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Adaptation Actions for a Changing Arctic: Perspectives from the Baffin Bay/Davis Strait Region

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*The Executive summary was written by the assessment leads and Knud Falk, and commented by the lead authors*
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9. Shipping

Lead authors: Tom Christensen, Frederic Lasserre, Jackie Dawson, Emmanuel Guy, Jean-François Pelletier

Key messages

- The Baffin Bay/Davis Strait (BBDS) region depends heavily on shipping. This sector is an important driver of economic activity.
- Shipping in the region is generally expected to benefit from climate change. This benefit will probably facilitate some growth in the industry.
- However, other drivers of change are probably more important than climate change. Other important drivers include issues of geopolitics (e.g., Suez and Panama canals, political issues outside the region), global and regional economies (e.g., effects on mining, oil exploration/exploitation, and other industries), national priorities (e.g., deep-water port projects along the Canadian coast), and insurance (i.e., winter shipping versus summer shipping).
- Increased shipping may bring some positive economic impacts to the region. However, local residents express concern for the social, cultural, and environmental effects related to expansion.
- Shipping-related environmental impacts on ecosystems and species in the region include oil (and chemical) spills; noise and disturbance, underwater and above; garbage (including organic); invasive species; and light (i.e., artificial illumination) disturbance (especially of seabirds).
- Some shipping regulations related to environmental impacts are currently in place, and new regulations related to the IMO Polar Code and the IMO Ballast Water Management Convention will be important additions. These regulations do not, however, include guidelines for accidental (oil) spills, use of heavy fuel oil, or noise disturbance.
- The BBDS region contains a number of areas of heightened ecological importance and significance. Though these areas are not necessarily ecologically vulnerable to environmental impacts from shipping (i.e., if there are no shipping-related activities or threats in the area), the foreseen changes in shipping may require long-term management and adaptation planning – that is, an adaptive ecosystem-based management (EBM) approach.
- Very limited information is currently available on how increased cruise traffic may affect culturally important sites. Large numbers of tourists wandering on fragile sites may lead to damage.
- Significant areas of the BBDS region are poorly charted or are not charted at all. Increased investment in charting, ice monitoring research, and multi-use infrastructure is needed.
- Safety is a serious concern for some ship types (i.e., passenger vessels and pleasure craft). Should an accident take place involving hundreds of passengers in harsh weather conditions, are safety devices on board and are search and rescue capacities adequate to quickly rescue them?
- In the future, the shipping sector will require increased support, management, and regulation in order to reduce safety issues and to manage cultural and environmental challenges.

Guiding Questions

What is the status of shipping in the Baffin Bay/Davis Strait region, and what are the major trends?

What are the impacts of climate change on shipping in the region, and what other drivers may influence the shipping industry?

What safety risks and environmental implications are connected with shipping in the region?

How will changes in marine infrastructure, including the amount and type or structure of shipping, interact with the environment and socio-economy in the region?

How may regulations for shipping activities enhance regional opportunities and development?

9.1. Introduction

A warmer Arctic climate is causing a reduction of ice cover. The projected losses of Arctic sea ice will influence future shipping activities and routes, as natural resource development, regional trade, tourism, research activities, and transportation of goods may change. Changes to Arctic shipping activities will have significant socio-economic and political implications. The Arctic Marine Shipping Assessment 2009 Report (PAME, 2009), approved at the Arctic Council’s 2009 ministerial meeting and often referred to as “the AMSA Report,” describes current and potential future Arctic marine activity and also provides a foundation for developing a further understanding of the implications of shipping in the Arctic.

The Baffin Bay/Davis Strait region has also experienced a reduction of sea ice (see Subchapter 3.1), which has increased the navigability of the region’s marine waters. How this change may influence the shipping sector is already being discussed.
among various stakeholders in the region. In 2014, for example, the Greenland government published a “dialogue report” about possible adaptation actions related to shipping in Greenland (Government of Greenland, 2014). In relation to the development of this AACA chapter, many stakeholders were consulted. These consultations contributed to the development of the chapter, and it is hoped that this report will contribute to continued discussions across the entire BBDS region. The chapter includes an overall description of marine use (related to shipping) in the region and also an overview of current factors relevant to future shipping.

Although there are many similarities across the BBDS region, there are also important differences with implications for shipping. The shipping season is longer around Greenland because the open water season is longer than in Canada, which experiences more extensive ice and thicker ice (Figure 2.6). Greenland also has substantial shipping infrastructure (e.g., port facilities, wharfs, docks, refueling centers), whereas Canada has extremely limited infrastructure (see further details in Chapters 2 and 10).

9.1.1 Status and trends in shipping activity

The BBDS region does not at this stage display as great an intensity of vessel traffic as the European seas or the more southern Canadian regions. The reasons are partly because relatively few people live in the region and partly because there are no regular international transit routes through the region. Still, in Greenland waters alone, approximately 50–70 larger ships are navigating in the area at given any time (Stuer-Lauridsen and Overgaard, 2012). The BBDS region is also characterized by extreme weather conditions, numerous icebergs, inaccurate or incomplete sea charts, and limited marine infrastructure overall. Thus, help can be far away. These factors are concerning, as shipping traffic in the region has increased in the past decade and is expected to continue to increase in the future due to climate change effects, including the expected reduction of sea ice (Stuer-Lauridsen and Overgaard, 2012; Government of Greenland, 2014; Pelletier and Guy, 2014; Pizzolato et al., 2014; DNV GL, 2015; Lasserre and Alexeeva, 2015).

The types of ships that typically operate in the region (and that are considered in this chapter) can be divided into seven categories: (1) transport ships (e.g., of passengers, general cargo, bulk cargo, containers), (2) ships related to the mineral industry (e.g., bulk carriers, oil tankers, offshore supply ships), (3) fishing vessels, (4) research vessels, (5) cruise ships, (6) government vessels, and (7) other vessels. Smaller boats such as small fishing boats and yaws are not considered in this chapter. Table 9.1 shows the typical vessel categories that operate in the Greenland part of the region, as well as the number of registered sailings for all of Greenland, 2004–2013 (Arctic Command, 2014). The table shows large year-to-year variation but also a general increase, from 390 registered sailings in 2004 to 507 in 2013. For cruise ships, the number of sailings increased from 84 to 130. The 2010 increase for “other ships” is mainly due to oil exploration during that year. Table 9.2 shows number of voyages by vessel category for the Canadian Arctic, 2005–2014 (no statistics are available for only the Nunavut portion of the BBDS region). In the Canadian Arctic, the total increased from 121 to 301. As shown in both tables, recent years have seen increasing traffic intensity in the region (Government of Greenland, 2014).

Four shipping modes, or types of voyages, undertaken in the BBDS region can be identified:

- **Intra-regional transport within a single country** (cabotage). Examples are fishing vessels that are authorized to do trade or marine transport in coastal waters between ports along the coast of either Canada or Greenland. A prime example is the Arctic Umiaq Line, which carries passengers along the west coast of Greenland (Stuer-Lauridsen and Overgaard, 2012). This type of voyage is specific to Greenland, as sea passenger traffic remains very limited in the Canadian Arctic. In general, ferries play a significant role in domestic travel in the Greenland area because there are no roads between towns and communities and, south of Sisimiut, there is year-round open water (Figure 2.6). In Nunavut, Group Desgagnés, a Canadian shipping company, services northern communities on a cabotage basis. Transportation related to mineral exploration or exploitation may also be included in this type of voyage. In Canada, Fednav is the predominant shipping company that services local mines.

- **Intra-regional transport or marine activity between Nunavut and West Greenland**. Examples include the Nunavut fishing boats that call at Greenland ports to offload their catch, due to the lack of infrastructure (wharves and fish treatment plants) in Nunavut communities (Boyer 2013; see also Chapter 10). It is also very common for cruise ships to begin voyages in western Greenland and then travel to eastern

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<td>Fishing vessels</td>
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<td>54</td>
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<td>Government vessels</td>
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<td>12</td>
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<td>Other ships</td>
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<td>36</td>
<td>23</td>
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<td>697</td>
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<td>507</td>
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* Each sailing (voyage) corresponds to one entry into the Greenland Exclusive Economic Zone.
Canada. Over 70% of such voyages currently operate intra-regionally in order to avoid a cabotage duty tax related to the Canadian Coasting Trade Act. The majority of cruise vessels are foreign flagged and would be subject to a duty tax if they operated within Canadian waters only (Dawson et al., 2014).

- **Destinational transport, in which a ship sails into or out of the BBDS region.** This mode includes the cargo and oil transporters and the large cruise ships that sail from southern ports to the west coast of Greenland in summer (Stuer-Lauridsen and Overgaard, 2012). The category also includes the vessels that handle the sealift of cargo from southern Canadian ports to Canadian Arctic communities, as well as the vessels that service mining operations (e.g., Voisey’s Bay in Nunatsiavut, for the Voisey’s Bay mine; Deception Bay in Nunavik, for the Raglan and Nunavik Nickel mines; and Milne Inlet in Nunavut for the Mary River mine (Têtu et al., 2015). In Greenland, destinational transport also includes the export of fish and shrimp (Government of Greenland, 2014). Goods transport to Greenland is carried out by general cargo ships, container ships, and product tankers.

- **Trans-regional (Arctic) transport or navigation, across the BBDS region.** This type of voyage can be through the Northwest Passage, between the Pacific and Atlantic oceans. Trans-regional voyages also include vessels that use the BBDS region as a marine link to or from other Arctic regions. This category could include pleasure craft vessels and adventure tourists (see Chapter 8).

As described by Pelletier and Guy (2014), port infrastructure is important in relation to intra-regional and destinational transport (see also Chapter 10).

### Table 9.2 Number of voyages (sailings) in the Canadian Arctic, by ship category, 2005–2014 (based on data from NORDREG; Lasserre and Alexeeva, 2015; Johnston et al., 2013).^a^

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<td>Government vessels (Navy, Coast Guard)</td>
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<td>257</td>
<td>317</td>
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</table>

^a^ Each voyage (sailing) corresponds to one NORDREG-zone entry and then exit.
Historically, it has been challenging to establish a complete understanding of ship volumes and densities across the Arctic due to data and monitoring challenges. Even the AMSA project (PAME, 2009), which produced the preeminent report on Arctic shipping, found it challenging to establish a time series of shipping change and instead had to rely on "snapshot" data for a single year (2004). However, recent years have seen the widespread adoption of automated identification system (AIS) technology, which now makes it possible to monitor ship traffic. AIS data have been available in Arctic regions only since 2009 but are now becoming increasingly available and increasingly relied upon by all vessel types in the region. AIS is required for vessels over 300 gross tons (GT) in international traffic, vessels over 500 GT engaged on domestic voyages, and all tankers and passenger ships regardless of size. As of 31 May 2014, there are new rules for AIS on fishing vessels. All fishing vessels bigger than 50 GT must have AIS on board in Greenland. Exempt from the requirement to be equipped with AIS are the special categories of warships, naval auxiliaries, state-owned or state-operated vessels, and small craft yachts. There are, however, far more ships carrying AIS than those that are required (Christensen et al., 2015).

Figure 9.1 shows the traffic pattern (number of ships per unit area) seen in the BBDS study area for the period 1990–2013. For information about fishing (trawl) vessels, see Subchapter 6.4; for information about passenger cruise ships, see Chapter 8.

In Greenland, Royal Arctic Harbour Service handles operations in the 13 largest ports/harbors, and it also has some port authority on behalf of the state in these ports/harbors (Government of Greenland, 2014). There is broad political consensus that Nuuk’s port is too small and has too little storage space, which creates bottlenecks for freight traffic throughout western Greenland. Therefore, funds have been allocated to renew the port and facilities in Nuuk, and this expansion has begun. The project was expected to be completed in 2016 (Transportkommissionen, 2011; Rambøll, 2013). Further, there are plans for developing harbors in Aasiat and Sisimiut to better facilitate industry operations (see also Chapter 10).

On the Nunavut side of the region, discussions about the need to build concrete wharves and port infrastructure have been ongoing for several decades, as there are only a few commercial ports in the Canadian Arctic: Churchill in Manitoba (the only port to service a community), closed since August 2016 (the owner, OmniTRAX, is looking for a buyer); Nanisivik on Baffin Island in Nunavut (no commercial operation presently; set to become a naval facility in 2018); Deception Bay in northern Quebec; and Milne Inlet, operational since 2015. The Mary River mine project is now serviced through the new port facility at Milne Inlet, on Baffin Island’s north shore (Chapter 7). There is also a small craft harbor in Pangnirtung and one approved for construction in Pond Inlet. All other communities are serviced.
by ships that anchor offshore and use barges to transfer cargo to the beach or a flat area of the shoreline (Turmel, 2013; see also details in Chapter 10). The lack of port infrastructure is an impediment to the development of the fishing industry and the cruise ship industry in Nunavut. The lack of infrastructure also slows down the delivery of consumer goods to communities, but the current shipping firms are concerned that the construction of wharves could attract competitors. Currently, the area can accommodate only expedition-style cruise ships that carry a maximum of approximately 200 passengers. Cruise tourists must be taken ashore by small inflatable boats, which is a time-consuming process. Improved infrastructure would enable larger vessels to operate on the Nunavut side of the region and could improve economic development opportunities for its communities (Dawson et al., 2014; see also Chapter 8).

9.1.2 Shipping as a part of other socio-economic sectors in the BBDS region

Regarding shipping and its links to socio-economic considerations (see Chapters 2–3, 5–8, and 10), including supply and demand, it is important to note that communities in the BBDS region are located near the coast and that roads between the inhabited areas are absent in most cases (Chapter 10). Therefore, shipping plays a key role in the region, serving as a lifeline and ensuring the delivery of supplies to almost all other socio-economic sectors, in "bigger" towns as well as settlements (Transportkommissionen, 2011). Conversely, the development of other sectors can also have a major influence on shipping.

In Greenland, examples of shipping and logistics companies are Royal Arctic Line, Arctic Base Supply, Martek, and Blue Water Shipping. Royal Arctic Line A/S, which is owned by the Government of Greenland, has the exclusive right (concession) to ship goods to and from Greenland and to ship internally between the towns in Greenland. This exclusivity does not extend to freight between the towns and other possible destinations in Greenland. Several conditions are associated with this arrangement, regarding the frequency, capacity, and security of supply for the towns (NIIRAS, 2014). Through Royal Arctic Bygdeservice, a subsidiary of Royal Arctic Line A/S, goods are carried to all the settlements. General cargo ships and container ships supply goods to the population, while product tankers supply gas and oil, which is used as fuel. Goods transport is driven by population size and consumption levels.

In Canada, the Canadian Coast Guard (CCG) took over responsibility for the resupply of Inuit communities in 1959. Basically, sealift resupply contracts were awarded by the CCG to shipping lines. Resupply services to the Nunavut side of the BBDS region have traditionally been carried out from the Montreal area by general cargo ships and tankers. In 2001, the Government of Nunavut took over the management of sealift contracts from the CCG. These contracts are awarded to shipping lines to deliver general cargo and petroleum/oil/lubricants to specific areas of Nunavut in accord with governmental supply requirements. Individuals and organizations can benefit from the rates negotiated by the government, but they can also contract with other lines.

In general, communities in the BBDS region are supplied all of their durables or consumer goods either by air (a very expensive transportation mode) or by sea when the shipping season is open. Extension of the navigable period thus presents coastal communities and natural resource companies with interesting economic opportunities, as the number of ship callings increase (Pelletier and Guy, 2014).

Natural resources development is linked either directly or indirectly to marine transportation, with ships traveling to and from worksites and across marine survey areas. As mentioned in Chapter 7, interest in the oil and gas potential of the region has experienced many ups and downs over the past fifty years. At times, price spikes have spurred exploration, while at other times, price declines and the lack of significant findings have slowed exploration. Political restrictions have been equally important in shaping activity. In relation to shipping, it should be mentioned that almost all industrial projects in Greenland and many projects in Nunavut can be serviced only through shipping (e.g., the Mary River iron mining project on Baffin Island). Other projected mining sites close to Bathurst Inlet in Nunavut are also considering using sea logistics rather than land roads (Lasserre, 2010; Tétu et al., 2015). There is presently no production of offshore oil or gas in Greenland, but in recent years there has been a significant amount of ship traffic related to exploratory work (Table 9.1; Chapter 7).

Fishing is the primary basis of the Greenland economy (see Chapter 2 and Subchapters 3.3 and 6.4). The fleet in the Greenland part of the BBDS region consists of about 800 vessels of various sizes, plus an estimated 5,000 smaller dinghies (Statistics Greenland, 2016). The ocean-going fleet includes a number of large vessels that fish outside the limit of 3 nautical miles (i.e., the limit of the territorial sea of Greenland). Most large vessels have the capacity to process the catch on board (DNV GL, 2015). In Table 9.1, only large fishing vessels (likely vessels above 20 GT) are included, which explains why only 44–169 fishing vessels per year were recorded.

As shown in Table 9.1, Greenland cruise ship tourism increased over the ten-year period 2004–2013, although a small decline and stagnation was seen after 2010 (likely related to the global economic downturn and business mergers in the region) (Dawson et al., 2014; see also Chapter 8). In the past, high hopes have been placed on the development of a cruise ship industry. So far, growth has been slower in the Canadian Arctic than in Greenland (Stewart et al., 2010; Lasserre and Tétu, 2015; Dawson et al., 2014). For example, tourists account for one-third of the customers on the Arctic Umiaq Line in Greenland (see above) during the three-month high season. Growth in the tourism shipping sector can be highly beneficial to the BBDS region, assuming the industry is well managed and supported. Among the benefits is the potential for economic development and greater employment opportunities in small, remote communities. Cruise ship tourism also facilitates the sharing of Indigenous cultures with international visitors, thus enabling educational experiences and enhancing understanding (Stewart et al., 2012, 2015; Dawson et al., 2016; see also Subchapter 3.3 and Chapters 5 and 8).
As noted in Chapter 5, there is a positive correlation between education and industrial development, and the level of education and skills of the regional work force may influence the development of the shipping industry in the BBDS region. The increased need for skilled mariners in relation to operations, preparation, and planning for voyages in ice-covered waters is recognized not only in the BBDS region but also on a circumpolar scale (PAME, 2009; Ministry of Foreign Affairs, 2011; DFO, 2012; Government of Greenland, 2014). Denmark’s 2011–2020 strategy for the Arctic (Ministry of Foreign Affairs, 2011) and a Government of Greenland discussion paper regarding shipping and climate change (Government of Greenland, 2014) both mention that key focus areas for Greenland are education, training, and the improvement of employee proficiencies (see also Chapter 5). In an analysis of commercial opportunities and challenges in the Arctic for the Danish realm’s maritime industries (NIRAS, 2014; conducted for the Danish Maritime Authority), it is concluded that an important step can be to integrate training in Arctic maritime conditions, including ice navigation, into the maritime schools. In this regard, it is recommended that attention be paid to new regulations and potential requirements for future shipping in the region, including challenges associated with the International Maritime Organization (IMO) Polar Code. There may also be a need within business schools and technical universities to enhance awareness of the Arctic market. More Arctic-specific training empowers and positions the workforce to engage with the companies that produce or operate in the Arctic. Such training also provides the maritime industry with a larger and more capable recruiting base to meet future demands.

9.2 Current and potential future drivers of shipping change in the BBDS region

In the Arctic Marine Shipping Assessment report (PAME, 2009), Arctic natural resource development (hydrocarbons, hard minerals, and fisheries) and regional trade are described as the key drivers of future marine activity. However, there are many other factors and uncertainties of importance for the BBDS region. These factors include issues of governance, geopolitics (e.g., the Suez and Panama canals, political issues outside the region), oil prices, changes in global trade, changes in regional trade, national priorities for critical infrastructure (e.g., port expansion in Nuuk and deep-water port projects in the Canadian Arctic), new natural resource discoveries, tourism demand, insurance for ships, and Arctic marine technologies. These drivers are considered later in the chapter, to help estimate likely future changes in BBDS activities. Table 9.3 shows different types of shipping activity and their possible main drivers.

Although changing sea ice extent (see Subchapter 3.1) is recognized as an important driver of future shipping, it is a relatively minor driver of change compared to industry and market constraints, as well as geopolitics – e.g., the deepening of the Panama Canal (2016) and the Suez Canal (deepening in 2009 and widening to allow for two-way traffic in 2016). Operational and market factors remain key. For shipping firms deciding whether to invest in a specific market, just-in-time
constraints\(^8\) will always prevail in the liner service (container, reefer, general cargo), while freight rates remain a paramount consideration in the bulk segment (Lasserre and Pelletier, 2011; Beveridge et al., 2015, 2016). Cost structures also represent a major deterrent for would-be Arctic shipping companies, including insurance costs and Arctic-specific crew training and equipment adaptations demanded by the insurance industry (Sarrabezoles et al., 2014; Beveridge et al., 2015). Empirical evidence identifying climate change as a relatively minor driver of Arctic ship traffic in Canada was established by Pizzolato et al. (2014), who found only a weak correlation between sea ice and overall ship traffic. The strength of the correlation has been increasing over time, though, and has been strongest in more recent years, suggesting that climate change certainly plays some role in driving ship traffic – albeit to a much lesser extent than geopolitical and economic factors.

It is also important to note that demand within the region can evolve differently for different sectors (e.g., fishing, cruise, bulk exportation, community resupply, transit), as can the associated human and environmental challenges and possibilities. For example, the moderate increase already seen in BBDS shipping activity/traffic to date is provided as an average across all sectors – but at any time, conditions can change very rapidly to affect a particular sector, community, or maritime region quite dramatically. Ship traffic linked to the extraction of resources will see boom and bust trends according to the life cycles of specific projects. If the number of individual projects in the BBDS and adjacent regions remains low, then the opening or closing of a single site can dramatically transform traffic statistics from year to year (see Chapter 7 for details on the development potential for extractive industries in the BBDS region).

Altogether, it must be emphasized that because the drivers of shipping are diverse (see Table 9.3), there can be a sharp increase in one segment simultaneous with a decline in another.

9.3 Environmental issues related to shipping

Increased shipping activity, if not regulated properly, can potentially have serious consequences for the Arctic environment and for the Indigenous peoples who live in the region and rely on the environment for subsistence and livelihoods. The possibility of an oil spill is a major concern for the fishing and hunting sector, including local Inuit who are especially concerned about the disruption of culturally important marine species. Impacts from shipping are potentially more hazardous in the Arctic than at lower latitudes due to the special adaptations of Arctic species and due to the low temperatures and the presence of ice. These physical factors hamper the degradation and removal of pollutants and slow the recovery of impacted habitats. Shipping-related impacts include the accidental or regular discharge of oil, noise in the

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\(^8\) “Just in time” is a logistics management technique by which inventories are kept minimal – thus, finished goods and intermediate parts in a production process must be delivered exactly when the last one is used. This logistical technique reduces inventory costs but forces transportation and manufacturing companies to set up extremely efficient logistical chains lest the production process be disrupted. The container industry works on this basis, selling not only the transportation of manufactured goods but also the pledge to deliver them on precise schedules.

<table>
<thead>
<tr>
<th>Types of shipping activity</th>
<th>Possible main drivers</th>
</tr>
</thead>
</table>
| Dry bulk shipping – destination transport | • Ore prices, global demand  
• Life cycles of Arctic mines |
| Oil activities | • Oil prices, global demand, technical development, environmental regulation  
• Mining and oil/gas projects: peak activity during the construction phases  
• Life cycle of Arctic extraction sites |
| Regional supply deliveries – general cargo and petroleum products | • Local demographics and economic development |
| Transit traffic (all types) | • Cost of implementing Polar Code requirements  
• Insurance markets  
• Icebreaking/escort policies and fees  
• Ice cover trends  
• Panama Canal pricing policy and congestion  
• Shipping markets and the daily time charter equivalent (when shipping markets are hot, the value of time is higher) |
| Fishing | • Stock evaluations  
• Commercialization of new species  
• Knowledge transfer and fishing rights  
• Port infrastructure |
| Cruise (tourism) | • Tourism markets and demand  
• Availability of ice-strengthened vessels and other vessels |
underwater environment, emissions to air, discharge of garbage, introduction of invasive species, artificial-light disturbance, and whale strikes. These impacts can potentially act together with impacts from other activities in the area (e.g., fishing, hunting, mineral exploration, and tourism) as cumulative impacts. A large oil spill is probably the most serious hazard to the Arctic environment (Skjoldal et al., 2009).

The consequences of ship emissions to the air – e.g. carbon dioxide (CO₂), methane (CH₄), chlorofluorocarbons (CFCs), aerosols, nitrogen oxides (NOₓ), sulfur oxides (SOₓ), and carbon monoxide (CO) – are mostly indirect in relation to environmental consequences in the region. However, the emission of black carbon (the primary component of soot) is of particular concern in the Arctic because it accelerates melting when deposited on snow or ice (NIRAS, 2014).

Ship discharges to water include oil, oily water (bilge water, drain water), garbage, gray water, and cargo (liquid or dry). Discharges can have a wide range of impacts on the marine environment, including toxic impacts. Garbage and other debris can cause damage to marine habitats, entanglement of wildlife, and animal ingestion of unsuitable items (Skjoldal et al., 2009). The bioaccumulation of contaminants also has serious health implications for northerners who rely on country food (see Subchapter 3.2 and Chapter 4).

Accidental release of oil is the most serious shipping-related threat to marine ecosystems in the BBDS region (Chapters 6 and 7). Consequences would depend on the amount of oil spilled and on how long the spill endures. Spilled oil has both immediate effects – for example, on birds and marine resources – and long-term effects if the oil persists in the environment (Christensen et al., 2012; see also Subchapters 6.4–6.5).

Ship traffic and associated activities may create numerous disturbances in the marine environment, ranging from direct injury, death, or displacement from key habitats to more subtle behavioral changes (Skjoldal et al., 2009). Shipping-related activities can affect a wide range of marine species, including marine mammals, fish, and seabirds. The underwater acoustic environment is inherently complex and sometimes relatively noisy due to a myriad of natural and anthropogenic sound sources. Impacts from noise will vary by sound source (e.g., vessel operation, icebreaker operations, seismic activities, hydroacoustic devices) and location, as well as by species (i.e., different species hear and use sound differently). Very few of these acoustic effects are expected to include direct physical injuries to hearing or other systems; rather, there is more concern regarding behavioral disturbance and displacement from key habitats, as well as interference masking of acoustic communication (see further in Section 6.5.2).

Compared to other vessels, icebreakers produce louder and more variable sounds, due to the episodic nature of their normal function (i.e., ram forward into the ice and then move in reverse to begin the process again). Still, the act of physically breaking the ice does not produce the majority of icebreaker noise underwater; instead, as with other vessels, propeller cavitation is the main source of noise.
Seabirds are especially vulnerable to certain types of disturbance, mainly because they concentrate in large numbers in colonies or in flocks, so that a single disturbance can affect thousands of birds. The breeding period is a very sensitive period, as is the molting period, when some species are flightless. In this regard, it should be mentioned that most of the important seabird areas are in relatively shallow water or are close to the coast.

Vessel collisions, resulting in death or serious injury, are a threat to marine mammals worldwide. These encounters, also referred to as ship strikes, occur primarily with large whale species. In the BBDS region, slow-moving species such as bowhead whales and right whales are vulnerable to ship strikes.

Many birds are attracted to lights during the dark hours and especially during low-visibility conditions (snow or fog). Birds migrating during the night are therefore at risk of colliding with structures that are within or near illuminated areas. Searchlights on ships have caused bird deaths during migration seasons and in winter (Merkel and Jøhansen, 2011). There are specific areas in the BBDS region where large numbers of birds winter – including eiders, which are sensitive to light attraction.

Cruise ships constitute a special case of shipping because they actively seek out areas of special interest, including superior wildlife-viewing opportunities – often in areas that are poorly charted, off the main navigational corridors. This situation creates risks to vessels and also creates the potential for cruise ships to have greater impacts on high concentrations of wildlife, not only from the ship transit itself but also other activities related to the tourism package – e.g., close approaches to haul-outs and colonies, small-craft landings of tourists on colony sites, and longer times spent near concentrations of animals (Dawson et al., 2014, 2016; see also Chapter 8). The industry itself tends to be highly aware of its impact and thus reduces impacts when possible. The cruise ship industry has a vested interest in maintaining healthy wildlife populations, in support of their tourism packages (Christensen et al., 2012; see also Chapter 12).

The introduction and spread of alien invasive species is a potentially serious problem with ecological, economic, health, and environmental impacts, including the loss of native biological diversity. The shipping-related threat from invasive species stems from four sources: unmanaged ballast water discharge, hull fouling, invasive species discharge involved with cargo operations and casualties, and shipwrecks. The most important threat appears to be related to ballast water (CAFF, 2013). Only a few studies have examined invasive species in the Arctic, but if no focused preventative management is initiated, then the risk of introduction and establishment of such species in the Arctic is expected to increase (Ware et al., 2013).

9.4 Governance of shipping in the region

The governance of shipping activities in the BBDS region might be described as a complicated mosaic, and this chapter does not provide a full overview of applicable international laws. However, the chapter does outline some of the most relevant issues for the BBDS region and also considers weaknesses in the existing framework, as seen from a regional perspective.

9.4.1 Maritime jurisdictional zones in the BBDS region

The coastal state maritime jurisdictional zone claims for the territorial sea are not the same for Greenland and Canada. In Greenland, the limit is 3 nautical miles (nm); in Canada, 12 nm. For both countries, the extent of the exclusive economic zone (EEZ) is 200 nm (PAME, 2009). Figure 9.2 illustrates marine jurisdictional zones.

In Canada, all ocean areas that are not prescribed to be inland waters are under federal jurisdiction.

In Greenland, the situation is more complex. Greenland is a self-governing unit within the Danish realm, and the Danish Constitution applies to Greenland. Greenland began its state-building process with the introduction of “Home Rule” in 1979, following adoption of the Act on Greenland Self-Government No. 473 of 21 June 2009 (the “Self-Government Act”). As a self-governing unit, Greenland has claimed a territorial sea that extends 3 nm from the territorial sea baseline and, as a part of the Danish realm, an EEZ that extends 200 nm from the...
baseline. In Greenland territorial waters, specific requirements are in effect regarding ice-strengthening, local knowledge, and certain specific routes, but those rules do not apply across the Greenland EEZ (Stuer-Lauridsen and Overgaard, 2012). In relation to the marine environment, jurisdictional responsibility is also shared between Greenland and Denmark. Greenland Self-Government authorities are responsible for ocean areas within 3 nm of the territorial sea baseline. Beyond the 3 nm limit, responsibility for the marine environment rests with Danish authorities, with the important exception that all activities related to raw materials extraction in Greenland are regulated by Greenland Self-Government, including the export of crude oil but not the shipping of mineral ore. The area beyond 3 nautical miles is in general regulated by the Royal Order for the enforcement of the Environmental Protection Act for Greenland of 2004 (Government of Greenland, 2014).

9.4.2 Polar Code and IMO Ballast Water Management Convention

An important upcoming regulation for the region will be the United Nations’ International Maritime Organization Polar Code (IMO, 2015) and the related amendments to make it mandatory under both the International Convention for the Safety of Life at Sea (SOLAS; IMO, 1974) and the International Convention for the Prevention of Pollution from Ships (MARPOL; IMO, 1973). The purpose of the code is to impose stricter requirements on ice classification and safety on board for sailing in Arctic waters. It also includes operational requirements for the maritime education system and the training of crews, as well as navigation in ice-covered waters. In relation to safety aspects, the Polar Code will be mandatory for all commercial carriers and passenger ships of 500 tons or more. In relation to environmental aspects, the Polar Code will in principle apply to all vessels (IMO, 2015). The code, which will contribute to the international maritime safety and environmental conventions that already apply to the Arctic, will come into force in 2017. Though the Polar Code will be a key framework agreement, it is not comprehensive and will not directly address such issues (and impacts) as black carbon from ship emissions, heavy fuel oil use in the Arctic, or ballast water discharge (Christensen et al., 2015). However, in relation to ballast water, the IMO Ballast Water Management Convention (IMO, 2004) will minimize the transfer of alien species. Denmark ratified the convention in 2012, with an exemption for Greenland (Christensen et al., 2015). Canada ratified it in 2010.

9.4.3 Safety and environmental risks

Improved safety (for navigation) and search and rescue is seen as a challenge in relation to shipping in the region (see also Chapter 8). The IMO Polar Code (IMO, 2015) will be a step in the right direction, but some areas of the region remain hazardous for navigation, and increased investment in hydrographic surveys and nautical charting, as well as ice monitoring research, is needed. This need is mentioned as a future priority for the Greenland part of the BBDS region in Denmark’s strategy for the Arctic (Ministry of Foreign Affairs, 2011, among others). The focus on this area is also seen through the work of the Danish Ministry of Defence, which has an increased emphasis on improved safety and search and rescue (SAR) through analysis of its future Arctic tasks and capabilities (Danish Ministry of Defence, 2016). The need to invest in Arctic hydrography in Canada was identified in a 2014 report by Transport Canada’s Tanker Safety Expert Panel (Transport Canada, 2014).

Another step in the right direction is the increased focus on search and rescue from the Arctic Council and its members. In 2016, the Arctic Council’s Emergency Prevention, Preparedness and Response Working Group (EPPR) adopted SAR in its strategic plan (EPPR, 2016). The strategic plan states that “EPPR facilitates implementation of the SAR agreement by focusing on enhancing cooperation, highlighting best practices, exchanging information, analyzing results of exercises, and sharing lessons learned. EPPR will maintain a repository for lessons learned in Arctic SAR exercises and incidents.” (EPPR, 2016, p. 4). The EPPR work on search and rescue will be under continuous development (EPPR, 2016).

Safety, especially for cruise shipping, is a serious issue. Existing regulations offer loopholes that allow large cruise vessels with low ice-class notations to enter national waters. In addition, cruise vessels sometimes transit the region without making stopovers – thus, without submitting to port state regulations. There is also a BBDS trend of increasing numbers of larger ships, which would require special search and rescue capabilities in the event of an accident. Commercial ships in the Arctic follow the better-mapped navigation channels (in Arctic Canada, 35% of the marine corridors are well surveyed), but some cruise ships tend to travel off the commonly used transportation corridors in search of wildlife and other viewing opportunities. In general, areas outside the most-used navigation channels are poorly mapped.

Pleasure crafts present some of the highest risks in the region, as these vessels are not ice strengthened, they are exempt from any reporting or other regulatory requirements (e.g., carrying AIS transponders) because of their small size, and their operators typically do not have experience navigating in ice-infested waters. These ships also present security risks because they travel under the radar of most authorities and can more easily enter national waters unnoticed.

Oil tankers may represent a significant risk in the form of a major oil spill. For now, there is no traffic linked to oil exploitation in the Arctic areas of Canada and Greenland because no major discovery has been declared and oil prices have collapsed, thus postponing most exploration plans (Chapter 7). In the past (1985–1996), oil from Cameron Island in Nunavut was shipped by the ice-class oil tanker MV Arctic (Fednav). The oil tankers that do ply these waters are servicing local communities, and they represent about 10% of the total traffic (about 25% of commercial cargo ships or barges in the Canadian Arctic and a smaller fraction in Greenland’s waters). Because these tankers service local communities, they must comply with port state regulations. On the Nunavut side of the region, Transport Canada regularly inspects cargo ships that fall under its supervision and that ply Canadian Arctic waters (Transport Canada, 2014). Should oil exploitation eventually develop in BBDS waters, specific care from regulatory authorities will be advised (see Chapter 7).
Box 9.1 Areas with a need for heightened awareness in relation to impacts from shipping (based on Christensen et al., 2012, 2015; AMAP/CAFF/SDWG, 2013)

Environmental impacts from shipping include noise in the underwater and above-water environments, disturbances to marine mammals and seabirds, introduction of invasive species, and accidental or illegal discharges of oil, chemicals, and waste. In this context, a large oil spill is regarded as the most serious threat to the Arctic marine environment. Based on IMO guidelines for the designation of particularly sensitive sea areas (PSSAs), the Arctic Council has identified a number of areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine uses.

The Ministry of Environment and Food of Denmark in collaboration with the Greenland Home Rule government asked Aarhus University and the Greenland Institute of Natural Resources to identify and prioritize marine areas around Greenland that are ecologically valuable and vulnerable, based on 11 criteria for designating PSSAs in line with the IMO guidelines. Seven such areas were identified within the BBDS region (Figure 9.3). (Note that Nunavut was not included in this exercise – for that area of the BBDS region, see the ecologically or biologically significant marine areas, EBSAs, listed in Subchapter 6.2.)

Based on the results of this exercise, the ministry further requested Aarhus University to clarify management initiatives and needs in the Disko Bay and Store Hellefskebanke area (area V5) with regard to potential environmental consequences from shipping. For this step, 41 map layers of the spatial distributions of important marine species and ecosystem components were combined to show the most biologically important areas, according to a set of criteria incorporating those used by the Convention on Biological Diversity to identify EBSAs and by the IMO to identify PSSAs. Each biological layer was further assessed and ranked according to its specific sensitivity to potential environmental effects caused by shipping. It was thus demonstrated that a number of smaller areas around Disko Bay and Store Hellefskebanke are sensitive or very sensitive to the environmental impacts that shipping may cause. Five subareas were identified as possibly needing heightened awareness in relation to impacts from shipping (Figure 9.4).
Given that destinational traffic is expected to grow more rapidly than transit traffic (see Subchapter 9.5 below), attention to how the safety of shipping has been improved in the south can be relevant. The definition of proper standards can be a first step, but enforcing the standards is equally important and can be challenging. Port state control programs, which verify the application of standards set by IMO conventions, are being implemented worldwide as an essential component of a shipping safety net. This implementation will, however, probably take several years to complete, and in the BBDS, it will potentially also be a very large and expensive task. Thus, implementation of the Polar Code and its requirements will require substantial manpower and logistical management to send inspectors to board vessels as needed.

According to Denmark’s Arctic strategy, “the Arctic and its current potential must be developed to promote sustainable growth and social sustainability. This development must take place firstly to the benefit of the inhabitants of the Arctic and go hand in hand in safeguarding the Arctic’s environment” (Ministry of Foreign Affairs, 2011, p. 7). Based on this principle, the Danish Defence Agreement 2013–2017 stipulated that a risk assessment be prepared for the marine environment in and around Greenland, including the BBDS region (DNV GL, 2015). The scope of work for the analyses was to quantify and assess the effectiveness of oil spill response measures and to recommend potential future solutions for oil spill contingencies, as well as risk-reduction measures (DNV GL, 2015).

In recent years, the Danish Ministry of Environment and the Greenland Self-Government have jointly initiated work on management initiatives regarding the potential environmental consequences of shipping (Christensen et al., 2012, 2015). As noted above (Subchapter 9.3), environmental impacts caused by shipping can potentially act together with impacts from other activities in the region (e.g., fishing, hunting, mineral exploration, and tourism) to contribute to cumulative impacts. Therefore, ecosystem-based management for particularly sensitive sea areas can be applied in the future management of shipping in the region (see also Box 9.1). Fisheries and Oceans Canada has delineated a number of environmentally or biologically significant marine areas (EBSAs) across the Canadian Arctic (see also Chapters 2 and 6).

### 9.5 Ship traffic, expected future change, and impacts

Shipping will probably continue to be important for the economy of the BBDS region, and in that sense, the demand, supply, and need for marine transportation is a very important driver to consider. However, as previously mentioned, these parameters can evolve very differently by segment (e.g., fishing, cruise tourism, mineral exploration/exploitation and bulk exportation, community resupply, transit). This section provides estimates for future changes by shipping segment and, based on these estimates in combination with the scenarios shown in Table 9.4, also suggests relevant adaptation options (Table 9.5).

The *fishing industry* includes fishing vessels and reefers (refrigerated ships) that carry the catch. The fishing industry is regulated mainly by quotas and license regulations to ensure sustainable use of the natural resources; a number of factors can influence these regulatory mechanisms, including national and international fisheries policies as well as possible changes in ecosystems (see Subchapters 3.3 and 6.4). Fishing vessel activity is also influenced by the size, technology, and efficiency of the vessels themselves. On the Greenland side of

<table>
<thead>
<tr>
<th>Table 9.4 Future shipping (intensity, patterns, and impacts) in the BBDS region, in relation to scenarios1 for climate change (moderate to dramatic) and the development of resource-extractive industries (moderate to intensive).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario 1: Dramatic climate change and modest development of extractive industries</strong></td>
</tr>
<tr>
<td>Longer cruise tourism season and increasing demand for cruising and yachting</td>
</tr>
<tr>
<td>Little growth in cargo vessel movement (which is driven mainly by regional economics and demographics)</td>
</tr>
<tr>
<td>Increased safety risks associated with tourism vessels</td>
</tr>
<tr>
<td>Increased interest and feasibility in transit shipping through the Northwest Passage; hazards in the passage will remain high</td>
</tr>
<tr>
<td><strong>Scenario 2: Dramatic climate change and intensive development of extractive industries</strong></td>
</tr>
<tr>
<td>Longer cruise tourism season and increasing demand for cruising and yachting</td>
</tr>
<tr>
<td>Significant increases in winter shipping activities, with increased environmental risk</td>
</tr>
<tr>
<td>Important growth in cargo vessel movement in the region</td>
</tr>
<tr>
<td>Increased user conflicts between resource vessels and tourism vessels</td>
</tr>
<tr>
<td>Greater shipping safety, facilitated by extractive industry shipping and associated contingency systems</td>
</tr>
<tr>
<td>Increased interest and feasibility in transit shipping through the Northwest Passage; hazards in the passage will remain high</td>
</tr>
<tr>
<td>Climate change is more likely to lengthen the shipping season than to change the routing of traffic</td>
</tr>
<tr>
<td><strong>Scenario 3: Moderate climate change and modest development of extractive industries</strong></td>
</tr>
<tr>
<td>Important growth in cargo vessel movement in the region</td>
</tr>
<tr>
<td>Climate change is more likely to lengthen the shipping season than to change the routing of traffic</td>
</tr>
<tr>
<td><strong>Scenario 4: Moderate climate change and intensive development of extractive industries</strong></td>
</tr>
<tr>
<td>Important growth in cargo vessel movement (which is driven mainly by regional economics and demographics)</td>
</tr>
</tbody>
</table>

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1 For more information about these framework scenarios, see Subchapter 3.4.
the BBDS, it is very likely (as mentioned in Subchapter 6.4) that some commercially important fish stocks will increase in the future – including cod and mackerel, in particular. For other species (e.g., shrimp), declines are very likely. In Canada, fisheries seem to be on the rise, with trawlers from Nunavut and Newfoundland increasingly plying BBDS waters on the Nunavut side. As described above, however, many factors influence the development of a fishing fleet. Some factors may result in an increase in shipping (as expressed in terms of sailed distances, numbers of ships, or ship sizes), and some may result in a decrease. Fishing fleets are constantly changing, with a general trend toward fewer, larger, and more efficient vessels. The shift toward larger vessels may result in fewer vessels performing the same amount of work as previously performed by a larger fleet of smaller vessels, as well as a decrease in the total distance sailed. On the other hand, an increase in available fish stock could lead to increased shipping activity.

In relation to cruise ships, the increasing trends shown in Tables 9.1 and 9.2, coupled with the global growth of cruise activity in remote places, suggests a likely increase in the number of cruise passengers coming to the BBDS region in coming years. Pleasure craft activity, in particular, is expected to increase. It is also expected that the size of cruise ships will increase, which would translate into substantial increases in numbers of visitors, with only moderate increases in the number of voyages (see also Chapter 8). However, a significant shift toward larger ships is not expected before 2030, due to fluctuations in the cruise market (including numbers of passengers) and deficits in major ports and infrastructure in Nunavut (Chapter 10). This anticipated size trend is assumed

Table 9.5 Possible climate change adaptation options related to shipping.

<table>
<thead>
<tr>
<th>Governance, Policy, and Regulation (see also Environmental Sustainability options and Safety options below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Explore the possibility of making AIS mandatory for all vessels regardless of size</td>
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<tr>
<td>• Improve the monitoring of shipping intensity, type, and patterns; enforcement capabilities; and other parameters</td>
</tr>
<tr>
<td>• Improve ship reporting capacity</td>
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<tr>
<td>• In the short term, supervise and actively encourage the implementation of Polar Code requirements</td>
</tr>
<tr>
<td>• Assess the need for eventual implementation of a pilotage system (as in southern Canadian waters)</td>
</tr>
<tr>
<td>• Consider transnational collaboration in the Northern Marine Transportation Corridors initiative</td>
</tr>
<tr>
<td>• Incorporate climate change scenarios into policies regarding the annual positioning of icebreakers and other search and rescue assets</td>
</tr>
<tr>
<td>Infrastructure (see also the Safety options below)</td>
</tr>
<tr>
<td>• Improve port facilities and other marine infrastructure – especially on the Nunavut side of the region</td>
</tr>
<tr>
<td>• Enhance the communications infrastructure in the region</td>
</tr>
<tr>
<td>• Consider investing in the renewal and development of the Canadian Coast Guard fleet</td>
</tr>
<tr>
<td>• Hasten the revision of existing nautical charts and the production of new ones, making the best use of available data acquisition technologies</td>
</tr>
<tr>
<td>• Deep-water ports are more challenging to establish in some parts of the BBDS region than in others. When required for extractive activities, these ports will be tailored built by private investors for each specific site. For the resupplying of communities, the current system can be foreseen working until at least 2030 in Greenland. Investments in Nunavut should continue to be a priority in order to increase the (re)supply capacity (i.e., operating period and regularity/quality of services) and to improve safety;</td>
</tr>
<tr>
<td>• Develop infrastructure in support of emergency response capacity to save lives and combat oil spills</td>
</tr>
<tr>
<td>Economic Development and Planning</td>
</tr>
<tr>
<td>• Invest in multi-use infrastructure that benefits both the shipping industry and local communities</td>
</tr>
<tr>
<td>• Enhance education and skills training for shipping in a changing Arctic</td>
</tr>
</tbody>
</table>

Environmental Sustainability

- Improve the monitoring of sensitive ecosystems in relation to impacts from shipping
- In the short term, supervise and actively encourage the implementation of Polar Code and Ballast Water Management Convention requirements
- Continue work related to the identification of ecologically sensitive areas, and consider implementing ecosystem-based management in such areas (in coordination with other socio-economic sectors)
- In the longer term, consider whether the regulatory framework of PSSA designations, especially in relation to "route and reporting measures," may be a relevant instrument to examine
- In the short term, consider the establishment of codes of conduct for wildlife viewing and of site guidelines for sensitive ecological sites for the cruise tourism industry; create site guidelines for sensitive ecological and cultural sites that are highly visited by tourism vessels (i.e., similar to those of Antarctica and Svalbard)
- Consider environmental impacts and threats from heavy fuel oil in the region, as well as potential regulation related to its use (as seen in Svalbard)
- Establish oil response strategies (e.g., source control, response in open water, in situ burning, dispersion), including ways to shorten response times; consider requirements for on board response equipment on certain ships

Safety

- Improve capabilities for monitoring vessel traffic (AIS, satellite, other assets)
- Prioritize funding to improve bathymetric charting (consider a crowdsourcing approach)
- Engage in focused research to understand sea ice reductions, iceberg transport, and other hazards
to be a very long-term change (DNV GL, 2015). There is also a trend toward a longer cruise ship season, meaning the season can start earlier and end later (Dawson et al., 2014; Pizzolato et al., 2014). For the next few decades, it can be assumed that cruise ships will be traveling routes similar to today's routes (see also Chapter 8).

Because the local population in Greenland is not expected to increase in the near-term future, population will not drive an increase in Greenland's passenger ship traffic. However, because tourists are also using the passenger ships along the Greenland coast, it is reasonable to expect a small increase in passenger ship traffic, especially during the summer, due to the expected increase in tourism.

A lengthening of the navigation season will, in general, entail a regular increase of container/cargo shipping for the servicing of northern communities in the region (e.g., delivering fuel, consumer goods, and durables). However, the two biggest factors governing the future activities of container ships and general cargo ships to and within the region are demographic changes and economic growth. For Greenland, potential changes in block grants from Denmark may also be important (DNV GL, 2015). In Canada, ship owners currently serving the community markets have made significant investments in the renewal of their Arctic-dedicated vessels for the future. Their expertise in autonomous loading onto beaches from anchorage points (i.e., using carry-on barges and tugs without the support of port equipment) effectively constitutes a barrier to entry for potential market competitors. Based on ship owners' current demands to policy-makers – i.e., more mapping and better visual aids, but no docking infrastructures – the owners are expected to defend this barrier (Turmel, 2013).

As described in Chapter 7, new projects related to mineral exploration and exploitation (including oil and gas) could emerge in the region within the next few years. There is some uncertainty, but the cyclical nature of ore prices is likely to bring mining sites in the region into production, especially those that benefit from a high-quality ore (e.g., Mary River iron ore). The development of mineral projects will generate destinational traffic, first during the site development phase and then during the exploitation phase. This sector can be expected to be the most significant in terms of bringing important and rapid transformations to shipping in the region (Table 9.4). The main drivers of this sector will continue to be linked to the cyclical markets for resources (unrelated to climate or regional factors). The recent evolution of the Mary River mining site perhaps exemplifies potential future trends. After a few years of test shipments, the mine entered into production in 2015. By then, the initial plan to ship up to 18 million tons annually through Steensby Inlet (south Baffin Island) had already been shelved due to dropping demand for iron ore (see also Chapters 7 and 10). The revised plan was to start operations with summer-only shipments from the north coast of Baffin Island, with a yearly target of 3.5 million tons. Because the plugging trend has continued worldwide, though, the first year saw approximately 1 million tons shipped. This lower level of activity still entailed about 20 distinct shipments (Maritime Magazine, 2015), which represents a significant increase in shipping activity through the region.

Future transit ship traffic in the region seems only a remote possibility because of navigational constraints. According to the projections of Smith and Stephenson (2013), a trans-Arctic route across the North Pole will be navigable by mid-century for moderately ice-strengthened vessels (Figure 9.5); the Northwest Passage, and thus passage to the BBDS, will be navigable by...
2050 for vessels without ice strengthening (53% probability). Other models project that at the end of this century, there will be free passage through the Northwest Passage for 2–4 months of the year (Khon et al., 2010). Projected cost analyses by a number of authors have shown that potential Arctic transit traffic can be highly attractive under various conditions along different Arctic routes (Laulajainen, 2009; Schøyen and Bråthen, 2011). Somanathan et al. (2009), however, emphasize that the profitability of the transit routes may be limited, depending on the locations of the origin and destination ports.

Several other simulations have led to more nuanced conclusions, emphasizing the high costs, difficult operational conditions, and high marketing constraints associated with Arctic transits (Verny and Grigentin, 2009; DNV, 2010; Carmel, 2012; Lasserre, 2014). However, as Xu et al. (2011) and others have noted, there exist numerous operational and environmental issues that prevent a final appraisal of Arctic routes as shortcuts between world markets. Further, as described in Chapter 3, variable ice conditions and icebergs are likely to remain a major hazard for shipping in the Canadian Arctic, including the Canadian Arctic Archipelago and the Northwest Passage, for the foreseeable future (Haas and Howell, 2015).

It is likely that commercial transit traffic will indeed increase from its present nearly negligible level. However, projections for future Arctic shipping activity, as described above, reveal considerable uncertainty in the estimates. In relation to the BBDS region and based on existing literature, it is estimated to be unlikely that transpolar traffic will occur before 2030. Further, the shortcut effect between markets such as China and northern Europe is greater when vessels sail directly through or around the North Pole, as opposed to a routing via Baffin Bay and the Canadian Archipelago. As a result, even if Arctic transit does develop to a significant level (e.g., as in longer-term scenarios of drastic climate change), it would not likely concern the BBDS region directly. However, if traffic should eventually transit through the Northwest Passage, it will most likely be on the Canadian side of the region.

References


