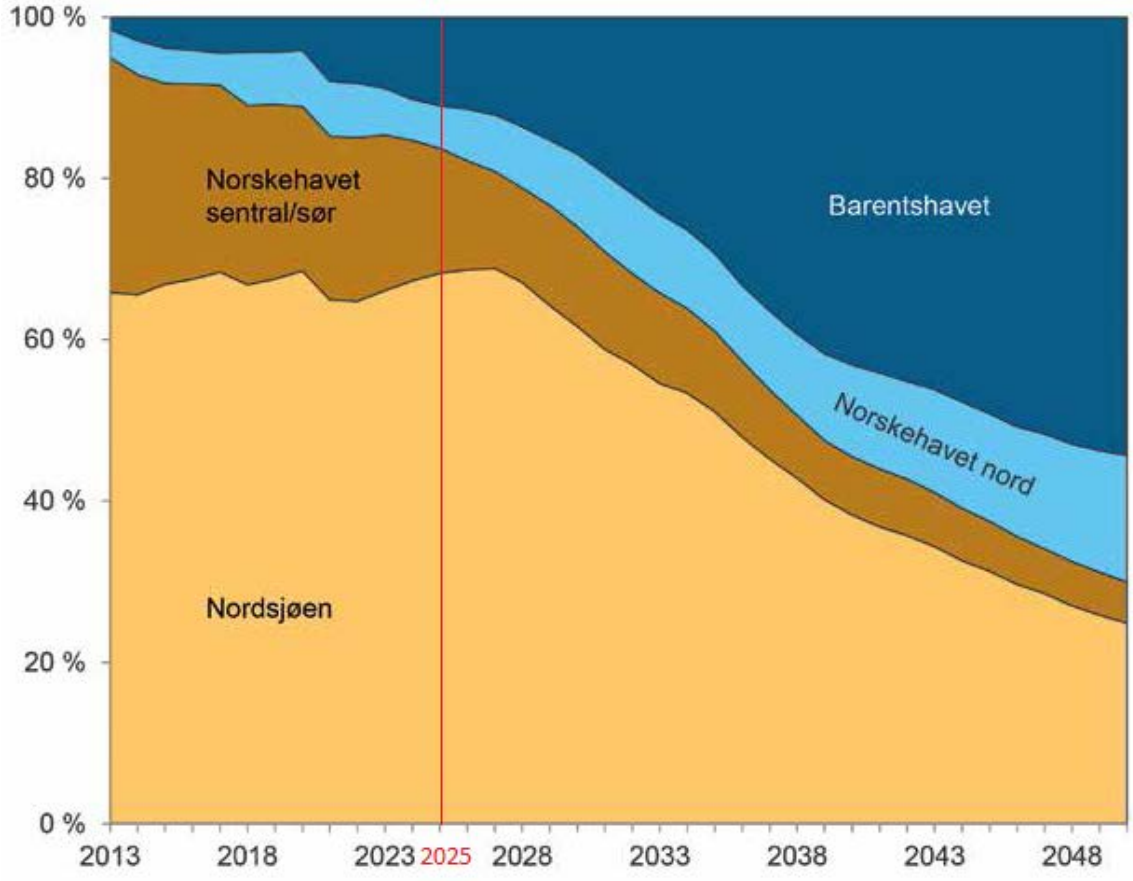
Together with Goliat, the Johan Castberg field will remain being substantially important. The Johan Castberg is located further out to sea. It is expected to develop more drilling wells, and was originally planned to start new production in 2018. Due to low oil prices, the development of the field is put on hold. The field if realized will operate over a period of minimum 30 years.

Up to 2025, the activity in the south of the Barents Sea will include Goliat and maybe the Johan Castberg installations. There will be vessels engaged in seismic shooting, and drilling rigs for exploration purposes. It takes about 10 years before new oil production can be started through impact assessments, geological mapping, licensing, exploration, development and drilling activities. Therefore, this outlook up to 2025 is relatively stable.

As for the Norwegian Sea, the impact assessment starts in 2018 there and the licensing can start from 2021. That means that the first production can start soonest in 2030. By 2025, mostly drilling exploration activity is expected here.

Jan Mayen has no developed infrastructure regarding environment, emergency preparedness or transport, so petroleum activity cannot be started before investments into necessary for that infrastructure are done.

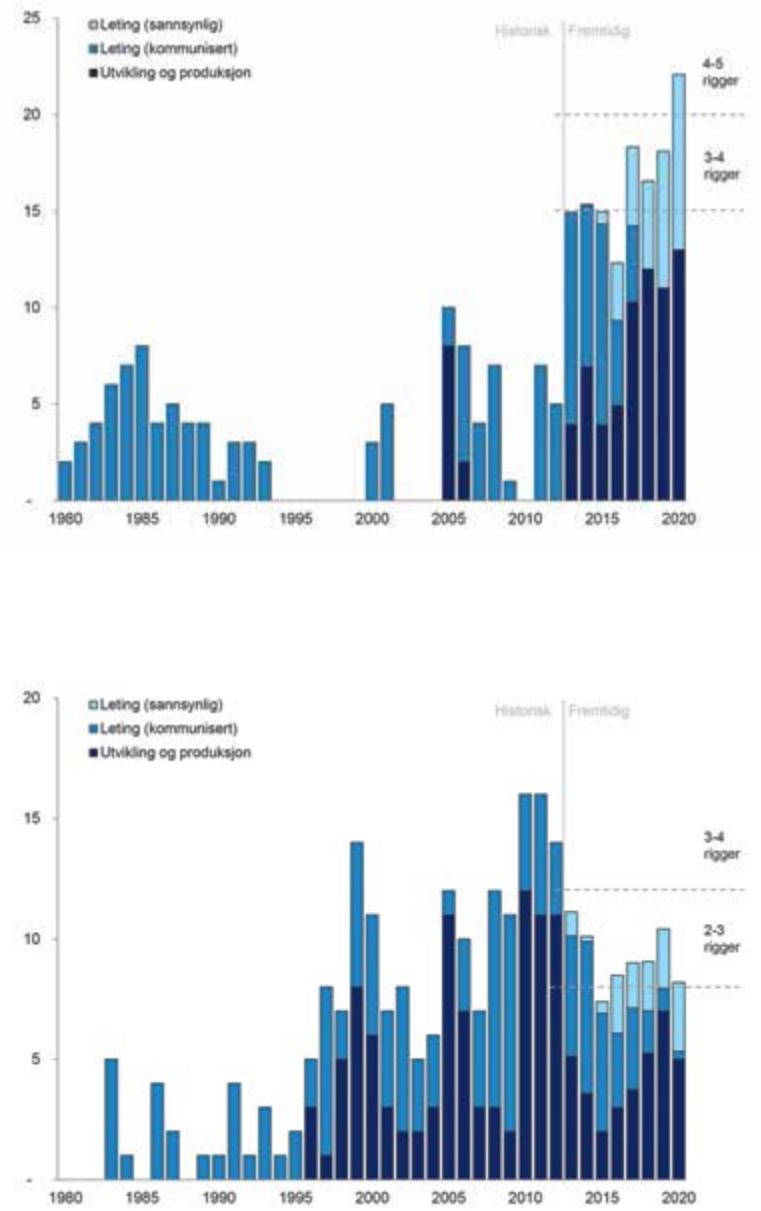
It is expected that Barents Sea and the north of Norwegian Sea together will be greater contributors to the increase of petroleum production, than Northern Sea and central / south areas of Norwegian Sea by 2050 (Figure 20).



FIGUR 19 DAILY OIL PRODUCTION IN NORWAY

(Source: Rystad Energy, 2013)

As demonstrated by Figure 21, there is expected permanent high drilling activity on total of 7-9 drilling wigs in these sea areas (Rystad Energy, 2013).



FIGUR 20 (A) NUMBER OF WELLS IN BARENTS SEA (B) NUMBER OF WELLS IN THE NORTH OF NORWEGIAN SEA

(Source: Rystad Energy, 2013)

One of the objectives of the Norwegian Government is to promote further development of petroleum exploration and production in the High North and to enhance knowledge and expertise to meet the technological and environmental challenges (Norwegian Ministry of Foreign Affairs, 2014).

The total traffic related to oil and gas in the coming ten years may represent up to five drilling rigs with three-four offshore service vessels (OSV) per drilling rig. In addition, there will be oil shuttle tankers out of the Goliat and LNG tankers out of Melkøya every week.

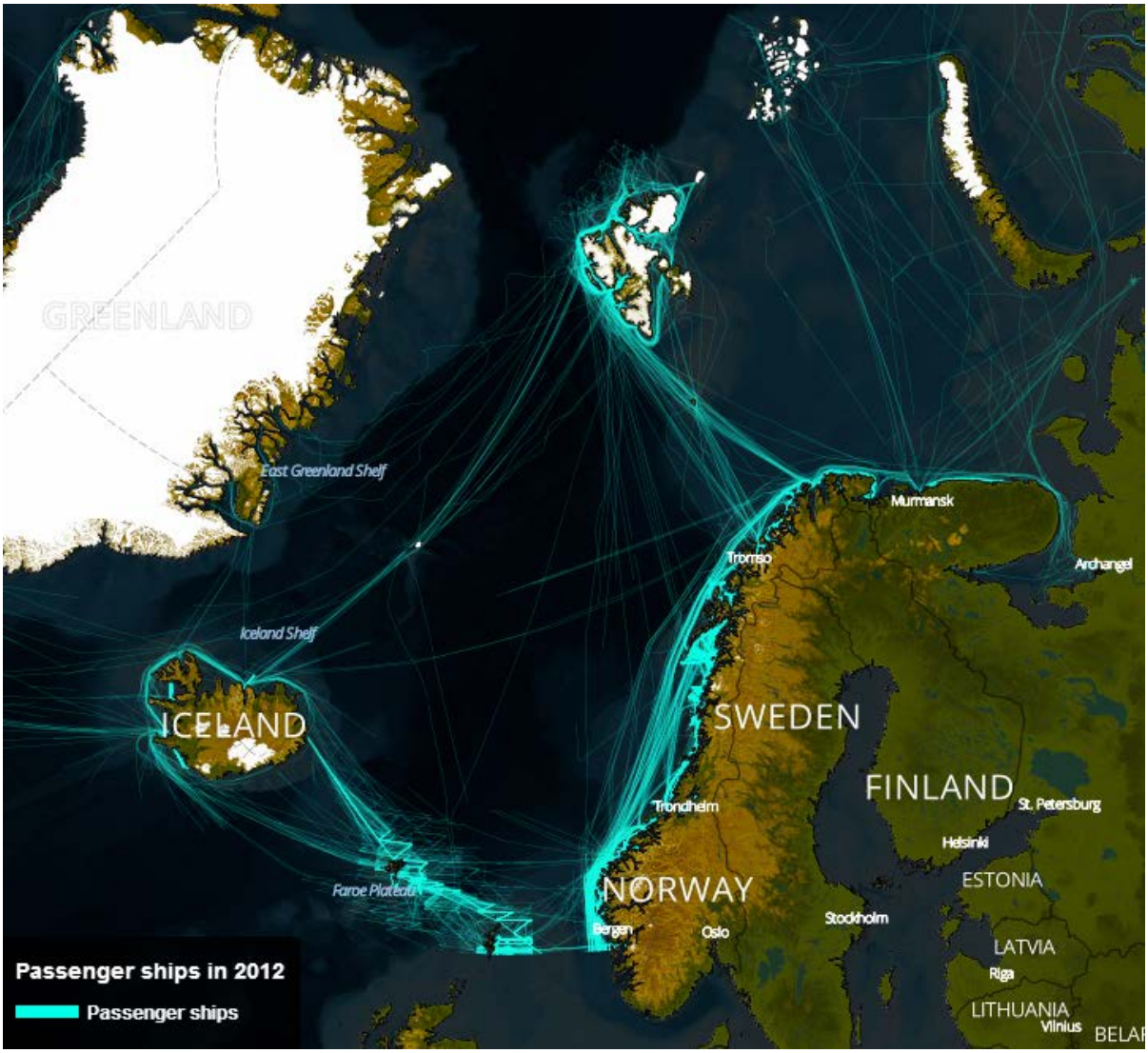
MARITIME TOURISM

The number of vessels to the Arctic archipelago has gone up during the last years, especially when it comes to cruise vessels (Pettersen, 2013). Tourism is the industry with the fastest growth rate in the world. In the Northern Norway travelling along the coastline and around Svalbard is increasing. The most popular destinations in Northern Norway are Lofoten, Tromso, Hammerfest and Honningsvåg. Tromsø has around a 100 cruise ship visits a year over a 8 months season with approx. 50 different cruise vessels. The largest ship in 2015, MSC Spledida, had 3900 passengers and a crew of 1300, in total 5200 persons on board[4]. The main season is from May to September, but winter cruises or Northern light cruises are increasing in numbers in February and March, although with only a few ships.

Tourism to and around Svalbard has got a higher interest during recent years. The tours are operated by different sizes of passenger vessels. The increase is strong both in terms of the number of ships, and the number of passengers. As to conventional cruises, in 2012, there were 36 visits to Longeyarbyen with 60,000 passengers. In 2014 it was 48 visits to Longyearbyen and in 2015 28 calls. In 2016, 36 calls are planned by 25 different cruise vessels. (for more detail see: www.sysselmannen.no) The visiting cruise ships have become larger. Some vessels have a capacity of 3-4000 people including crew. The season goes from June through August, and some vessel visit Spitsbergen.

The figure 22 demonstrates the cruise activity in the High North. A growing activity in cruise traffic is shown eastward and into Russia.

[4] http://www.tromso.havn.no/2015/10/nytt-rekordar-innen-cruise/



FIGUR 21 PASSENGER SHIPS IN THE HIGH NORTH

(Source: ArkGIS.no)

Cruise traffic to and around Svalbard is uniquely large for such high latitude. There is no other place in the world where cruise liners with no ice class with almost 4000 tourists can reach the latitude of 80 degrees North. The main season for cruise ships on Svalbard is from June to September. This traffic here is divided into three segments: 1) Overseas cruises; 2) Expedition cruise vessels, 3) Day trip ships (see Figure 23).

FIGUR 22 VESSELS OF ALL THREE TYPES IN ADVENT FJORD

(Photo: Nataly Marchenko)

Overseas cruise normally consist of larger vessels (with a length between 100 and 300 meters), where Svalbard is one of the destinations on the cruise. These ships take up to 3,800 passengers. The typical oversea cruise ship in Longyearbyen harbor is illustrated on Figure 24. AIS data and information on the operational pattern for cruise vessels indicates that vessels primarily visit a select few and relatively narrow locations. Most visited places are Magdalenefjorden, Ny-Ålesund and Longyearbyen (Figure 25). Policies suggested by the Norwegian Coastal Authority imply that these vessels will be covered by the pilot requirements for Svalbard. Smaller vessels have been denied PEC based on size.

FIGUR 23 MSG MAGNIFICA. TYPICAL OVERSEA CRUISE SHIP IN LONGYEARBYEN HARBOR

(Photo: Nataly Marchenko)

FIGUR 24 THE MOST COMMON ROUTE FOR OVERSEAS CRUISE TRAFFIC AROUND SVALBARD

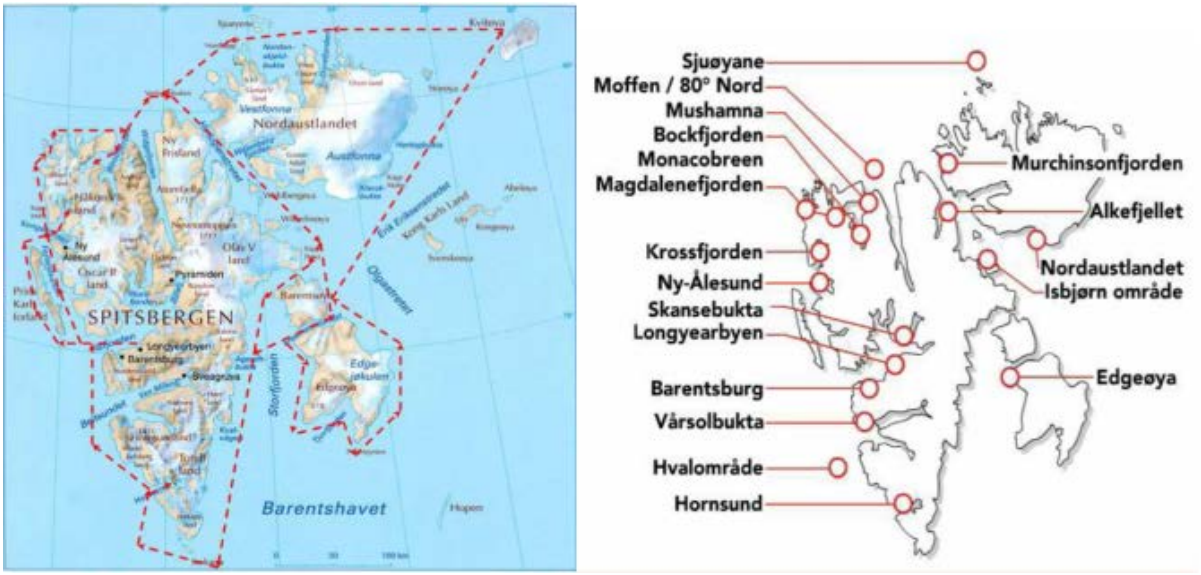
(Source: Kystverket, 2007)

Expedition coastal cruise goes around the archipelago and may have Longyearbyen as a starting point. Expedition cruise performed with small and medium-sized passenger ship (size varies from about 40 to 120 meters) that takes 12-300 passengers. They make trips of varying lengths, typical duration is 3 - 14 days and operate all around Svalbard, see Figure 20.

Passengers land in many locations (see Figure 26). The vessels normally do not go to the shore, but must set out smaller boats for tourists to come ashore. Expedition Cruise vessels with a length of 50 meters or a passenger capacity of over 12 will be covered by the pilot requirements according to criteria set by the NCA. NCA expects that most skippers on expedition cruise vessels are eligible for a PEC.

FIGUR 25 TYPICAL EXPEDITION SHIPS IN LONGYEARBYEN HARBOR. FROM TOP DOWN: NATIONAL GEOGRAPHIC EXPLORER, OCEAN NOVA AND ORIGO IN FRONT OF CELEBRITY CONSTELLATION

(Photo: Nataly Marchenko)



FIGUR 26 THE MOST COMMON ROUTES AND PLACES TO VISIT DURING EXPEDITION CRUISES

(Source: Kystverket, 2007).

The third segment is day cruises along the Isfjorden, the second largest fjord in the archipelago of Svalbard. It is performed by small vessels up to 40 meters and 90 passengers (Figure 28). The day cruises from Longyearbyen to Isfjorden have landing also in Barentsburg, Pyramiden, and occasionally some other places in the Isfjorden area. They will most likely be exempt for polar pilot requirements and PEC.

FIGUR 27 TYPICAL DAY CRUISE VESSELS IN LONGYEARBYEN HARBOR - POLAR GIRL AND LANDØYSUND IN FRONT OF MSG MAGNIFICA

(Photo: Nataly Marchenko)

FIGUR 28 AREA OF OPERATIONS FOR THE DAY CRUISE VESSELS ON SVALBARD (INDICATED BY RED CIRCLE)

(Source: Kystverket, 2007)

In addition, there is an increased activity of sailing boats and yachts in the north (Figure 30). Up to 65 private yachts have visited Svalbard in the summer period in recent years. These vessels are below the vessel limits covered by polar pilot requirements.

FIGUR 29 YACHTS

(Photo: Nataly Marchenko)

Cruise traffic around Svalbard has increased in recent years. The total number of visitors on land on Svalbard has increased from about 20 – 25 000 per year in 1996 – 2000. The number of passengers onboard conventional cruise vessels was 27 000 in 2008 plus 10 000 onboard expedition cruise vessels (Governor of Svalbard). Parts of this increase can be attributed to improved report systems, but it is still clear that cruise tourism has increased. Some of this increase is caused by the so-called expedition cruises, but the number of tourists joining these cruises has been relatively stable the past few years.

As a consequence of the increased numbers of expedition cruise vessels, the number of landing sites has increased over the past few years. In 1996 the number of landing sites visited by cruise passengers was reported to be 52. In 2007 this number had increased to 140 (Governor of Svalbard), and in 2010 144 landing sites were visited.

In addition, the number of conventional cruise ships (large overseas cruise vessels) has increased during recent years. However, these ships have few landings on their journeys, and the few made are usually to settlements (Longyearbyen, Ny-Ålesund) or to the Magdalenefjorden (Gravneset).

In the recent years, tourism in the Arctic has become popular so the commercial pressure on the remote areas may increase. Large ships using heavy fuel oil increase pollution risk. Stricter regulations are introduced by the Polar Code of the International Maritime Organization (IMO) that comes into place from 2017. The purpose of this regulation is intended to cover the full range of shipping-related matters relevant to navigation in waters surrounding the two poles – ship design, construction and equipment; operational and training concerns; search and rescue; and, equally important, the protection of the unique environment and eco-systems of the polar regions. The Polar Code covers the full range of design, construction, equipment, operational, training, search and rescue and environmental protection matters relevant to ships operating in the inhospitable waters surrounding the two poles (IMO).

Estimated Activity

The general trend is the growing of cruise tourism, although it shows uneven development (Stepien et al., 2014). Along the Norwegian mainland the number of vessels are fluctuating with the international market trends. The average size of the vessels is in general increasing.

The number of cruise vessel along the mainland coast are between 50-100 vessels, the largest with more than 5000 persons on board. The season is from June through August. Both the number of ships and the number of passengers may increase in the future.

In Svalbard, the trend for overseas cruise ship is that there are fewer ships, but they increase in size and number of passengers. Furthermore, season extension trend, i.e. that the season starts earlier and ends later. Expedition Cruises have a long history of Svalbard and most likely will continue the same procedure and volume. It has been between 8-10 thousands passengers annually over the past five years. Day trips are sightseeing of Longyearbyen and performed today by two companies with very similar products and prices. They are quite popular and probably will increase in volume.

One of the priorities for future development for the Norwegian government is developing the transport and tourism system in the north in a reliable manner (Norwegian Ministry of Foreign Affairs, 2014).

RESEARCH AND OTHER GOVERNMENTAL ACTIVITY

Today there is a growing research and monitoring activity in the High North, which includes representatives of many nationalities. Some of the involved research vessels are commercial. It is a significant increase in activities of the vessels engaged in seismic shooting. It is also a major military activity in the area. Military and public civil vessels undertake some challenging operations in these areas. The surveillance activity is particular important during winter. The vessels should be well equipped, the crew should be well-qualified crew and operations should be well planned.

There are few research vessels that operate in the Northern Norway at present. “G.O.Sars” is a research vessel of the Institute of Marine Research and is equipped with state-of-the-art technology in order to carry out a wide variety of research work. “Haakon Mosby” is owned and managed by the Institute of Marine Research and is mainly used coastal waters around Bergen and in northern waters, including the coastal waters of Svalbard (Spitsbergen) (Institute of Marine Research, 2009).

“RV Lance” – once a top-of-the-line seal hunting boat, now is turned to research and expedition vessel (Figure 25). Lance is equipped with a helicopter platform suitable for small and medium-sized helicopters. With the starting point out of Longyearbyen, Svalbard, it operates primarily in the Arctic. It is possible to hire Lance in available times for expeditions and scientific cruises.

FIGUR 30 RV LANCE IN THE ICE NEAR SVALBARD

(Photo: Nataly Marchenko)

Both research vessels operates year round on Svalbard. 5-8 vessels come in addition during the period July to September. This category includes, educational and research vessels, Navy and Coast Guard vessels and vessels belonging to the Svalbard Governor (Figures 32 and 33). Navy and Coast Guard vessels are exempt from the polar pilot requirements. All other vessels over the vessel limits will be subject to polar pilot requirements. The majority of these vessels are expected to be eligible for PEC.

FIGUR 31 NORDSYSSEL. SVALBARD GOVERNOR VESSEL BEFORE SEPTEMBER 2014

(Photo: Nataly Marchenko

FIGUR 32 POLARSYSSEL. SVALBARD GOVERNOR VESSEL SINCE SEPTEMBER 2014

(Photo: Svalbardposten)

In the period from June to October there about 2-4 seismic vessels working at Bjørnøya and South/ South-East of Svalbard. Longyearbyen Port states about addition traffic to and from the activity in East Greenland since 2009. This has been seismic vessels, icebreakers and vessels with supply and support functions.

As for military activity, the Norwegian coast guard is the dominating actor along the Norwegian coast and in the Barents Sea. Nevertheless, it is important for Norwegian Coast Guard to get all the tasks performed for civilian agencies in fisheries control, assistance to vessels in distress, SAR and many other different responsibilities apart from military activities.

The Norwegian coast guard has four larger vessels for operations in the High North including the icebreaker KV Svalbard. In addition, they have 10 vessels for closer to coast operations. Its main base is at Sortland in Northern Norway. The sailing patterns include patrol in the Barents Sea and Svalbard region, and all along the Norwegian coast. In the Barents Sea one-two vessels may be present most of the time.

The Norwegian navy has five ultra-modern frigates and six MTB, six submarines and six mine hunters, together with logistics vessel. Its main base is at Haakonsvern in Bergen. Eighty per cent of the sailing time of this fleet in 2014 was in the Southern part of Norway or abroad.

Estimated Activity

The level of scientific research and monitoring activity is increasing in terms of the number of the vessels and routes. Some of the Norwegian research vessels are getting old, and the Government has a plan to invest in new ones. A new ice-class vessel will replace the two present vessels (Norwegian Ministry of Foreign Affairs, 2014). A new icebreaker research vessel “Kronprins Haakon” is scheduled for delivery in 2016 (Norwegian Polar Institute, 2015). In the meantime, “RV Lance” with international research team on board will investigate more closely the sea ice in the Arctic (Jaycen, 2014). Marine scientific research is increasing as the commercial activity in fisheries, oil and gas and mineral extraction is developing. With the increasing marine traffic, surveillance activity will increase. Future inevitable expansion of industrial activity to the North, arises scientific activity off the coast of Norway and in Svalbard area and will continue the nearest years.

As for the navy, one may expect more sailing time in the North as scheduled by the Navy. The Norwegian coast guard will also have new vessels that will increase their capacity for operations in the North, including new NH 90 long-range helicopters.

SUMMARY

In general, there is a tendency of a greater maritime activity in the High North. The activity level is moving farther northward and to the west especially within fisheries and cruise industry. Fisheries in Norway will probably stay on the same level in the near future in the High North areas, though the volume of production can be increased per vessel. The number of large fishing trawlers operating in the Svalbard area amounts to more than fifty vessels during Autumn months.

The maritime transportation of goods is dominated by transit traffic and highly interlinked with extraction of resources in the Arctic. Shipping across the Arctic areas is expanding but very slowly because of major constraints of natural environment and technology, high risks and low profitability to use these routes. An increased number of tanker ships from Russia in transit along the Norwegian coast are to be expected from the approx. 15 per months at present. At Svalbard there are about 25-35 calls by ships carrying coal from Svea during July to December.

Petroleum activity represents a significant increase in activity in the High North in terms of exploration and production. Development activity has a little slowdown but is expected to be higher after 2017. The oil and gas activity moves into areas where natural conditions are a major challenge not only for operators, but also for the whole preparedness system. Within the oil and gas production, the two main fields in the next decennium are Goliat and probably the new Johan Castberg field. They will both represent increased traffic of oil shuttle tankers. This fields and additional exploration with drilling rigs may represent an increase in the number of units in the Barents Sea by approx. five drilling rigs and 10-15 offshore service vessels.

Within cruise tourism, approximately 50 vessels are visiting Norwegian mainland harbors during the main season from May to October. There is a few vessels coming in the winter months, and the number may increase. At Svalbard the season is from June till September. The number of cruise vessels and the average size is expected to increase. There is also a number of up to 100 leisure vessels visiting the Svalbard islands each year.

PART III THE ICELANDIC SEA AREAS AND ACTIVITY LEVEL UP TO 2025 *BY VALUR INGIMUNDARSON AND HALLA GUNNARSDÓTTIR*

This report analyzes the current maritime traffic within the Icelandic Exclusive Economic Zone (EEZ) and the Search and Rescue Region (SRR) and gives an estimation of the activity level up to 2025. It looks into different types of vessels and – to the possible extent – offers predictions on future activity in the different categories. It is based on information provided by the Icelandic Vessel Monitoring System (VMS), which consists of the Automatic Identification System (AIS) and the satellite-based INMARSAT as well as on written reports that offer statistical overviews over time. This includes annual reports of the Icelandic Coast Guard and of *Faxaflóahafnir Associated Icelandic Ports,* where large majority of ships that sail to Iceland come into port. Additionally, the authors have interviewed key actors within the Icelandic maritime surveillance and preparedness system to provide the best possible picture of the current situation.

The first chapter focuses on coastal sea traffic, such as coastal cargo vessels and passenger ferries, which both have increased in numbers in the past years. The second chapter offers information on intercontinental transport in the sea around Iceland. It finds that cargo vessel and tanker traffic is likely to increase in the coming years. On the other hand, the previously predicted sharp rise in oil transportation from Russia to North America has not materialized, and is unlikely to do so in the near future.

The largest part of maritime activity around Iceland is related to fisheries, which are covered in chapter 3. Owing to improved technology, the fishing fleet has shrunk in the past decades and is likely to continue doing so. If sea temperatures continue to rise, fishing activity is likely to further increase north of Iceland and by the east coast of Greenland.

Chapter 4 shows that oil exploration north of Iceland is unlikely to lead to large rise in vessel traffic within the next ten years. If natural resource extraction proves to be economically feasible, however, it could result in increased activity from a long-term perspective. Chapter 5 discusses the current trends in maritime tourism around Iceland, where the number of passengers went up from 9,000 to 90,000 in roughly 20 years. Given the current popularity of Iceland as a tourist destination, the sharp growth in the number of passengers is likely to continue. Finally, the research and monitoring activity in Icelandic waters is explored. Despite

a continuing interest in the Arctic, research and monitoring is not likely to make a large part of maritime activity in the area, given the small number of such vessels.

COASTAL SEA TRAFFIC

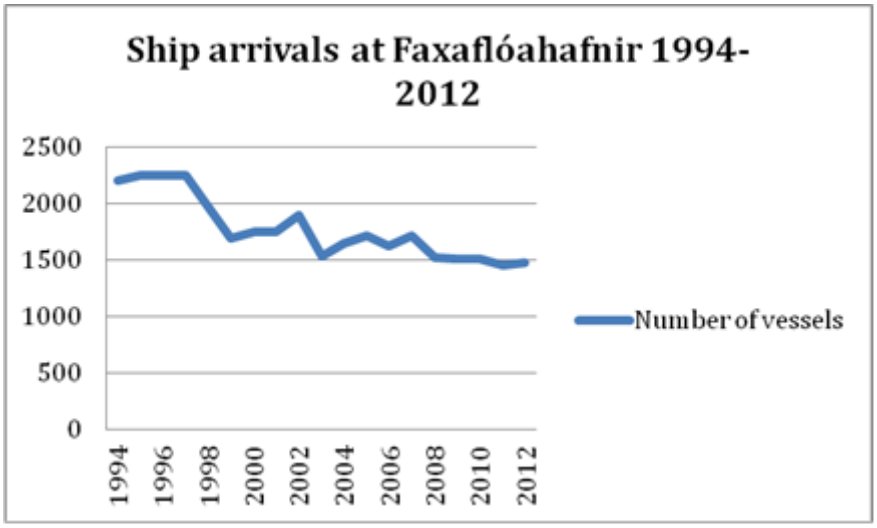
After the abolition of state subsidy to domestic coastal cargo in 1992, such cargo steadily decreased in the last decade of the 20th century. Eventually the largest Icelandic shipping companies, *Eimskip* and *Samskip*, stopped offering the service and shifted to road and air cargo only. This decision led to an unprecedented load on the country's road system and an estimated 52% increase in maintenance costs for the Icelandic Road and Coastal Administration.[5] Following a government announcement on revoking state subsidy through an invitation for tender, the large shipping companies started coastal cargo again in 2011. 110,000 GT are now transported by sea, reducing transportation costs for many companies in Iceland, particularly for fishing companies in the countryside.[6]

The largest part of the Icelandic population lives on the mainland, but there are few inhabited islands around the country, such as *Vestmannaeyjar* (4,000 inhabitants), *Hrísey* (190 inhabitants) and *Grímsey* (90 inhabitants). Regular ferry routes serve the islands, which are also popular with domestic and international tourists. A number of smaller boats operate services for travellers and organized trips for tourists, such as whale watching and sightseeing. The largest ferry, *Herjólfur*, transports close to 400 people and 60–70 cars to and from *Vestmannaeyjar*. The number of passengers in *Herjólfur* doubled in 2011 after the construction of the port *Landeyjarhöfn*, which shortened the sailing time significantly, despite repeated closures of the harbor due to poor weather conditions and entrance problems. A detailed emergency management plan has been made for *Herjólfur*, which can be applied to other ferry incidents. A new ferry, which would replace *Herjólfur*, is under construction with aim of solving the difficulties of sailing into port in *Landeyjarhöfn*. This might increase the number of people on sea, but decrease the risks of the current passageway. Apart from that, nothing indicates a large growth in coastal cargo or number of ferries in the coming years.

[5] "Mat á hagkvæmni strandflutninga á Íslandi" (Feasibility Study of Coastal Cargo in Iceland). 2010. Samgöngu- og sveitarstjórnarráðuneytið. Retrieved from http://www.innanrikisraduneyti.is/media/utgafa2010/Hagkvaemni_strandflutninga_04062010-.pdf, p. 33

[6] "Strandsiglingar spara fyrirtækjum stórfé". 2014. *Visir.is.* Retrieved from http://www.visir.is/strandsiglingar-spara-fyrirtaekjum-storfe/article/2014140228731

In addition to the coastal traffic, shipping routes of all ships that come into port in Iceland are close to the coast. As the following picture demonstrates, the number of vessels entering *Faxaflói* has decreased in the past 20 years.

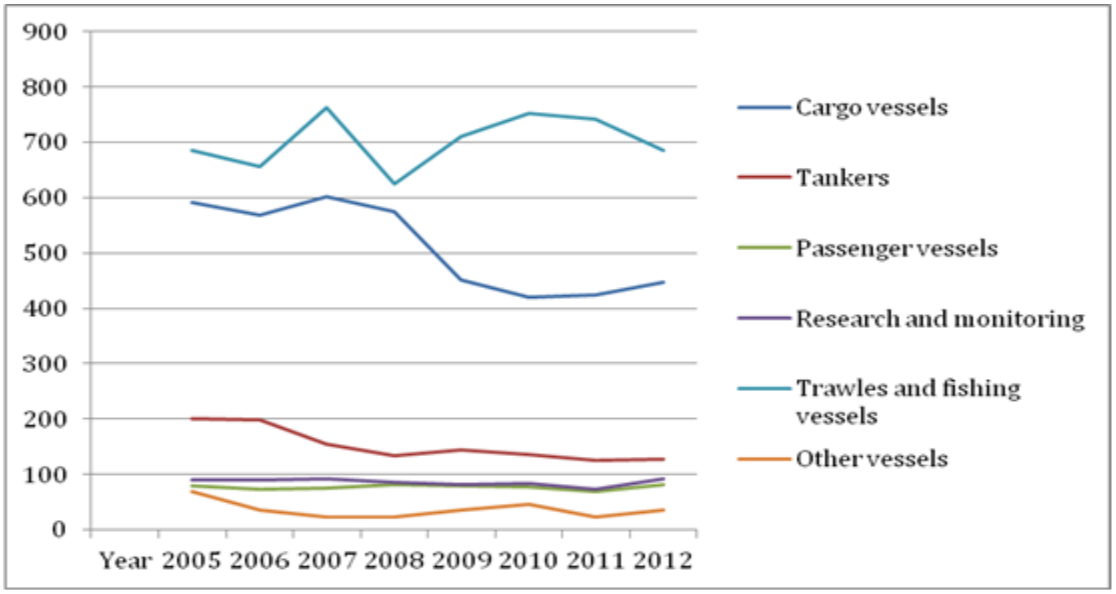


FIGUR 33 SHIP ARRIVALS IN FAXAFLÓAHAFNIR 1994-2006

Source: Statistics Iceland. Information Retrieved from DataMarket https://datamarket.com/data/list/?q=faxafl%C3%B3ahafnir&ref=search

On the other hand, the ships arriving are ever larger, and the total gross tonnage increased steadily in the same period of time, with the exception of the years of 2008–2011, when Iceland was grappling with serious economic difficulties.[7] In particular, cargo transport to Iceland decreased, as well as arrivals of tankers, but both are rising again.

[7] See: https://datamarket.com/is/data/set/4b0u/samanlogd-staerd-skipa-bt#!ds=4b0u!7bhd=7&display=line and https://datamarket.com/is/data/set/unf/skipakomur-til-faxafloahafna-1994-2006#!ds=unf!op=1urd:oq=phb&display=line



FIGUR 34 SHIP ARRIVALS IN FAXAFLÓAHAFNIR 2005-2013 BY VESSEL TYPE

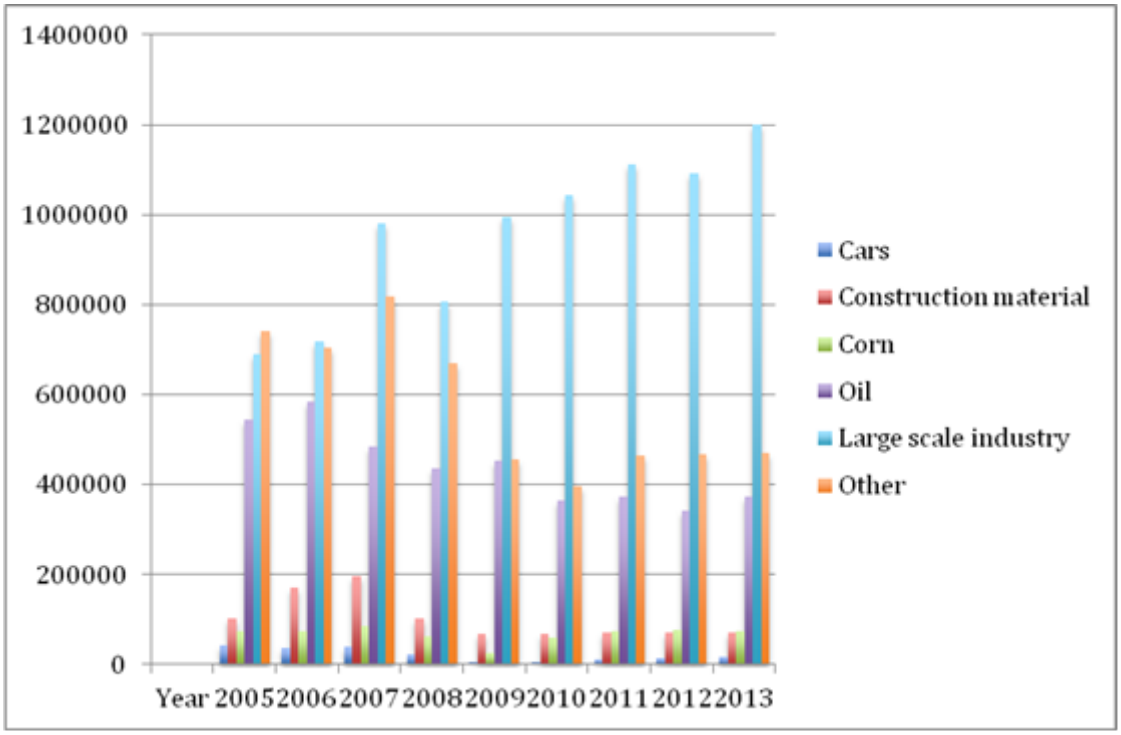
Source: Faxaflóahafnir. Retrieved from DataMarket
https://datamarket.com/data/list/?q=faxafl%C3%B3ahafnir&ref=search

The different kinds of vessels sailing to Iceland will be further explored in the following chapters.

INTERCONTINENTAL TRANSPORT

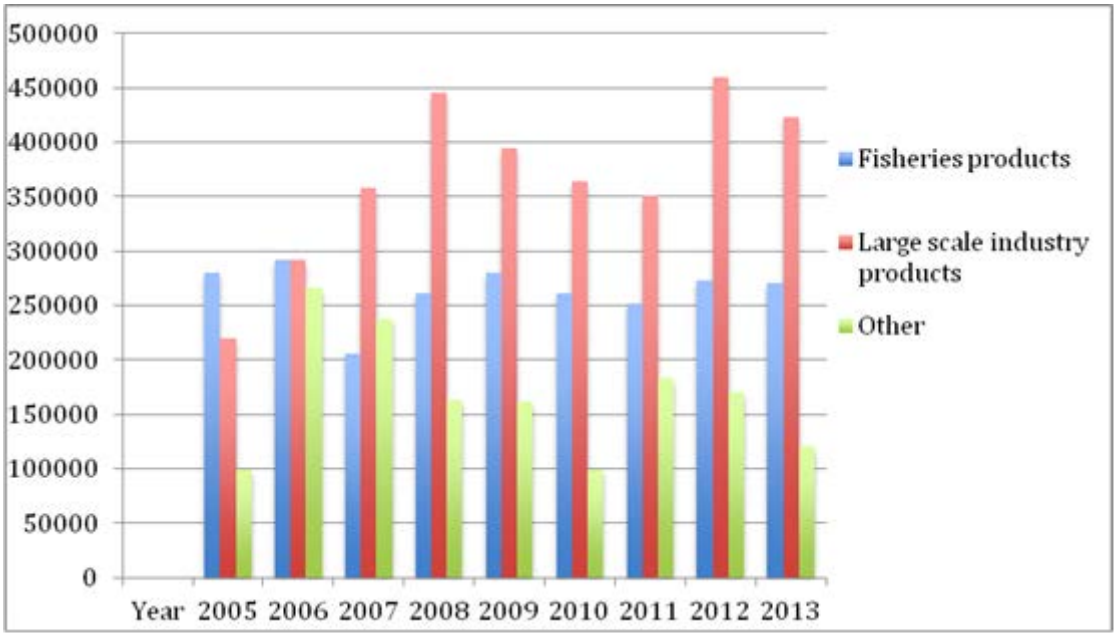
The large majority of cargo vessels and tankers come into port in *Faxaflói*. There is, however, also a significant number that enters *Reyðarfjörður* in eastern Iceland, serving the Alcoa smelter in the area. Cargo shipping to *Faxaflói* increased steadily the first years of this century, but decreased during the recent recession. Exports of fish and industry products increased, but most other imports and exports suffered a decline. The number of imported cars dropped, for example, from 39,000 in 2007 to 3,500 in 2009, but has increased again and was over 15,000 in 2013. The number of vessels is consequently rising and in 2013 around 500 cargo vessels came into port in *Faxaflói*.[8]

[8] "Ársskýrsla Faxaflóahafna" (Faxaflóahafnir Associated Icelandic Ports Annual Report). 2013. Retrieved from http://www.faxafloahafnir.is/category/is/fyrirtaekid/arsskyrslur/



FIGUR 35 GT IMPORT TO FAXAFLÓAHAFNIR

Source: Faxaflóahafnir. Retrieved from DataMarket https://datamarket.com/data/list/?q=faxaflóahafnir&ref=search



FIGUR 36 GT EXPORT FROM FAXAFLÓAHAFNIR

Source: Faxaflóahafnir. Retrieved from DataMarket https://datamarket.com/data/list/?q=faxaflóahafnir&ref=search

While relying on domestic renewable energy resources for a great part of the energy consumption, Iceland is also dependent on oil and gas imports, particularly for vessels, boats

and cars. Oil imports decreased gradually from 2006 to 2012, but are rising again.[9] Whereas the decline in oil imports had much to do with the recession, the shut down of the US Naval Air Station in *Keflavík* in 2006 was also a factor. Close to 200 tankers came into port in Faxaflói in 2006, but the number dropped to 155 in 2007. The number of tankers were at the lowest of 125 in 2011 but increased to 141 in 2013.[10]

The last decade saw an increasing number of tankers passing the Icelandic EEZ, mainly transporting oil and gas from Russia to the United States and Canada.[11] A 2007 report predicted a steady increase in tankers traffic or up to 500 full loaded vessels a year.[12] This turned out to be an overestimate. The construction of new oil pipelines in Europe – and less demand from North America – has decreased tankers traffic and currently they are a rare sight north of Iceland. On the other hand, there is certain number of Europe-America cargo vessels that sail 100–300nm south of Iceland. In most cases, they are sailing great circle track or avoiding existing weather conditions.

Predictions on the opening of new Arctic sea routes have also fueled a discussion on Iceland serving as a transshipment port. The German engineering company, Bremenport, has invested in preliminary research on the possibility of building a transshipment port in *Finnafjörður* in the northeast of Iceland. Results are to be presented in 2016. Still, playing down the immediacy of the issue, the company stated that it will not be known for several years whether anything will come of the project.

Estimated Activity to 2025

Given the economic recovery, cargo vessel and tanker traffic around Iceland is likely to continue to grow in the coming years. Tankers traffic from Russia to North America is, on the other hand, likely to stay at the minimum.

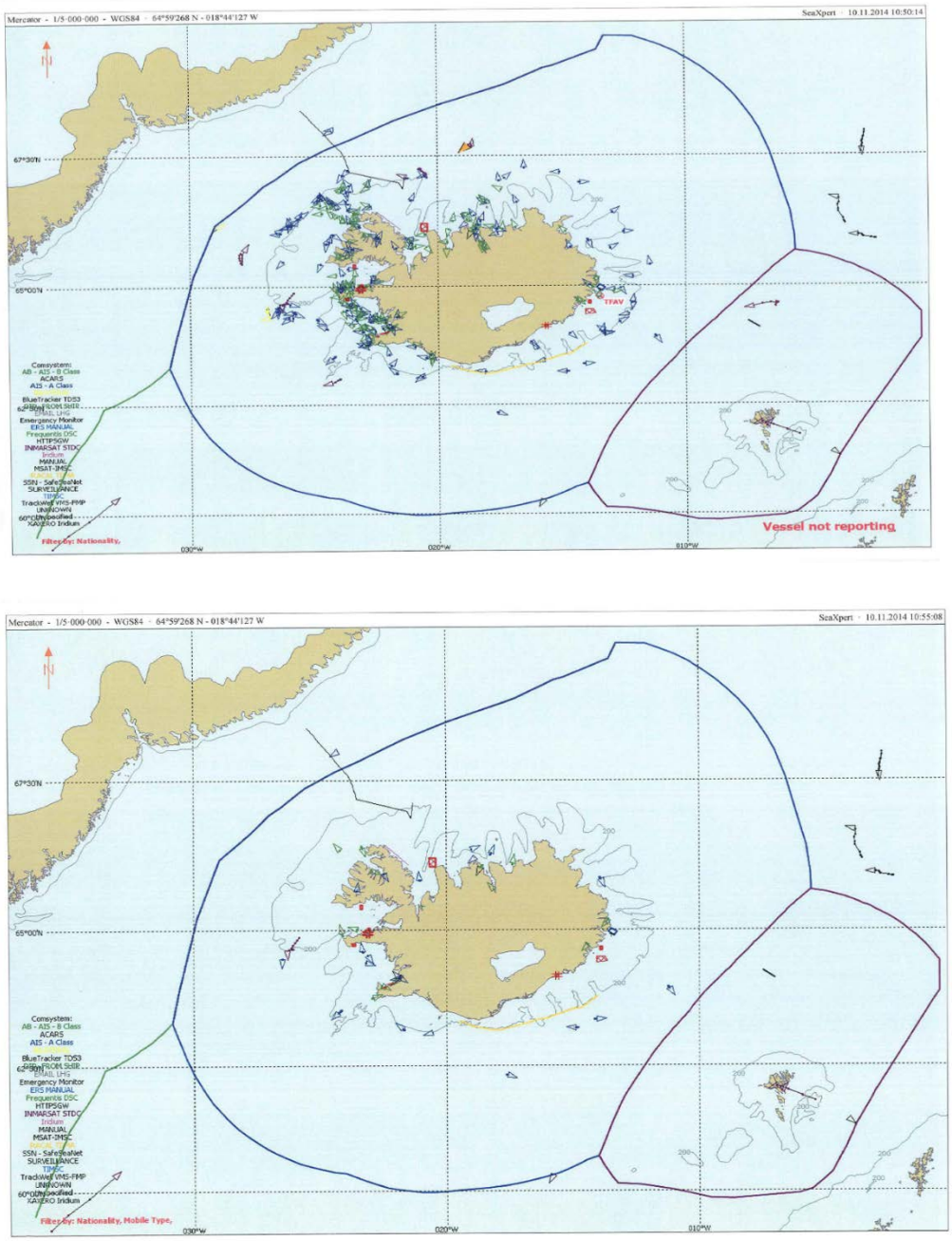
FISHERIES

[9] Faxaflóahafnir Annual Report. 2013
[10] Faxaflóahafnir Annual Report. 2013
[11] "Ísland á norðurslóðum" (Iceland in the Arctic). 2009. Retrieved from http://www.utanrikisraduneyti.is/media/Skyrslur/Skyrslan_Island_a_nordurslodumm.pdf, p. 27-28 and Progress Report. 2007
[12] Progress Report. 2007

The number of fishing vessels has remained steady in the past decade, with an increase in smaller, fast-paced fishing boats. From the early 1980s until 2005, it had decreased significantly due to the adoption of a fishing quota system (which was partly in response to overfishing) and to larger vessels and improved technology.[13] According to the ICG, there are seasonal differences with more fishing activity during the summer months. In any case, the large majority of maritime traffic around Iceland consists of fishing vessels, as shown in pictures 38. Of the 2,300 ships and boats registered in Iceland, close to 1,700 are for fishing.[14]

[13] Pétursdóttir, Guðrún, Tryggvi Hjörvar and Emil Snorrason. 2007. "Fatal Accidents in the Icelandic Fishing Fleet 1980-2005. *International Maritime. Health*, 58, p 1–4. Retrieved from http://imh.mug.edu.pl/attachment/attachment/1326/2007_x04.pdf

[14] "Skrá yfir íslensk skip og báta 2013" (List of Icelandic Ships and Boats 2013). Retrieved from http://www.samgongustofa.is/media/siglingar/skip/Vefskipaskra-2013.pdf



FIGUR 37 (A) VESSEL TRAFFIC AROUND ICELAND NOVEMBER 10 2014, INCLUDING FISHING VESSELS; (B) VESSEL TRAFFIC AROUND ICELAND NOVEMBER 10 2014, EXCLUDING FISHING VESSELS

Source: The Icelandic VMS. Picture provided by the Icelandic Coast Guard

The AIS system reaches approximately 45 nm radius around Iceland. Outside that area, ships are obliged to inform the Icelandic Coast Guard regularly about their location, speed and direction through the INMARSAT satellite network. Ships longer than 24 m send information every hour, but shorter ships and passenger ships are obliged to inform the ICG every 15 minutes. Consequently, the ICG has a good overview over marine traffic in the Icelandic EEZ and is able to respond quickly to any incidents.

A part of the Search and Rescue Region of Iceland is within the EEZ of Greenland. According to the Icelandic Coast Guard, the traffic of foreign fishing vessels has increased in that area, particularly due to quota rental to ships from China and other countries. There are concerns about the increase, since the crews are not necessarily trained for the weather conditions in the area. If incidents occur, the Icelandic Coast Guard would be the point of contact. Due to lack of infrastructure along the east coast of Greenland, Iceland would also be the location of the closest services, including medical services and docks.

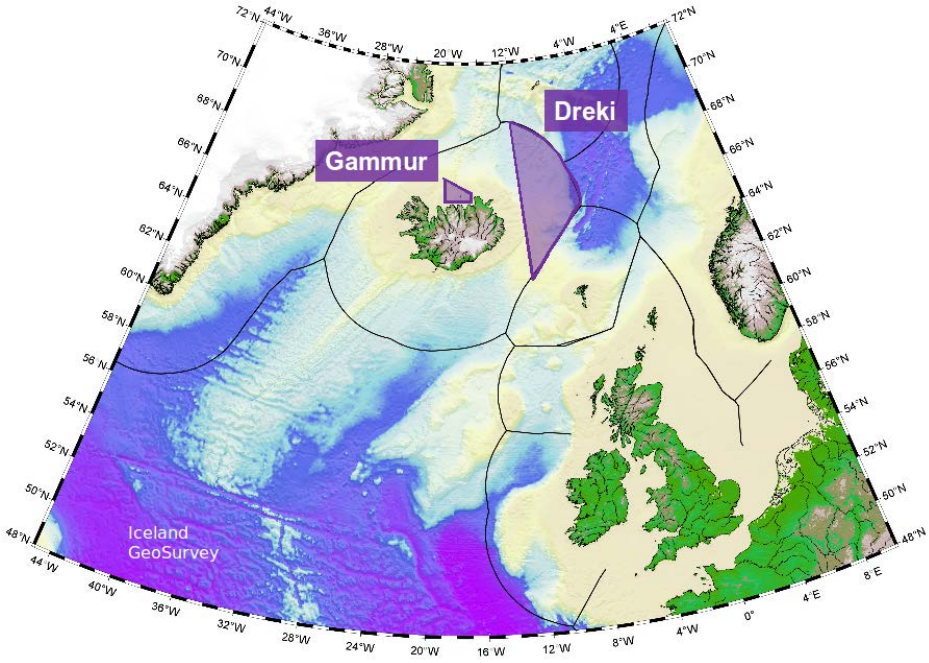
Estimated Activity to 2025

Fisheries will continue as the main maritime activity around Iceland in the next decade. Given the continuing development of larger high-tech vessels replacing the smaller, the number of fishing vessels and seamen in the sea around Iceland is likely to shrink in the coming years. Shifting of fish stocks, which might be partly owing to global warming,[15] could, on the other hand, change routes of fishing vessels and bring more of them further north.

PETROLEUM ACTIVITY

Two areas on the Icelandic Continental Shelf are thought to have the potential for commercial accumulations of oil and gas: *Dreki* northeast of Iceland, between Iceland and the Norwegian island of Jan Mayen, and *Gammur* on the northern insular shelf of Iceland. Three exploration licenses have been granted for *Dreki* and activity will commence in the summer of 2015, but Strategic Environmental Assessment has not been made for Gammur yet.

[15] See e.g. http://www.theguardian.com/environment/2014/aug/02/gurnard-and-chips-cod-warmer-seas-uk-fish-stock.



FIGUR 38 AREAS FOR COMMERCIAL ACCUMULATIONS OF OIL AND GAS: DREKI AND GAMMUR

Photo retrieved from *http://orkustofnun.is/oliuleit/svaedi-og-gogn/*

Gammur is located on the northern insular shelf of Iceland, but Dreki is further northeast and includes the southern tip of Jan Mayen.

The license holders are currently evaluating data already collected. Should they decide to further explore the area, it would lead to increase in research vessel traffic, but not on a large scale. The exploration phase can take up to 10–15 years, with the possible participation of more actors, but it remains unknown whether the area contains oil, gas or metal deposits. The exploration phase involves limited disturbance in this unfrequented area. Echo sounding may lead to temporary discomfort for the marine animal life, but should not pose any danger to it.[16] Should the exploration lead to further production, it is more likely to be performed by drill ships than by constructing an oil platform, due to the depth of the sea in the area.[17] Mineral and hydrocarbon exploration/exploitation in Greenland has also been singled out. Such projects are, however, still on the drawing boards. While the uncertainties are many, Iceland has formulated

[16] "Olíuleit á Drekasvæði við Jan Mayen-hrygg: Tillaga að áætlun og drög að umhverfisskýrslu vegna útgáfu sérleyfa til leitar, rannsókna og vinnslu á olíu og gasi á norðanverðu Drekasvæði við Jan Mayen-hrygginn" (Oil Exploration in the Dreki area by Jan Mayen). 2007. Iðnaðarráðuneyti. Retrieved from http://orkustofnun.is/media/utbod2009/Umhverfisskyrsla_2007.pdf

[17] See e.g.: http://www.mbl.is/vidskipti/frettir/2013/01/04/island_er_frumkvodlasvaedi/

interest in providing services to the so-called "energy triangle", the space from North-East Greenland to Jan Mayen and from there south to Iceland.[18]

Estimated Activity to 2025

Should any of the explorations for oil and gas around Iceland, North-East Greenland or in the Jan Mayen area be successful, it could lead to increased maritime activity north and northeast of Iceland. However, as the exploration phase can take up to 15 years, such increase is not likely to happen in the next decade.

MARITIME TOURISM

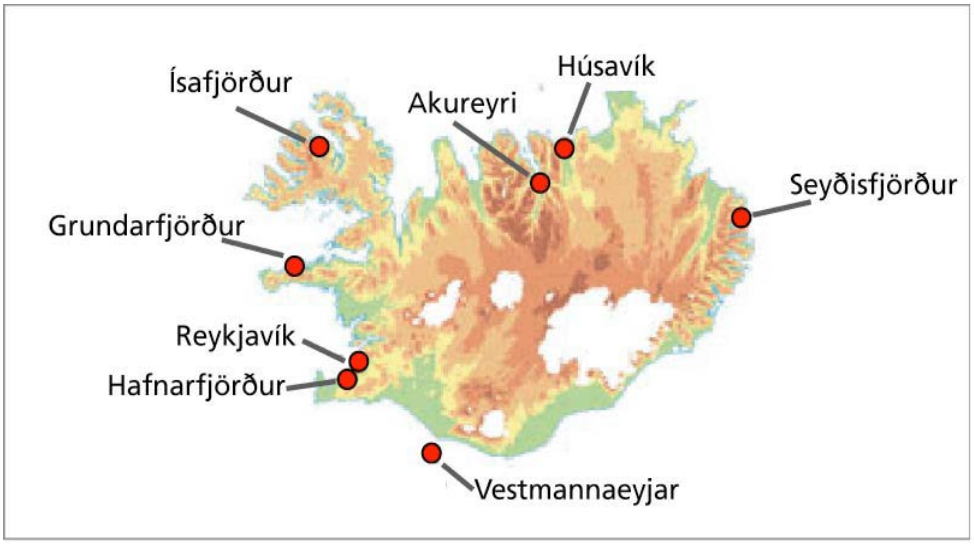
Maritime tourism has increased significantly in Iceland in the past decades. From 1970 to 1990, an average of 9,000 cruise tourists visited Iceland each year. Since then, the number has increased steadily, and in 2013 passengers were over 90.000, with the sharpest rise between 2011 and 2012. One third of the passengers are of German nationality and there is also a significant number from the United States and the United Kingdom.[19]

90% of holiday cruise vessels that sail to Iceland come into port in *Reykjavík* (Faxaflói). However, many of them do also visit other places in Iceland, such as *Seyðisfjörður* in the east, *Akureyri* in the north, *Ísafjörður* in the northwest, and *Grundarfjörður* in the west.[20] The average number of cruise vessels has remained constant in the past years, but the vessels are larger and consequently the number of passengers has increased steadily (Figure 40).

[18] See e.g. the 2013 address of Össur Skarphéðinsson, Minister for Foreign Affairs, to the Icelandic Parliament: http://www.mfa.is/media/Raedur/framsoguraeda-OS-14-feb-2013.pdf

[19] "Skýrsla starfshóps um móttöku skemmtiferðaskipa". (Report on the Arrivals of Cruise Vessels to Iceland). 2007. Innanríkisráðuneytið and Faxaflóahafnir Annual Report. 2013

[20] Report on the Arrivals of Cruise Vessels to Iceland. 2007



FIGUR 39 MAP OF HARBORS THAT OFFER HOLIDAY CRUISE FACILITIES IN ICELAND

Source: Report on the Arrivals of Cruise Vessels to Iceland. 2007

While it is not the general rule, there are examples of operators offering expeditionary cruises that route along the northeast coast of Greenland and to Svalbard.[21] In addition to the cruise vessels, Smyril line has for over 30 years offered passenger transportation from *Seyðisfjörður* in the east of Iceland to the Faroe Islands, Denmark and Germany. The current ferry, M/S Norröna, takes in total 1,500 passengers and up to 800 cars. A detailed emergency response plan has been made for Norröna.[22]

No serious passenger vessel incidents have occurred close to Iceland. However, weather conditions have created difficulties for larger vessels to travel to and from port. In 2012, for example, the 113,000 GT and 290 m long Caribbean Princess departed *Reykjavík* 13 hours later than intended due to heavy wind. The same year the smaller Crystal Symphony experienced a five-hour delay, which also affected other ships waiting to leave or come into port in *Reykjavík*. Port authorities in *Faxaflói* own four harbor tugs (total of 88 GT capacities) that are available to assist ships arriving or departing. However, these – and as a matter of fact most towing vessels – are insufficient for the purpose of towing the larger cruise vessels. In urgent cases,

[21] See e.g. Arctic Cruise Adventure with Polar Cruises: http://www.polarcruises.com/arctic/ships/luxury-expedition-ships/le-boreal-arctic/arctic-cruise-adventure-norway-greenland; Wildlife Cruises with Responsible Travel: http://www.responsibletravel.com/holiday/2508/wildlife-cruises-to-spitzbergen-greenland-and-iceland; and Svalbard, Iceland & Greenland's East Coast tour with Arctic: http://www.expeditions.com/destinations/arctic/svalbard-greenland-iceland/day-by-day/.

[22] See http://www.almannavarnir.is/upload/files/Ferjuslys-Sey%C3%B0isfj%C3%B6r%C3%B0ur.pdf

assistance from the ICG's patrol vessel *Þór* could be requested, as well as from nearby trawlers.[23]

There has also been a rise in recreational sailing to/from and around Iceland during the summer months. As recreational boats are not covered by the AIS, exact numbers are lacking. Nonetheless, with assistance from police, harbor and custom authorities the ICG has a rough overview of the situation each time. Annually, the ICG receives many assistance requests from recreational boats.

Estimated Activity to 2025

Given the good infrastructure for cruise vessels, which has been built up in Iceland, the number of passengers is likely to continue rising in the coming years. Recreational sailing is also growing more popular. On the other hand, these predictions rely upon many factors, such as the popularity of Iceland as a tourist destination and the infrastructure for cruise vessels in other Arctic countries.

RESEARCH AND OTHER GOVERNMENTAL ACTIVITY

Research and monitoring activity remains stable in the sea around Iceland with 70–90 research and monitoring vessels coming into port in *Reykjavík* each year.[24] Only seven research vessels are registered in Iceland, mainly designed for marine and fisheries research. Additionally, three patrol vessels and one hydrographic surveying vessel are registered.[25] International research vessels are frequent visitors in Iceland, exploring maritime environment in the north.

The Icelandic Coast Guard fleet has three offshore patrol vessels (OPV) and one coastal hydrographic and patrol vessel.

[23] "Samantekt varðandi öryggi skemmtiferðaskipa hjá Faxaflóahöfnum sf." (Summary of the Cruise Vessels Safety at Faxaflóahafnir). 2012. Retrieved from http://www.faxafloahafnir.is/wp-content/uploads/2013/08/upload/files/fundargerdir_hafnarstjornar/fundir_2012/102._fundur/oryggi_skemmtiferdaskipa_-_samantekt_5__okt_2012.pdf
[24] Faxaflóahafnir Annual Report. 2013
[25] List of Icelandic Ships and Boats. 2013

Estimated Activity to 2025

With the continuing interest in the Arctic, the traffic of research and monitoring vessels might increase in the coming years. Nevertheless, given the low number of such vessels this will not make a large part of maritime activity in the area.

SUMMARY

The total number of vessels in the Icelandic Search and Rescue Region has decreased in the past years. However, the vessels are, generally, larger than before. The number of seamen has also gone down, but ever more passengers are travelling with cruise vessels and, in some instances, ferries. The maritime activity has, thus, partly taken on a new face.

Predictions on the opening of new sea routes in the Arctic and exploration for oil and natural gas have not, yet, led to significant increase in traffic in the sea around Iceland. On the other hand, there are examples of foreign fishing vessels and cruise vessels travelling in previously unfrequented areas by the east coast of Greenland within the Icelandic SRR. Any accidents in this area would pose a great challenge to the Icelandic preparedness system and to the existing cooperation mechanisms in the region.

PART IV THE GREENLANDIC SEA AREAS AND ACTIVITY LEVEL UP TO 2025

BY UFFE JAKOBSEN AND BIRITA Í DALI

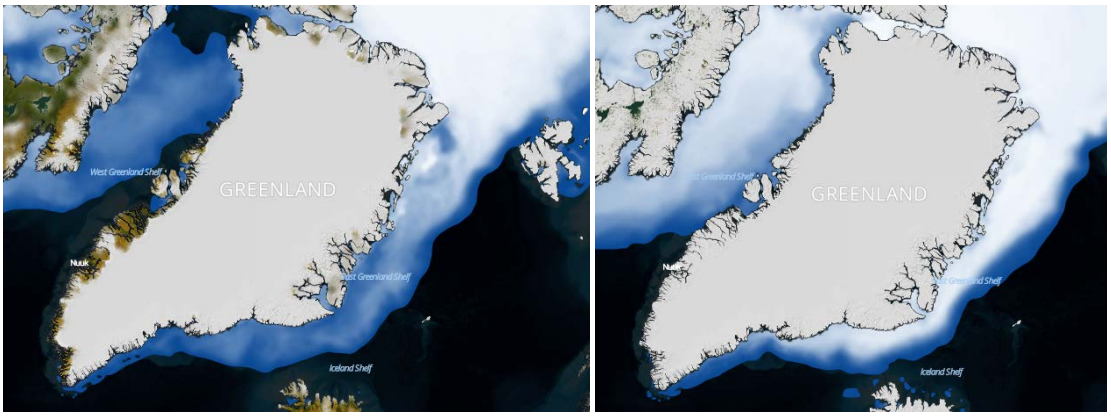
To understand the current and estimated future level of maritime activity and implications for risks/security and for emergency prevention preparedness and response (EPPR) systems a few facts on the geography, climate, population size, settlement patterns, administrative systems and infrastructure in Greenland are important.

Greenland is the largest island in the world - more than 2 million square kilometers - with a very limited population living in remote areas far away from the rest of the world, including places with which Greenland has regular contact. The longest distance from south to north is 2.670 km, from west to east 1.050 km and the total coastline amounts to 44.087 km. The Greenland ice sheet covers the main part of Greenland, so only 15% of the territory of Greenland is without permanent ice and only the coastal areas are habitable. Also the sea territory of Greenland is huge, covering more than more than 2 million square kilometers.

While geographically part of the North American continent, historically Greenland is part of Europe, the Nordic countries or Scandinavia and, especially, Denmark and culturally the majority of people living in Greenland see themselves as part of an Inuit tradition. However, Greenland was a Danish colony from 1721 to 1953, and an integrated part of Denmark from 1953 (Beukel, Jensen & Rytter, 2010), before Greenland achieved Home Rule in 1979 (Dahl, 1986), which developed into Self-Government in 2009 (Ackrén & Jbsen, 2015). Administratively, Greenland together with the Faroe Islands and Denmark proper form the Danish Commonwealth or the Danish Realm or the Kingdom of Denmark (Denmark, Greenland, & Faroe Islands, 2011, p. 10). The Self-Government of Greenland, like the Home Rule of the Faroe Islands, is quite comprehensive in domestic policy areas, while central policy areas as foreign, defence and security policy remain the prerogative of the Danish government (Kleist, 2010).

Greenland has a typical Arctic **climate** with average summer temperature below 10 degrees Celsius and average winter temperature below minus 20 degrees Celsius in north-western Greenland. The coastal waters of Greenland is also partly ice covered or marked by icebergs and pack ice making shipping difficult, dangerous or impossible for ships without ice class hulls or icebreaker assistance. This goes for the northern coast and most of the eastern coast all year round and for the northern part of western coast part of the year. Only parts of the south-western

coastal areas of Greenland belong to the so-called “open water areas” that are ice-free all year round. So, Greenlandic waters are generally characterized by these special climatic circumstances or extreme weather and ice conditions (Klima- og Energikontoret, 2014, pp. 10–11).



FIGUR 40 SUMMER AND WINTER SEA ICE EXTENT IN GREENLAND WATERS

Source: ArkGis.no. 2012

The total size of the **population** in Greenland is less than 56.000 and the island is very sparsely populated. Greenland has 17 towns with a population of 17.000 in the capital of Nuuk, and 426 in Ittoqqortoormiit in eastern Greenland. There are around 60 settlements with a population of less that 8.000. 80% of the population live in the towns, 50% of the population live in the four biggest towns (Nuuk, Sisimiut (5.500), Ilulissat (4.500) and Qaqortoq (3.000)) and only 6% of the population (3.500) live in two towns of Ittoqqortoormiit and Tasiilaq and the settlements around Tasiilaq on the southern part of the eastern coast (Statistics Greenland 2015). The remaining north eastern quarter of Greenland is a national park (972.000 square km) with no permanent inhabitants (Statistics Greenland, 2015).

In addition to the 17 towns in Greenland, also the US Thule air base in Pituffik and the former US military airports in Kangerlussuaq (Sondrestrom) and Narsarsuaq, now Greenlandic civilian airports, are shown on the map.

FIGUR 41 THE SETTLEMENT PATTERN OF GREENLAND

Source: Statistics Greenland.

The infrastructure or **overall transport system** is different from most countries and largely determined by Greenland's size, climate, settlement pattern or dispersed population and even its history as a colony and former integrated part of Denmark. Also, Greenland's military strategic importance for the US during World War II and the Cold War has remaining impacts on the transport system. Due to the large distances, dispersed population, rough geography and harsh climate, land transport is difficult and almost excluded, so no road system or railways exist in Greenland between towns and settlements. Therefore, transport between cities and towns must be done exclusively by flight or shipping. And due to ice conditions, especially in the northern and eastern parts of Greenland even shipping is impossible and supply have to be

transported by flight three to six months of the year in the winter season (Royal Arctic Line, 2014, p. 48). Economically, this means large infrastructure investments in relation to the number of inhabitants, and the necessary investments and the long distances make traffic almost impossible on commercial terms. The transport system has to be publicly subsidised and the need of agreements between government and transportation operators also creates government owned transportation companies and a near-monopoly situation in most of the supply transportation sector, as well. Even if Greenland is economically subsidised by Denmark with an annual grant of 500 millions USD, a sustainable Greenlandic national economy is a political goal as part of maintaining a modern welfare society but also as part of making possible the long term goal of political independence, so resources also within the overall transport system in Greenland must be used effectively (Transportkommissionen, 2011, pp. 11–13)

In the context of climate change, and due to the expected reduction of the sea ice extent in the Artic region, the Government of Greenland expects a comprehensive **climate change impact on shipping**, so that ship traffic will envisage longer sailing seasons and new shipping routes. Also, climate change and sea ice reduction are expected to create a development within offshore oil and gas as well as mining industries, which again will lead to significantly increases in ship traffic and maritime activity in general. Moreover it is expected that fisheries will expand and that the branding of Greenland as a tourist destination will affect the number of cruise ship and cruises and result in additional maritime activity (Klima- og Energikontoret, 2014, pp. 10–11); also cf. (AMAP (Arctic Monitoring and Assessment Programme), 2011) and (Arctic Council, 2009) and (Arctic Council, 2005). Actually, climate change impact on sea ice reduction has already resulted in an extension of the open water area on the west coast of Greenland so that **longer sailing seasons** have emerged within the last 10 years or so. It has made possible all year round sailing to Ilulissat and other towns and settlements in the Disco Bay area (Klima- og Energikontoret, 2014, p. 9).

In the longer-term perspective, climate change will presumably result in a permanent opening of **new Arctic shipping routes** such as the North West Passage (Transportkommissionen, 2011, p. 276) and the North East Passage or Northern Sea Route (Stuer-Lauridsen & Overgaard, 2013, p. 7), as well, and a shortening of transportation distances and costs between the Arctic and Asia.

These perspectives are clearly playing a role in **political debates** in Denmark (The Danish Government, 2010, p. 16) and in Greenland. Thus, in her opening speech of the Greenland

parliament in September 2013, the then Premier Aleqa Hammond stated that “climate change and receding ice mean that new business opportunities become available” and that “mining industries can expand the exploration of raw materials”, and that more ice-free Arctic waters in the future may play a role as “an alternative route for container traffic to and from Asia” cf. (Gad, Jakobsen, & Strandsbjerg, forthcoming).

However, even if climate change will have positive effects in terms of economic development for business and society in general in Greenland, the increased traffic connected to an increase in fisheries, offshore and mining industries and also tourism will result in **increased risks of accidents** in Greenland (The Danish Government, 2010, p. 16). And, even if the increased traffic means that more ships than earlier probably will be around in case of an emergency, the North Atlantic and the Arctic Ocean for a long time to come will still have less intensity of vessels than is the case in European seas and, due to a low population density, less developed infrastructure. Therefore, sufficient rescue resources will still only be available from long distances (Stuer-Lauridsen & Overgaard, 2013, p. 25). Increased shipping, thus, has its security implications under the prevailing conditions and, consequently, creates a need for extended EPPR capacities and trans-border cooperation and partnership building.

The responsibility of administration, regulation and **governance of shipping** in Greenlandic waters is divided between Greenlandic and Danish authorities. As a self-governing society but sub-state territory within the Kingdom of Denmark, Greenland has the authority and decision making power concerning the sea territory from the coastline of Greenland to the three nautical miles limit, while Denmark has the authority and decision making power concerning the sea territory from the three nautical miles limit to the Exclusive Economic Zone (EEZ) limit of Greenland. However, governance of shipping concerning natural resources exploration and exploitation is the responsibility of Greenlandic authorities within both the three miles limit and the EEZ limit. This, of course, presupposes coordination and cooperation between Greenlandic and Danish authorities. But differences exist or have existed, since relevant ice class have been mandatory in coastal Greenlandic waters within the three miles limit but not in the rest of the waters within the Greenlandic EEZ. This situation will, however, change when the Polar Code adopted by the International Maritime Organization (IMO) enters force on 1 January 2017 and relevant ice class becomes mandatory for all ships sailing in Arctic waters.

This chapters draws on a number of available **sources** of information: journal articles, official reports by public institutions and private organisations, data from the Joint Arctic Command,

the Danish armed forces in Greenland and the Faroe Islands, and correspondence and interviews with a number of persons with experience of shipping in Greenlandic waters.

There is no automatic **monitoring of maritime traffic** in the Greenlandic waters. There has been a test of Automatic Identification System (AIS) by the Danish Maritime Authorities (DMA) via satellite (Stuer-Lauridsen & Overgaard 2011, 25). Of course, available websites for AIS data also include Greenlandic waters (marinetraffic.com), but one can get a snap shot and not systematic statistics of the current situation and past developments. Instead, the GREENPOS system and the Coastal Control system are used to collect information about maritime traffic. It is mandatory for all ships sailing to or from or within the Greenland EEZ to report to GREENPOS by sending reports about their position, destination, course and speed to the Joint Arctic Command (JAC) The Coastal Control system is mandatory for any ship of 20 GT or more and fishing vessels sailing within Greenlandic waters. These vessels must submit reports to the Coastal Control via Aasiaat Radio. JAC encourages ships navigating the Atlantic Ocean within the Greenland EEZ, including cruise ships and research vessels, to remain in the GREENPOS system during their entire voyage. Based on the reports received, JAC and Aasiaat Radio will keep track of the position in Greenland waters of ships participating in the reporting system (navigation.gl).

So, information about maritime traffic in Greenlandic waters is dependent on the actual reporting by the ships that are obliged to report to either JAC directly or to Aasiaat Radio that will send information received to JAC (JAC interview 2015). In 2010 more than 9.000 reports were received by GREENPOS and Coastal Control all together (Stuer-Lauridsen & Overgaard, 2013, p. 106) (Stuer-Lauridsen & Overgaard 2013, 106). However, there have been complaints that not all ships obey the rules (Søfartsstyrelsen, 2008, p. 28). The data used in this chapter has been sent by JAC on request but, again, it must be recognized that these data are made by JAC based on reports manually sent from ships within the Greenland EEZ and not automatic and permanent tracking data (JAC correspondence 2015). And since authorities register vessels differently, some differences in numbers may occur.

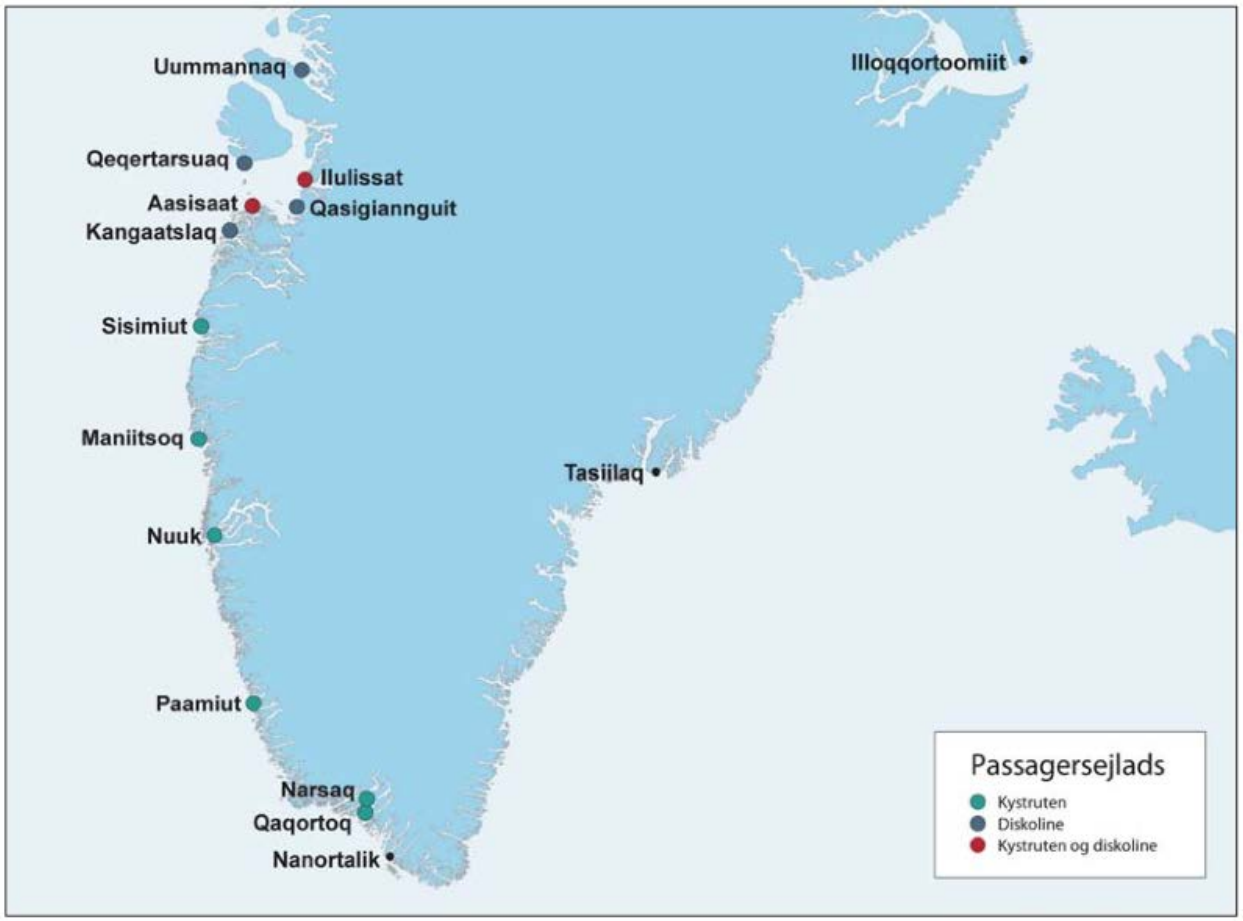
COASTAL SEA TRAFFIC

Sea traffic plays an important role in the traffic system in Greenland, since all Greenlandic towns and settlements are situated at the coast and since towns and settlements are not

connected by roads. Sea traffic plays an important role in passenger traffic (section 1.1 below), as does also air traffic, and plays an even more important role in goods supply (section 1.2 below). Almost all goods supply to towns and settlements is by sea (Transportkommissionen, 2011, p. 34). Therefore, harbors are also of great importance. All towns in Greenland have proper harbors and all settlements have berthing and fishing bridges or the like. In total there are around 185 coastal facilities when the number of all moorings, buoys etc. are included. However, only 7 of the towns have harbors that can handle overseas container ships, while 5 of the towns can handle so called feeder ships that can deliver twenty-foot containers from overseas harbors. Minor "settlement ships" service the remaining towns and all settlements. All ports and harbors are owned and operated by the Greenlandic authorities apart from Thule Airbase and a few private ports owned by mining companies, so-called project ports (Transportkommissionen, 2011, pp. 34–37).

Passenger transport

Only the southern part of the west coast of Greenland is serviced by passenger transport, since the number of inhabitants and the ice conditions in the northern part of the west coast and the east coast prohibit a regular service. So, passenger transport services are only available between Qaqortoq in the south and Uummannaq in the north. Three operators take care of the passenger transport: Arctic Umiaq Line (AUL) operates the route between Qaqortog and Ilulissat, Disko Line takes care of passenger transport in the Disco Bay and Ilulissat area and Royal Arctic Line operates passenger transport to and from settlements in connection with goods supply.



FIGUR 42 TOWNS SERVED BY THE ARCTIC UMIAQ LINE (AUL) (BLUE DOTS), DISKO LINE (GREY DOTS) AND BOTH THE AUL AND THE DISKO LINE (RED DOTS)

Source: Transportkommissionen 2011, 39.

The **frequency** of passenger transport is, however, dependent on seasonal conditions. AUL operates the route from Qaqortoq to Ilulissat from April to December but only from Qaqortoq to Sisimiut from December to January and from March to April while there are no services from early January to late March. During summertime the trip from Qaqortoq to Nuuk takes 33 hours, harbouring at three smaller towns and settlements during the trip, and the trip from Nuuk to Ilulissat takes 40 hours, harbouring at four smaller towns and settlements during the trip (aul.gl). So, all in all the trip from Qaqortoq to Ilulissat takes a little more that 3 days and nights including stop overs so that each town has two weekly arrivals. Number of port calls by AUL has been decreasing from 2001 to 2008.

TABELL 6 ANNUAL NUMBER OF PORT CALLS BY AUL

year	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Port calls	*2177*	*2008*	*1553*	*1928*	*1741*	*606*	*495*	*589*

(Source: Royal Arctic Line)

Disko Line operates routes between the towns of Ilulissat, Qeqertarsuaq, Aasiaat, Kangaatsiaq and Qasigiannguit and more than 10 small settlements in the area from July to October (diskoline.dk). It also used to service the town of Uummannaq as the northernmost town (Visit Greenland correspondence 2011).

The **numbers of vessels and passengers** vary. Disko Line has seven registered vessels of different size with capacities of 12 (3), 36 (3) and 60 (1) passengers (diskoline.dk). AUL has one big passenger ship, *Sarfaq Ittuk* ("rushing stream"), that has the capacity of 274 passengers with 22 crew members (aul.gl). The number of Disko Line passengers on a yearly basis is around 12.000 (Transportkommissionen, 2011, p. 38). It is an important link between Ilulissat on the mainland and Qeqertarsuaq on the Disco Island with around 900 inhabitants (Statistics Greenland 2015).

The annual number of passengers onboard *Sarfaq Ittuk* is around 20.000 mostly local passengers but also around 2000 tourists are travelling with this coastal line (aul.gl). Coastal passenger transport has a long history back in time with more ships, longer routes, higher frequencies and more passengers (Schultz-Lorentzen, 1998). The short time history shows a drop in the number of passengers after 2008:

TABELL 7 ANNUAL NUMBER OF PASSENGERS ON THE COASTLINE SHIP SARFAQ ITTUK FROM 2006 TO 2009

	2006	2007	2008	2009
Number pax	17.218	21.986	24.411	20.453

(*Source: Transportkommissionen 2011, 341)*

However, **estimations of the future level** of coastal ship passengers in the coastal traffic in Greenland should be based on the statistics in a bit longer perspective and analyses of reasons for past changes and, of course, future possible developments. Data from 2002 to 2008 for both AUL and RAL passenger transport show that the recent peak in 2008 represents a drastic decrease compared to numbers before 2006:

TABELL 8 DATA FROM 2002 TO 2008 FOR BOTH AUL AND RAL PASSENGER TRANSPORT

	2002	2003	2004	2005	2006	2007	2008
Number pax	90.527	83.877	88.901	91.230	43.448	23.528	28.629

(Source: Transportkommissionen 2010, 20)

The drop in the numbers from 2005 (more than 90.000) to 2007 (less than 24.000) coincides with a drop in the government subsidies of shipping. Further, the drop in the number of ship passengers from 2005 to 2006 that amounts to 50.000 passengers coincides with an equivalent increase in the number of flight passengers in the same period (Transportkommissionen 2010, 20-21). Today AUL is dependent on government subsidies and from a purely budgetary perspective, i.e. without considering historical, cultural or social aspects, a recommendation in 2011 for the Government of Greenland was to shut down the coastal passenger route (Transportkommissionen 2011, 341). However, the government decided to continue subsidising the coastal shipping route. So, if the government subsidies cease, the result will probably be an decrease of ship passengers and an equivalent increase in the number of flight passengers between towns and settlements that already have or will obtain air traffic services. Today, all of the destinations of AUL apart from two have either airports or heliports. But if the government subsidies continue, the estimation is that the level of ship passenger traffic will remain around 20.000 up to 2015 (AUL correspondence 2015).

FIGUR 43 ARCTIC UMIAQ LINE'S PASSENGER SHIP, SARFAQ ITTUK ("RUSHING STREAM")

Source: AUL

Arctic Umiaq Line's passenger ship, Sarfaq Ittuk ("rushing stream"), is classified by the Norwegian Veritas to sail in icy waters (ice class 1A). The ship is from 1992 and was modernized and extended in 2000. The ship has a length of 73 meters and width of 11 meters. The crew counts 22 people, and the ship capacity is 274 passengers.

Cargo transport

Royal Arctic Line that has concessions agreement carries out the intercontinental traffic as well as the goods supply within Greenland. Their over 700 workers are distributed around the 13 harbors in Greenland and their base harbor in Aalborg, Denmark. RAL is 100% owned by the Government of Greenland. In 2014 RAL has shipped a number of 60.000 of twenty-foot containers across the Atlantic to different places in Greenland (Royal Arctic Line, 2013).

RAL sails once a week all year inclusive the Disco bay. On the basis of three trends of recent years to changes in the ice situations RAL carries arrivals in all towns and villages, as ice and weather conditions allow. The subsidiary company of RAL, *Royal Arctic Bygdeservice* (RAB) has the responsibility of carrying the goods to and from and between towns and settlements in Greenland. In the ice free months, the RAB arrives every 14 days with goods. The fleet has 4 settlement ships and in high season RAB charters additional general cargo ships (Royal Arctic Line, 2013, p. 26).

TABELL 9 GOODS SHIPPED WITHIN GREENLAND

Year	2006	2007	2008	2009	2010	2011	2012
1.000 m^3	144	139	140	130	118	111	127

(Source: Statistics Greenland).

The number of port calls by the Settlement service, Royal Arctic Bygdeservice, is quite stable from 2001-2008, peaking in 2006.

TABELL 10 NUMBER OF PORT CALLS BY ROYAL ARCTIC

Year	2001	2002	2003	2004	2005	2006	2007	2008
Port calls	727	657	694	679	657	1003	742	768

(Source: Royal Arctic Line).

All in all climate change opens up for the possibility for more frequent goods transportation of some towns and settlements. However, the amount of goods transportation has remained almost the same within the last decade. The expectation for the future level of goods transportation is neither increase nor decrease but status quo (Royal Arctic Line, 2013).

INTERCONTINENTAL TRANSPORT

When it comes to intercontinental transport to/from Greenland it is the routes across the Atlantic Ocean that are relevant. Arctic routes are relevant regarding future expectations and these are dealt with in summary section.

Distribution of foreign goods to Greenland takes place in the port of Aalborg, Denmark. The traffic over the Atlantic is done by special build containerships, and is connected to ports in center of and south Greenland and ports in east Greenland that have the capacity of directly receiving container ships. Also, the ships across the Atlantic around once a month sail to port in Reykjavík, Iceland, which has ship connections to North America, and thereby serve as a connection between Greenland and North America (Transportkommissionen 2011, 36-37).

TABELL 11 AMOUNT OF CARGO/GOODS SHIPPED TO AND FROM GREENLAND

Year	2006	2007	2008	2009	2010	2011	2012
To Greenland	422	420	439	401	386	423	389
From Greenland	329	314	312	291	310	300	295

(Source: Grønlands statistik)

RAL has in total five big ships to cross the Atlantic Ocean. The amount of goods transported over the Atlantic Ocean from Denmark to Greenland and from Greenland to Denmark amount to about 400.000 cubic meters and 300 hundred cubic meters and also here is the expectation for the future level of goods transportation neither and increase nor a decrease but status quo (Royal Arctic Line, 2013).

FIGUR 44 NUKA ARCTICA, ONE OF RAL'S CARGO SHIPS

(Royal Arctic Line, 2014).

Nuka Arctica, one of RAL's cargo ships, arrives in Nuuk in March 2013 with an "extra" cargo of about 600 tons icing. This is one of the many challenges that can occur when sailing in Arctic waters

FISHERIES

Fisheries have an important role for the Greenlandic economy. Export of fisheries and fisheries products account for over 80% of the total export value. Therefore, fishing vessels constitute a significant portion of all vessel activity in Greenlandic waters. The fisheries in Greenland are divided into ocean fishing and coastal water fishing. The distinction is based on both distance from the coast (less or more than 3 nautical miles from the coast) and vessel size (less or more than 120 GT).

The Greenland fleet of fishing vessels has developed since 1960's. In 2014 the fishing fleet in Greenland with license consist of 530 vessels. Moreover, there are between 1.500 and 2000 boats, of which some is used for fishing and hunting, and some are associated with fishing boats that fish with net and similar fisheries (Grønlands statistik).

The ocean fishing fleet includes a number of large vessels over 120 GT, fishing outside the 3 nautical miles zone. Larger vessels have the capacity to process the catch on board. The coastal fleet comprises vessels under 120 GT and they are fishing within the three nautical miles zone. The fishing fleet is privately owned. The four trawlers which is owned by Royal Greenland is indirectly publicly owned, as Royal Greenland is owned 100 per cent by the government of Greenland (Greenland Statistics 2014). The coastal fishing takes place mainly on the west coast, as there are no commercial coastal fisheries of importance on the east coast, and no opportunities to sell. Offshore fisheries take place on both the west and east coast (GFLK, 2013).

The fishing vessels do not use the Greenpos system, and the registration of fishing vessels is not complete. Boats/vessels bigger than 6 meters and with fishing license are registered by Greenlandic Fisheries License Control authority (GFLK).

The fishing fleet consists of mostly Greenlandic vessels but also foreign fishing vessels. The number of Greenlandic vessels is stable and ranging from 365-387 vessels. The foreign fishing vessels come from the EU, Faroe Islands, Iceland, Norway and Russia.

TABELL 12 NUMBERS OF FISHING VESSELS

	2009	2010	2011	2012	2013	2014
Greenlandic	365	387	383	387	377	377
EU	24	27	34	27	26	32
Iceland	26	27	39	38	14	11
Faroese	18	14	18	16	15	8
Norwegian	25	25	103	105	21	90
Russian	16	16	14	13	10	12
Total	**484**	**496**	**591**	**586**	**463**	**530**

(source: GFLK)

The number of vessels does not tell us anything about the size of the vessels, except that they are all bigger than 6 meters. And many of the vessels have more than one license. The total number of vessels has been increasing since 2009, peaking in 2011 with 591 vessels fishing in Greenlandic waters.

PETROLEUM ACTIVITY

Since the US Geological Survey estimated that 13 % of the worlds undiscovered oil reserves and around 30% of the world undiscovered gas reserves are in the Arctic, there has been an increased interest for exploitation of oil and gas in the Arctic. Of the total oil and gas resources in the Arctic over 50% is in Russia, 20% in the US and the rest in Norway, Greenland and Canada.

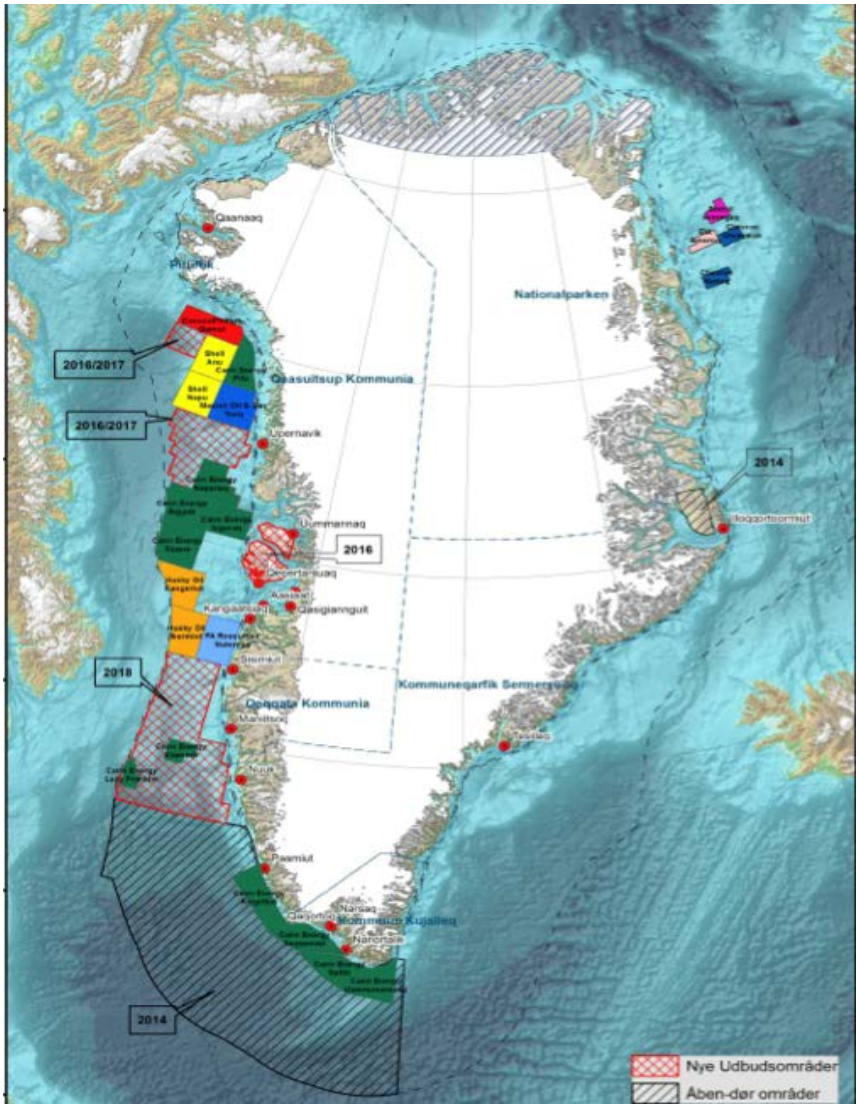
Greenland also experience high international interest in potential extractive industries. In January 2011 there were 20 active permissions to investigation and exploitation of oil and gas in the ocean west of Greenland. Different vessels are used to support and to function as supply and support and emergency prevention, preparedness and response for the activities. But the increasing maritime activities also serve other purposes, including offshore accommodation installations (Transportkommissionen 2011, 51).

TABELL 13 NUMBER AND ACTIVITIES OF VESSELS AND INSTALLATIONS CONCERNING OFFSHORE OIL AND GAS EXPLORATION

year	Vessels	journey	Type
2008	2	9	Safety Vessel, Platform Supply Ship
2009	3	9	Standby Safety Vessels
2010	18	97	Drilling Rig, Anchor Handling Vessel, Anchor Handling Tug Supply, Platform Supply Ship, Multi-Purpose Offshore Vessel, Standby Safety Vessel, Drilling Ship
2011	21	62	Platform Supply Ship, Anchor Handling Vessel, Drilling Ship, Standby Safety Vessel, Drilling Rig, Supply Ship/Tug Supplies, Diving Support Vessel, Multi-Purpose Offshore Vessel,
2012	13	18	Standby Safety Vessel, Research Survey Vessel, Anchor Handling Tug Supply, Offshore Tug, Diving Support Vessel, Drilling Ship, cable attaches.
2013	3	6	Research Survey Vessel, Drilling Ship, Anchor Handling Tug Supply

(Source: Joint Arctic Command)

The Government of Greenland published an oil and mineral strategy for 2014-2018 in February 2014 (Governments of Greenland, 2014), and it was optimistically estimated that there would be 1-2 offshore drilling projects every two years. The map below shows the oils fields that already have been explored without resulting in economically feasible findings, and areas that the Government of Greenland offers companies to explore in the near future:



FIGUR 45 EXPLORED AND AVAILABLE NEW OIL FIELDS 2014-2018

Source: Government of Greenland 2014.

MARITIME TOURISM

The maritime tourism can be divided into the cruise industry and smaller local operators. The cruise industry is increasing in general but not at all in the Arctic with the same speed as elsewhere. In addition, maritime tourism using smaller boats are, of course, dependent on local conditions.

Cruise shipping

There are huge opportunities for cruise tourism in Greenland. The operators are, however, not Greenlandic, but Greenland benefits, anyway, from foreign operators that have placed their starting points of their cruises in Greenland, passing and stopping in Greenland or even change passengers in Greenland.

The operators are not Greenlandic, but Greenland benefits from foreign operators starting their cruise in Greenland, passing and stopping in Greenland or even change passengers in Greenland.

TABELL 14 DEVELOPMENT IN THE CRUISE BUSINESS REGARDING NUMBER OF PASSENGERS; NUMBER OF DIFFERENT SHIPS ARRIVING IN GREENLAND AND THE NUMBERS OF THESE SHIPS' CRUISES IN GREENLAND

Year	2009	2010	2011	2012	2013	2014
Passengers						
total	26.976	30.271	29.826	23.399	21.434	20.216
Ships						
total	**31**	**41**	**34**	**30**	**27**	**35**
Expedition	15	19	16	14	15	17
201-500 pax	3	4	4	6	5	10
501-1200 pax	7	12	6	5	3	5
1201-3500 pax	6	6	7	5	4	3
Cruises						
total	**79**	**85**	**65**	**76**	**92**	**92**
Expedition	56	56	38	53	71	68
201-500 pax	4	6	12	12	11	15
501-1200 pax	12	16	8	6	5	5
1201-2500 pax	7	7	7	5	4	4

Source: Visit Greenland.

Even though there is a decrease in the total numbers of passengers, it is especially the medium sized cruise ships that can take 501-1200 passengers that are decreasing in Greenland, while the number of arrivals of smaller vessels, such as the expedition ships and the cruise ships with 201-500 passengers, are increasing. All in all the cruise tourism in Greenland is expected to increase (Klima- og Energikontoret 2014, 21).

Local maritime tourism

Local boats with local crew can offer smaller sailing trip to destination along the coast and daytrips to local societies. Experiences that will bring the tourist closer to nature like whale safari, fishing and sailing to the Greenland Ice Sheet are example of potentials for local maritime experience industry that have a potential for (Søfartsstyrelsen, 2014). These local operators serve both tourists that have arrived with flights and cruises. In Nuuk there are around 10 boats operating, and these can be vessels with 12 passengers, smaller vessels with 6 passengers and small open-air vessels with 2 passengers. The total of number of journeys and passengers are, however, not registered.

RESEARCH AND OTHER GOVERNMENTAL ACTIVITY

Research vessels, both Greenlandic and foreign, are active in Greenlandic waters. The Greenland Institute of Natural Resources (GINR) operates two larger research vessels, R/V Sanna and R/V Pâmiut, and several smaller boats (Erissaalik, used for fiels research in the Nuuk area, Aage V. Jensen II, used for quick transport in the Nuuk area, Aage V. Jensen I, used for research in northeast Greenland and other boats used for whale observation and used in connection with research work in sea ice.

FIGUR 46 THE RESEARCH VESSELS OF GINR, R/V PÂMIUT TO THE LEFT AND R/V SANNA TO THE RIGHT

Source: GINR.

R/V Pâmiut (build in 1971) is a Norwegian Veritas 1A1 ICE-A stern trawler. The Ship is mainly used for offshore research for shrimps, cod and deep sea fish. The ship is furnished with wet

and dry laboratory and hydrographic equipment and other technical equipment appropriate for sampling and treatment. Pâmiut is chartered regularly for research purposes in Canada.

R/V Sanna (build in 2012) is used mainly for research along the coast for cod, crabs and halibut as well as collecting samples in connection with climate and environmental research. The ship is equipped with trawl winches, A-frame for handling various major tools for scientific studies and several types of games for the handling of small tools include bongo- nets, crab pots, longlines and hydrographic measuring instruments (Greenland Institute of Natural Resources, 2014, p. 24).

The expedition plan for 2015 covers 12 expeditions for Sanna, where Sanna is chartered out in five of them and 7 expeditions for Pâmiut, where the first six are the yearly shrimp and fishery survey and the last one where Pâmiut is chartered to Canada to their yearly fishery survey. Also, the Greenland Climate Research Centre makes oceanic/hydrographical research using Danish navy vessels. The GINR estimates a small increase in their future vessel activity (Greenland Institute of Natural Resources 2014).

Also foreign vessels do research in Greenland. The number of research vessels from 2002-2014 registered in the Greenpos system is increasing vessels have been increasing, peaking in 2008-2010.

TABELL 15 NUMBER OF FOREIGN RESEARCH VESSELS REGISTERED IN GREENPOS

Year	02	03	04	05	06	07	08	09	10	11	12	13	14
Ships	1	13	15	12	16	14	20	21	21	15	18	9	12
Journeys	1	22	44	44	48	37	77	62	71	44	63	20	31

(Source JAC)

Other governmental activity is also registered in Greenlandic waters in the Greenpos system. Government vessels and warships enter Greenlandic waters, and the number of these has been increasing from 2002-2014, but peaking in 2008 and 2012. The state-vessels and warships are different types of vessels; icebreakers, research vessels. Government vessels and warships take part in different activities, for example some governmental ships are used for research or patrolling and some warships are passing and getting supply or making preparedness exercises in Greenlandic waters (source: Joint Arctic Command).

TABELL 16 INCREASE FROM 2202 TO 2014 OF STATE-VESSELS AND WARSHIPS IN GREENLANDIC WATERS

Year	02	03	04	05	06	07	08	09	10	11	12	13	14
Ships	3	4	3	10	5	9	11	5	7	10	11	5	8
Journeys	5	9	8	27	13	21	24	12	16	17	24	12	13

(Source JAC)

The Danish Arctic command at Greenland has six larger vessels for patrolling of the Greenlandic sea area, with a additional one under construction. Its base is at Nuuk.

SUMMARY

Concerning **current sea area activity** in Greenlandic waters maritime traffic amounts to less than 600 arrivals annually on an average within the last 10 years that report to the GREENPOS reporting system when entering Greenlandic waters. The number is increasing with a clear peak in 2008 and, after a decrease from 2010 to 2013, the number has been increasing again and reached 559 in 2014 (JAC 2015).

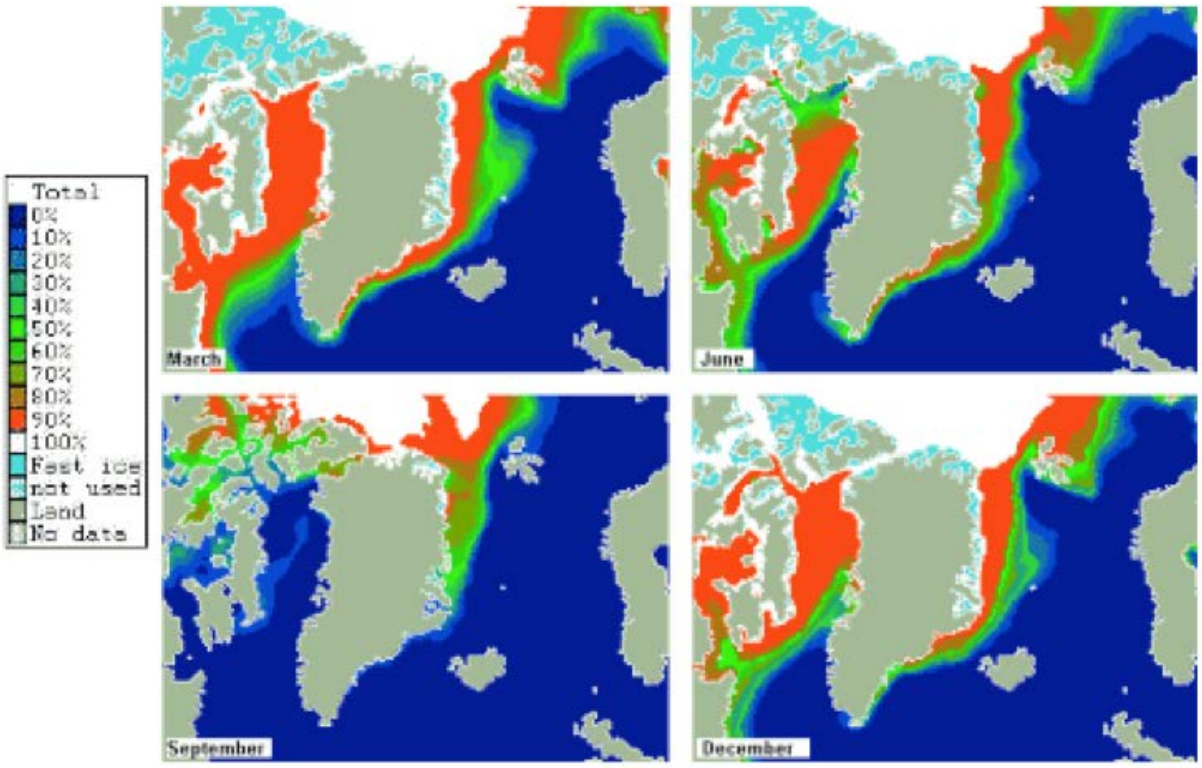
TABELL 17 REPORTED VESSELS AND JOURNEYS IN GREENLANDIC WATERS DISTRIBUTED ACCORDING TO THE DIFFERENT TYPES OF MARITIME ACTIVITIES

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Coastal/Atlantic vessels	23	32	29	34	38	40	34	32	27	19	18
Journeys	189	243	198	282	248	228	220	244	209	167	185
Intercontinental Arctic routes	- *	-	-	-	-	-	-	-	-	-	-
Journeys	-	-	-	-	-	-	-	-	-	-	-
Fishing vessels	-	-	-	-	-	484	496	591	586	463	530
Journeys **	-	-	-	-	-	-	-	-	-	-	-

Petroleum vessels	-	-	-	-	2	3	18	21	13	3	0
Journeys	-	-	-	-	9	9	97	62	18	6	0
Maritime tourist ships	25	21	30	29	36	30	38	30	30	31	33
Journeys	84	83	86	87	124	96	193	113	106	130	122
Research and governmental	18	22	21	23	31	26	28	25	29	14	20
Journeys	52	71	61	58	101	74	87	61	87	32	44
Other vessels	4	14	10	17	23	23	47	55	35	25	37
Journeys	16	36	23	35	67	50	89	76	72	48	88
Vessels in total	**70**	**89**	**90**	**103**	**130**	**606**	**661**	**754**	**720**	**555**	**638**
Journeys in total ***	**341**	**433**	**368**	**462**	**549**	**497**	**686**	**556**	**492**	**383**	**439**

The sign "-" indicates no registration or not available. ** The number of journeys for fishing vessels is not registered. * The number of total journeys is higher than in the table, since the fishing vessels journeys are not counted here. (Source: Based on data from Joint Arctic Command and Greenland fishery license control authority.)*

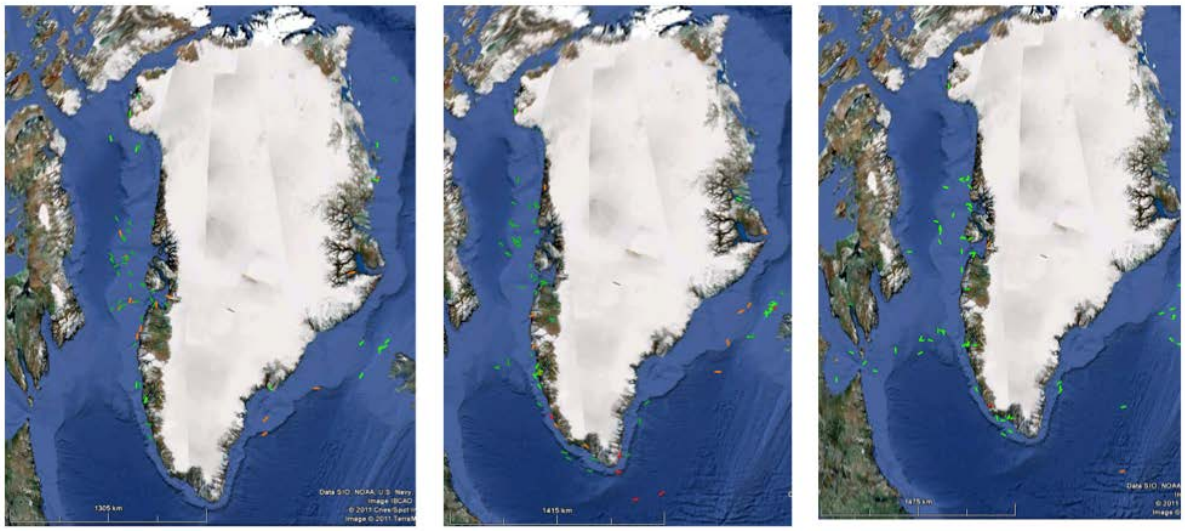
The relatively low numbers are explained by the small population, small exports and the absence of international transit routes. The Greenlandic waters have a low traffic density of trade vessels compared to European areas, partly because of the few people living in Greenland and partly because no international transit routes pass through the Greenlandic water (Stuer-Lauridsen & Overgaard 2013, 23 and 37). In addition, of course, the natural conditions with sea ice along the northwestern coast during winter seasons and along the eastern coast most of the year matter (dmi.dk).



FIGUR 47 FOUR CHARTS SHOWING THE SEA ICE SEASONAL EXTENT IN THE EASTERN COAST AND WESTERN COAST SEA ICE

Source: DMI, 2011 (from Stuer-Lauridsen & Overgaard (2013, 33)).

At any given time the estimated number of vessels in Greenlandic waters is around 50 when based on Automatic Identity System (AIS) out of which around 70% is estimated to be fishing vessels. The low numbers of vessels in the huge area of the Greenlandic EEZ result in a very low average traffic intensity (Stuer-Lauridsen & Overgaard 2013, 23).

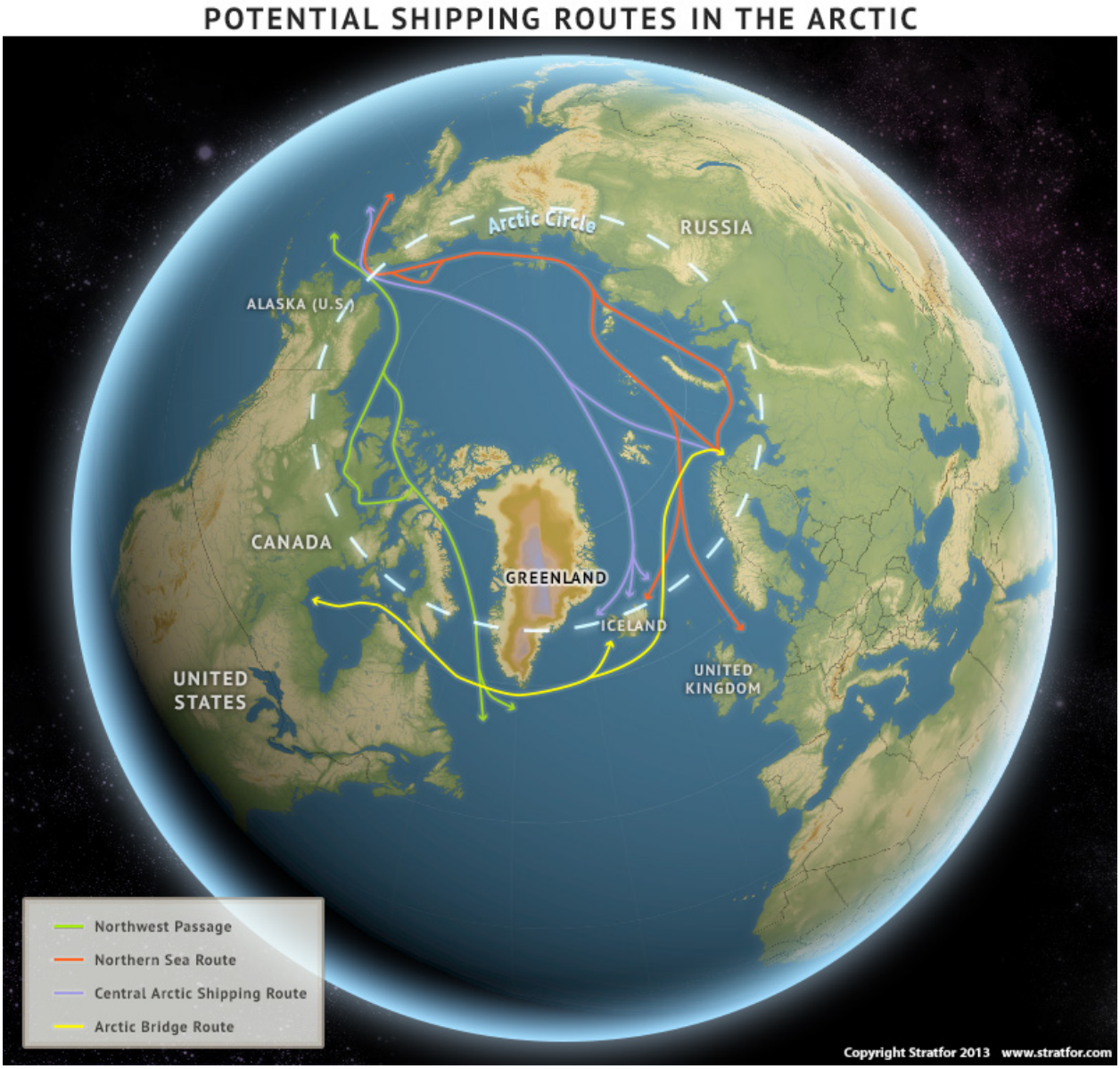


FIGUR 48 MARITIME TRAFFIC INTENSITY IN GREENLANDIC WATERS

Source: Stuer-Lauridsen & Overgaard 2013, 37.

On the Figure 49 three snapshots of ship intensity by Greenland 1 September 2010, 1 October 2010 and 30 October 2010. The individual points represent vessels in Greenlandic waters "real time". The pictures are art of the AIS test by the Danish Maritime Authorities.

Generally, a summary of the estimated level of maritime activity shows that the development up to the current level of maritime activities is expected to continue to increase in the next decade within all areas of activity from fisheries to oil/gas and mining, maritime tourism, research and government activities, except coastal passenger and goods transportation where status quo is expected. Climate change is seen as the main driver for the continued increase in the maritime activities, since climate change will bring about further decrease of the sea ice extent, or an increase in open water areas, and new shipping routes in the Arctic. Concerning new shipping routes, the Northwest Passage and the Northeast Passage or the Northern Sea Route as well as the Central Arctic Route is discussed in government papers. Different illustrations of these different sea routes pictured them in different distances to states and territories in the Arctic (Stratfor, 2013). Although it is recognized that many more ships so far have sailed along the Northeast Passage than the Northwest Passage, there is an unusual focus on the Northwest Passage by Greenlandic authorities compared with the international debate. The central issue is whether and how much the opening of the Northwest Passage for regular traffic will impact Greenland.



FIGUR 49 FUTURE SHIPPING ROUTES AND THE POTENTIAL IMPACT ON GREENLAND BY VESSELS USING THESE ROUTES

Source: Stratfor 2013.

One assessment is that this opening will lead ship traffic along the west coast of Greenland and that it will have "a huge impact" on Greenland "if this option is used to service the passing ships" (Transportkommissionen 2011, 276). Other assessments, however, are more moderate or even negative. Thus, in another government paper the assessment is that ships sailing through the Northwest Passage and along the west coast of Greenland will be doing so at a distance from Greenlandic coasts and without calling at Greenlandic ports (Klima- og Energikontoret 2014, 18 and 24). Also, negative aspects are touched upon in government papers, since vessels using the Northwest Passage will enter the Greenlandic EEZ and, thus, causing challenges in

terms of enhancing the level of demands for emergency prevention, preparedness and response system in Greenland even if these vessels are not calling at Greenlandic ports (Klima- og Energikontoret 2014, 18). Anyway, the shipping industry see the northwest passage as a significant alternative to the route between Europe and Asia, but the special challenges in the Arctic set out large requirements for ships, equipment and manpower. Therefore, it is hardly realistic for "ordinary" cargo ships to sail this route. One of the more pessimistic scenarios is that before 2020 no significant increase in the container and cargo ships along the new shipping routes is to be expected due to seasonal variations, ice-blockings, inadequate charts etc. for the Northwest Passage (Stuer-Lauridsen & Overgaard 2013, 37).

Thus, with increased maritime activity in the Arctic there is a need to focus on risks and security for ships, people and environment and to clarify **implications for emergency preparedness systems**. Like other Arctic states, there exist huge surveillance and preparedness challenges for Greenland. The harsh climate and vulnerable environment leads to a special need for quick help in case of accidents - something the huge geographical area makes difficult due to a lack of immediate available resources and a organisation of the cooperation, coordination and chain of command between Greenlandic and Danish authorities that have been strengthen but still have room for improvements (Joint Arctic Command, 2015). Especially the potential consequences for passengers on cruise ships and the potential consequences that accidents in connection with exploitation of oil could have for the marine environment. As part of a larger analysis of the military tasks in the Arctic, the Danish Armed Forces are analyzing possibilities for better surveillance in Greenlandic waters (Søfartsstyrelsen 2014). This long-awaited analysis has been postponed several times but is now expected to be published in the autumn of 2015.

FINDINGS: CURRENT AND ESTIMATED ACTIVITY LEVEL IN THE HIGH NORTH *BY NATALIA ANDREASSEN AND ODD JARL BORCH*

This chapter gives a comprehensive oversight of the activity in the sea areas from Greenland in the west to Northern-Eastern Russia. It provides an aggregated statistics on sea areas activity, including coastal and intercontinental marine transport, fisheries, oil and gas activity, maritime tourism and research and other governmental activity. We provide indications on the future activity up to 2025. We outline the high and low possible levels of development labelled "high" and "low" scenarios. A comparison of maritime activity between countries is given based on the analyses in the previous four parts of this report. Implications for the emergency preparedness system in the High North are discussed.

AGGREGATED STATISTICS ON SEA AREA ACTIVITY

The development of maritime traffic varies a lot along the High North waters. Natural resources, industrial development and other socio-economic factors in the countries have influenced the maritime infrastructure and the maritime activity.

The level of **coastal transport** is relatively stable across the analyzed regions. The coastal fleet in the Russian Northwest waters is represented by around 310 vessels. In Norway, coastal passenger and cargo transport is intensive and stable. Around 6000 registered vessels run approximately 27 thousand routes. In Iceland, coastal cargo and passenger shipping has been steadily decreasing in the past 20 years and counts for less than 1500 arrivals into Icelandic ports. In Greenland, coastal transport plays an important role because towns and settlements are situated along the coast and are not connected by roads. Passenger transportation is available only in the southern part of the west coast of Greenland and only during the period from April to December. The cargo and passenger coastal fleet has a capacity of 18 vessels of different sizes, and count about 1350 port arrivals a year.

Intercontinental traffic. The number of vessels through the Northeast Passage and the Northern Sea Route, passing through Russian coastal waters and along the coast of mainland Norway has increased. The increasing amount of tankers from Russia can lead to an increasing level of intercontinental traffic through Norwegian Arctic waters as well.

An increasing number of tankers is passing the Icelandic EEZ, mainly transporting oil and gas from Russia to the U.S. and Canada. Intercontinental transportation to and from Greenland has connections with the port of Aalborg, Denmark and the port in Reykjavík, Iceland, further connecting it to North America. There are no international transit routes passing through Greenlandic waters.

The **Fishing activity** has always been the key industry in many Arctic states. This activity has seasonal and geographical differences. There are 214 fishing vessels registered in the Northwestern Russia. Fishing vessels in Norway stand for 58% from the total transport in the Northern Norway region. About 3500 fishing vessels are registered in this region. The number of vessels is decreasing while the overall size is increasing. Norway has approx. 150 larger trawlers and pelagic fishing vessels. In Iceland, the number of fishing vessels has remained steady in the past decade, with an increase in smaller, fast-paced fishing boats. Fishing vessels stand for almost 74% of the total registered vessels in Iceland. There are around 1700 fishing vessels, with around 50 larger vessels. Fishing vessels constitute a significant portion of coastal fleet in Greenlandic waters and consists of consist of 530 vessels, a limited number of mainly shrimp trawlers, and between 1.500 and 2000 small fishing boats.

The **Oil and gas activity** in the Arctic is a special case for Russia because it produces 11% of Russia's national income and around 22% of the total Russian exports. The main Arctic activity include Prirazlomnoye field in Pechora Sea with the first Arctic-class ice-resistant oil platform Prirazlomnaya, fields and exploration licenses in the Kara and Barents Seas, and Prinovozemelsky blocks of the Kara Sea. The development of several offshore fields in Russia is postponed. In the autumn of 2015, the oil company Gazprom Neft postponed the development of the promising offshore oil field Dolginskoye until year 2031.

The total oil and gas products loading in sea ports in the Russian Arctic exceeds 83 million tons per year. The Northern Sea Route is used for transportation of around 757 thousand tons of oil and 125 thousand tons of gas condensate. Activity is scaled up in several of the existing oil and gas fields. Among others will the Prirazlomnaya field increase its production five times in the coming years. Thus, an increasing numbers of oil shuttle tankers and LNG vessels will travel from Northwestern Russia through the Barents Sea and Norwegian Sea areas.

For Norway, the most significant oil and gas activity is related to development of the Aasta Hansteen gas field in the Norwegian Sea and the Goliat fields in the Barents Sea. The Johan

Castberg field may be developed in the next ten years period. There is also an increased exploration activity in the southern part of the Barents Sea. Gas production in the Arctic Norwegian waters counts for 7,46 billion cubic meters. Tankers transport oil from the fields in the Norwegian Sea. The gas from Snøhvit in the Barents Sea is transported via pipeline to Melkøya, where it is processed and cooled into LNG, which is transported to the market using a handful specialized LNG tankers.

For Iceland two areas of Continental Shelf are important as to oil and gas exporation – Dreki and Gammur. Drilling on Dreki is started, and the Gammur is being assessed for licensing. Oil and gas exploration in the Norwegian regions of Jan Mayen up to the Iceland border is decided not opened by the Norwegian government.

The oil and gas activity in Greenland includes 20 granted permissions to explore in the ocean west of Greenland. There have been up to two rigs and 10 vessels operated by the Scottish oil company Cairn performing 33 journeys at the average, mostly including platform supply and research survey. With the limited prospects so far and the low oil and gas prices exploration drilling has been postponed also in this area.

Maritime tourism has a growing activity in the High Arctic. Some exclusive tours have been made to the North Pole on "Rosatomflot" icebreakers. However, the level of tourist activity in the Russian Arctic remains quite low. There are less than ten sea cruise ship visits per year in the Russian northwest.

In Norway, four types of vessels are involved in maritime tourism – distance cruises, overseas (conventional) cruises, expedition cruise vessels, day trip ships and yachts. Thousands of tourists are travelling along the coastline and around Svalbard. The number of cruise ships visiting mainland Norway is about fifty, the largest with more than 5000 persons on board. The most popular harbor in Northern Norway, Tromsø, has up to 100000 visitors a year. The number of conventional cruise ships travelling to Svalbard is about 25 vessels, some of them making two to three tours per summer season. Approximately 50 leisure vessels are visiting Spitsbergen during the summer season from June to September.

In Iceland, maritime tourism has increased significantly in the past decades. Over 90000 passengers are travelling in Icelandic waters. Around 90% of holiday cruises come into the port of Reykjavik. Some operators offer an expedition route along the northeast coast of Greenland and to Svalbard or Spitsbergen.

In Greenland, more than 20000 passengers are travelling the coastal regions. There are approx. 90 cruises and 35 other types of trips per year.

The main **research and other governmental activity** in the Russian Arctic includes activity related to the development of the gas fields and discovering new oil fields, surveillance, the coast guard vessels, the navy activity of the Northern fleet, and polar research. The activity is increasing in the region, not the least from navy vessels. There is also new transport routes to the reopened military bases in the North.

In the Northern Norway, there is a significant increase in activities of vessels engaged in seismic shooting, not the least in the Northern part of the Barents Sea. There are a few tours of research vessels and vessels with supply and support functions. The Norwegian coast guard has a high presence with its 15 vessels both along the coast of mainland Norway and with its four large seagoing vessels in the Barents Sea and Spitsbergen region.

In the sea areas around Iceland research and monitoring activity remains stable with 70–90 research and monitoring vessels, 7 registered Icelandic vessels and 3 patrol vessels. The activity is connected to the marine and fisheries research mainly, and to the surveillance.

Research vessels, both Greenlandic and foreign, are active in Greenlandic waters. The fleet includes 2 larger research vessels and 10 smaller boats used for quick transport and observations in connection to research work. Eight government vessels and coast guard vessels take part in different activities, including research, patrolling and preparedness exercises. The table below gives a course-grained overview of the activity types in the region.

TABELL 18 AGGREGATED STATISTICS ON SEA AREA ACTIVITY

	Russian Northwest	**Northern Norway**	**Iceland**	**Greenland**
Coastal cargo and passenger fleet	313 registered vessels	6000 registered vessels	2300 registered vessels	18 registered vessels
Intercontinental Arctic routes frequency	Moderate (NSR: 50-70 transits)	Increasing transit due to increased oil and gas transport from Russia	Low (only transit)	Low (connections to Denmark and Iceland, but no internat. transit)
Fishing fleet	214 registered vessels	3500 registered vessels and boats	1700 registered vessels	530 registered vessels + 1500 boats
Petroleum activity	Low in offshore areas, but increasing transport of oil and gas	Low, but increasing due to opening of Goliat field production and exploration in the 23rd licence round	Limited exploration	Limited exploration
Maritime tourism	Low (routes to the North Pole)	High (both mainland and Svalbard area)	High	Moderate to high
Research and other governmental activity	Moderate, but increasing due to navy activity	Moderate (coast guard and polar research)	Moderate	Moderate

The table 18 demonstrates that in the Northern Russia the increase in activity is represented by the transport of oil and gas from the shore and close to shore terminals, together with the increased activity of the Northern fleet. In Norway, the transit traffic from Russia of tankers is thus increasing. The cruise activity is increasing with larger vessels visiting both mainland Norway and Spitsbergen. The tourist traffic also includes many leisure vessels. The fishing vessels, including trawlers in the Spitsbergen area, represent the largest year-round traffic. Along the Norwegian mainland coast, the large number of ferry and fast-going passenger vessel routes represent a large part of the activity. In addition, there is cargo transport to and from oil and gas fields both in the Norwegian Sea and the Barents Sea. In Iceland, there is also quite a

large number of coastal passenger vessels together with a large group of coastal fishing vessels representing a significant all year traffic. In Greenland, there is also a very larger number of very small hunting and fishing boats along the coast. The cruise traffic is increasing along with the number of medium sized cruise ships.

For the entire studied area, the general picture describes that a large group of coastal fishing and passenger vessels represent most of the year-round traffic. As for larger vessels, year-round traffic of Russian oil and gas tankers are increasing from Northwestern Russia terminals also passing through Norwegian and Icelandic waters. In the summer months, both the total number and the size of the tourist vessels visiting harbors in the whole region are increasing, especially in Northern Norway and Spitsbergen. In Norwegian Barents Sea, an increasing number of drilling rigs will be present after the 23rd license round, but this depends very much on the oil prices.

FUTURE ACTIVITY IN EACH SEA AREA – HIGH AND LOW SCENARIOS UP TO 2025

The total activity in the High North waters and coastal areas from Greenland's west coast up to the Northwest of Russia is generally increasing, but estimation of the future level is difficult. Future activity assessments indicate some variations, and there is uncertainty as to future traffic pattern. For each region, we have projected "high" and "low" scenarios. The future activity estimations up to 2025 are presented in Table 19.

In Russian Northwest, the estimated increase in **coastal traffic** regards both cargo and passenger transportation. In the high scenario the Arctic transport strategy aims that at least 100 mln. tons of cargo will be processed in Arctic ports and terminals by 2025. The low scenario estimates slower development due to the climate conditions, special procedures for ice-class certification or pilotage requirements.

Coastal traffic in Norwegian waters and around Svalbard is going to increase in both scenarios. The cruise activity is expected to increase into the harbor in Longyearbyen because of new harbor infrastructure. Destination traffic using the Northern Sea Route may represent a slow increase if the international economy recovers and the amount of ice decreases.

In Iceland, given the economic recovery, cargo traffic is likely to grow in the coming years. The number of vessels is consequently rising as exports and imports stabilize. Coastal passenger

traffic may increase in the high scenario also because of new ferry capacities. In Greenland, the future maritime passenger traffic depends a lot on governmental subsidies. More people are moving into the larger towns, especially Nuuk. The expectation for the future level of goods transportation in coastal waters is that it maintains the status quo. The high scenario estimates the same level of maritime traffic and the low one estimates a decrease.

Intercontinental traffic along the Russian northwest coast goes through the Northern Sea Route. By 2025, the ice-free season is expected to be the same, about 4-5 months. The open water window will expand in time and range and influence on the opportunities for moderately ice-strengthened ships and may increase in the shipping activity. The high scenario of cargo transportation development including transit on the Northern Sea Route exceeds 14 million tons per year. In the low scenario it may reach 4 million tons.

In Norway, the number of transits sailing in or through the Northeast Passage may indicate more transit traffic. The Central Arctic Ocean Route in international waters is sparking interest as a future trans-Arctic transport corridor but in a longer perspective than 2025. In the high scenario forecasts, the increase amounting almost 6 times more the number of transit voyages with container ships operating in the Arctic. The low scenario counts high costs and high risks of the Arctic shipping and does not estimate any significant increase unless new solutions for transport systems and vessels are found.

In Iceland, intercontinental transit routes shipping tankers traffic from Russia to North America is likely to stay at the present level. Predictions on the opening of new Arctic sea routes have also raised a discussion on Iceland serving as a transshipment port but they are unlikely to happen by 2025.

In Greenland, the traffic increase across the Arctic is forecasted because of the climate change. New shipping routes at the Northwest Passage and the Northeast Passage are expected to involve the Greenland’s ports to some extent in the high scenario of the changed ice conditions, or not to involve in the low scenario if the conditions are the same.

The fisheries in Russia may have several new fishing vessels in future. The volume of fish production is increased during by 2014 year in the Russian Northwest region. The industrial quota for catch of cod and haddock is not fully used, so the high scenario shows the potential to increase fishing, however, most likely, the fishing activity level may remain stable in both scenarios.

Fisheries in Norway will likely be expanded in the near future in the High North areas. The activity is moving northwards. Changes in fish stock migration patterns are expected into remote areas. The volume of production can be increased and sustainable management solutions can be introduced to the whole sea food industry.

In Iceland, the fisheries are not expected to expand in the near future. As for the Icelandic fleet, larger vessels with advanced technologies will replace the smaller vessels.

Fisheries in Greenland are expected to be stable or reduced due to low resources especially on shrimp. Both ocean and coastal fishing are stagnating. Export of fisheries and fisheries products account for over 80% of the total export value. By 2025 they will maintain their important role for the Greenlandic economy.

Exploration and production **oil and gas activity** in the Russian West Arctic is expected to increase significantly in the high scenario. The low scenario forecasts that the increase by 2025 will not be that significant because of the low speed of exploration and development.

Oil exploration in the Norwegian Arctic is moving further north in the Norwegian Sea and further east and west in the Barents Sea. Up to 2025 greater development and production activity in the south of the Barents Sea is expected because of the launch of the Goliat field in 2016 and the probability that the Johan Castberg field production will be initiated during this time period. The high and low scenarios for petroleum activity differs for vessels and installations that will be engaged in exploration activity. An increase is expected in the number of exploration drillings but the production activity will stabilize after the Goliat production start up.

In Iceland, the high scenario may give a boost if the country is successful in oil and gas explorations in the “energy triangle”, the space from North-East Greenland to Jan Mayen and from there south to Iceland. It could lead to the increased maritime activity north and northeast of Iceland by 2025. There can also be expected a slight increase in traffic engaged in exploration. The low scenario may not include increased activity, and even termination of the present exploration like the experience in Greenland.

Since the enormous potential for oil and gas resources was proven for the High North sea areas, Greenland is also experiencing the increased interest for Arctic exploitation of oil and gas. Optimistically it is estimated that there will be 1-2 offshore drilling projects every two years.

There is no expectation for any production during the period up to 2025. In the low scenario there is no drilling activity as the findings from the drilling in the last years were limited.

There is an increased interest for **maritime tourism** in Russia. By 2025 in the high scenario maritime tourism in Russian Northwest is growing. There are plans to open a route to the North Pole including a visit to Svalbard and along the NSR. There are also plans to collaborate with cruise companies to extend the route to the ports of Murmansk, Arkhangelsk and Solovetsky islands. In the low scenario the level of tourism activity in the Arctic will remain quite low.

In Norway, in the high scenario, the increase of tourism will be significant because the ice-free season is extending and cruise traffic can cover more passengers. Lower prices for sightseeing day-trips make them more and more popular. In the low scenario, heavy oil ban on ships, the Polar code demands and the financing of the infrastructure development on land can keep cruises at the same level. Expedition cruises and yachts will remain here at the same level or increase slightly.

In Iceland, in the high scenario with well-developed infrastructure for cruise vessels, the number of passengers will continue rising in the coming years. In the low scenario, the popularity rate may remain the same, so the commercial activity will be at the same level.

Even though the total number of passengers is decreasing in Greenland, the frequency of arrivals of smaller vessels is increasing. It is estimated that the numbers of expedition ships and cruise ships with 201-500 passengers are going to increase. There is a rising popularity of whale safari, fishing and sailing to the Greenland ice edge.

Research and other governmental activity in the Russian Arctic is likely to increase in both scenarios, because of international tension and the need for presence in the area.

By 2025 the research activity will increase in the Norwegian Arctic. As minimum, at the low scenario, the new icebreaker research vessel “Kronprins Haakon” will start to operate from 2016. In the high scenario, with the increase in fisheries, oil and gas and mineral extraction and other industries the research activity will also increase.

With the continuing interest in the Arctic, the high scenario forecasts a limited change in traffic of research and monitoring vessels in Iceland in the coming years. The low scenario considers quite a low number of such vessels, so the activity will not be significant.

A small increase in the future research vessel activity is estimated in both scenarios for Greenland. Along with the industrial developments happening in fisheries, petroleum activity and maritime tourism, other governmental activity is going to increase. There are discussions about possibilities for better surveillance in Greenlandic waters and presence of the Danish navy.

TABELL 19 ESTIMATED LEVEL OF FUTURE MARITIME ACTIVITY UP TO 2025

HIGH SCENARIO					LOW SCENARIO				
	RUSSIA	NORWAY	ICELAND	GREENLAND		RUSSIA	NORWAY	ICELAND	GREENLAND
Coastal transport	↑	↑	↑	≡	Coastal transport	↑	↑	≡	↓
Intercontinental routes	↑	↑	≡	↑	Intercontinental routes	↑	≡	≡	≡
Fisheries	≡	↑	≡	≡	Fisheries	≡	↑	≡	↓
Offshore oil and gas	↑	↑	↑	↑	Offshore oil and gas	≡	↑	↓	↓
Maritime tourism/ cruise	↑	↑	↑	↑	Maritime tourism/ cruise	≡	≡	≡	≡
Government activity	↑	↑	≡	↑	Government activity	↑	↑	↓	↑

CONCLUSIONS AND IMPLICATIONS FOR EMERGENCY PREPAREDNESS SYSTEM

More commercial activity in the High North sea areas further from mainland may lead to more severe natural conditions. The increase in marine traffic will be more significant in the coastal areas of Norway, around Svalbard, around Iceland and along the Russian coastal areas based on tourism in the summer months and transport of oil and gas from Russia. Intercontinental transits may have a small increase in Greenland, Russia and Norway in favorable economic and climate conditions by 2025.

Maritime activity imply various agencies and departments involved in the High North emergency response system. Harsh environmental conditions such as ice, icebergs and icing, reduced visibility and general lack of infrastructure in the Arctic make emergency efforts in the region complicated. In all investigated countries, the coastal preparedness is more developed than the emergency preparedness in the High North, possible marine accidents can be dramatic in terms of time of response and capabilities of institutions. This calls for stronger cross-border cooperation, especially in border zones offshore and far in the north.

Most search and rescue operations are linked to the fishing fleet, primarily in the coastal areas. This activity calls for ensuring both towing and emergency helicopter capacities. The challenges related to fisheries in the High North will increase if the fishing fleet operate in a larger geographical area and further north. The particular attention should be given to the Norwegian waters because of the very high activity in the area. This especially demands more search and rescue helicopters.

The Petroleum activity is highly intensive in Norway and Russia because of new exploration projects, oil and gas transportation, pipelines and offshore platforms. The biggest increase is expected for Norway and Russia by 2025.

With a growing transport related to the petroleum industry, it is necessary to reexamine the monitoring system of coastal sea traffic, and the partnership between the Russian and Norwegian governments and the oil companies' preparedness system. Complex and year-round petroleum activity require higher level of emergency preparedness. The oil and gas fields have additional requirements for helicopters, vessels and equipment, which can handle long distances, ice and icing. Regarding search and rescue, the primary question is the needs for mass rescue operations versus rescue in individual accidents and only a few people at one time. Also, what risks are present as to the systems for major accidents involving acute spills and pollution. With limited public capacity for preparedness there is a need for cooperation to ensure response and develop special collecting equipment. In ice waters, oil collecting equipment is poorly developed and has limited capacity. According to our assessments, the particular attention should be divided to activity on pipelines, petroleum installations and transport vessels.

Maritime tourism has a very high level at sea areas of Northern Norway, around Svalbard and around Iceland. The popularity of adventure tourism is growing; therefore, by 2025 the most

likely scenario is the increase of maritime tourism across all the investigated territories. Maritime tourism is not less damaging activity than other activities. The increase in cruise traffic in terms of the number of ships, the size of ships and the number of passenger brings preparedness system more challenges. Additional vessels and future plans to establish more routes including several countries represent potentially large emergency needs for all studied territories. This influences the need for a preparedness system to respond to a large number of people, especially rescue in case of accidents, and to handle accidents that can happen in other country than the port of departure. The requirements for vessels and their activity and management procedures are important. For the development of routes travelling to the North Pole, the particular attention of emergency system should be given to Svalbard and Russian Northwest.

Research activity tends to move further up to the high seas. It is stable and rather moderate across all investigated areas. It is inevitably connected to other industrial activities, building international cooperation, developing a search and rescue system. By 2025, it is most likely to be an increase in governmental activity. Norway and Russia will launch the new icebreakers for research in the Arctic waters.

The high seas area radio and satellite communications capacity can be very poor. Operations in remote areas require helicopter preparedness with intermediate landing possibilities and fuel depots; either in the form of other vessels, or placed on land. Helicopters, ships and personnel capacity is very important.

Implications for emergency preparedness system need to be discussed in more detail and steps. Further on in the project MARPART we will map possible risks and consequences of maritime accidents in different Arctic areas, analyze preparedness institutions, capabilities and their potential to cooperate, and will investigate operational structures and managing mechanisms needed for maritime emergency preparedness system in the High North.

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