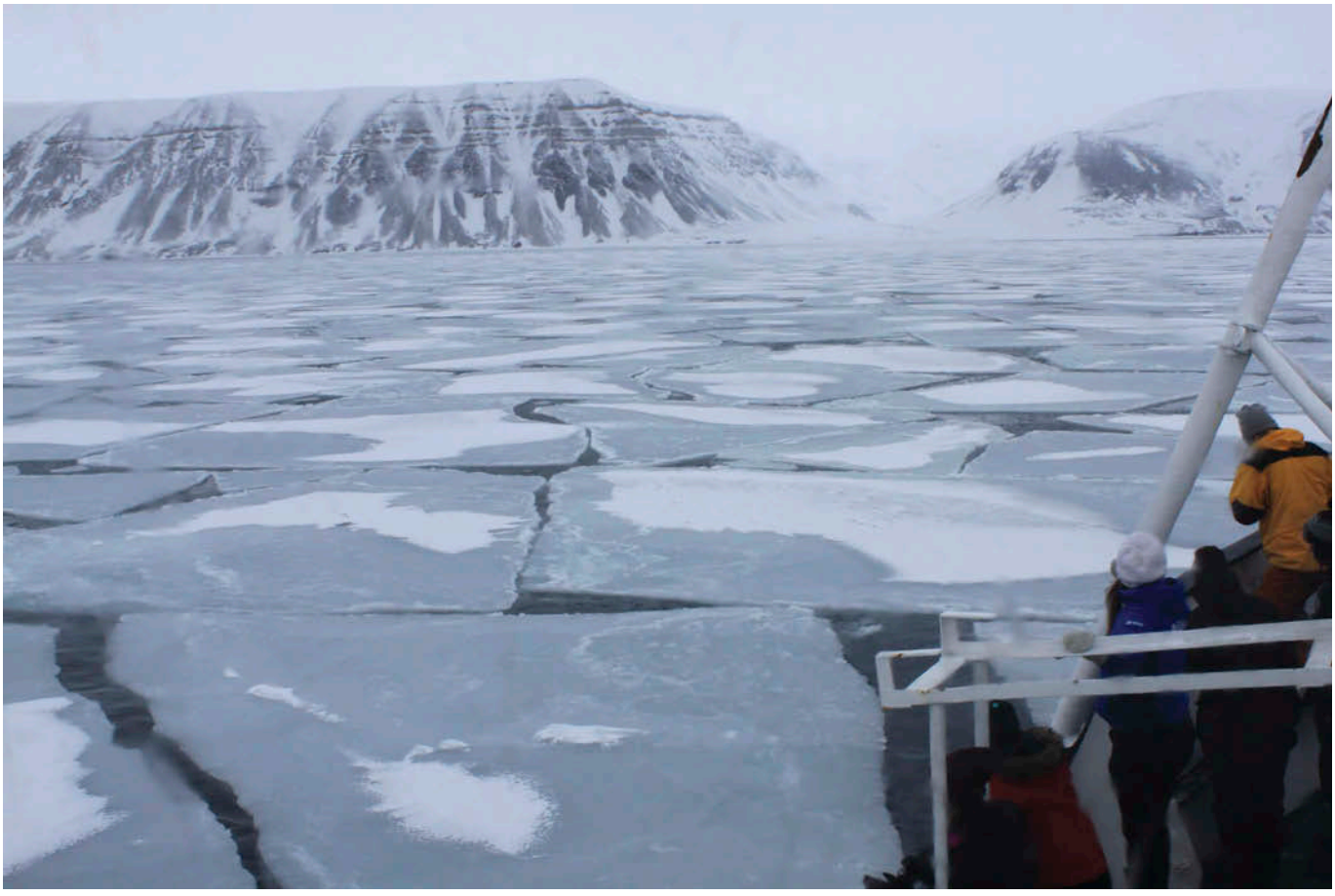

GEOGRAPHY | RESEARCH ARTICLE

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Community perspectives on the environmental impacts of Arctic shipping: case studies from Russia, Norway and Canada

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Abstract: Communities across the Arctic are experiencing growth in transiting, destination and domestic ship traffic. Environmental impacts resulting from Arctic shipping have been well documented, but little is known about how these impacts affect livelihoods and adaptive capacity of the local communities that are reliant on their natural landscapes. Given the heterogeneity of the Arctic, this study applied a community-based approach to empirically assess the impacts of shipping on the environment. Interviews were conducted in three island communities: Solovetsky in Russia (n = 24), Longyearbyen on Svalbard, Norway (n = 22) and Cambridge Bay, Canadian Arctic (n = 24). Despite differences in the trends of shipping activities that occur in each of the case study communities, there was consensus regarding significant environmental impacts from ship traffic on the natural environment, and that these in turn present a great concern for community livelihoods. The concerns differ greatly among the three communities and depended on the local context and perceptions and use of the natural environment. We conclude that the natural environment represents a salient determinant of adaptive capacity in the context of

ABOUT THE AUTHOR

Julia Olsen's primary research areas are local community's vulnerability and socioeconomic adaptation to multiple changes in the Barents part of the Arctic. The main objective of her current work is to assess the impact of increased shipping activities in the Barents Sea on local coastal communities and understand what the implications are for local adaptation and adaptive capacity. Her recent publications cover the topics related to local and regional perspectives on shipping development and social impacts and responses. Julia, together with her colleagues, conducts community-based research in order to assess local perspectives on regional, national and global development. She has fieldwork experience in Russian and Norwegian communities, municipalities and primary sectors. Julia graduated from Ukhta State Technical University in 2010, received her MA degree in science of Sustainable Management at Nord University in 2011 and currently is a Ph.D. Candidate in Sociology at Nord University, Norway.

PUBLIC INTEREST STATEMENT

Shipping activities has increased across the global Arctic. Consequently, several coastal communities have been experiencing the impacts of this rapid development on their socioeconomic and environmental conditions. In this paper, we study communities' perspectives on shipping impacts based on local use and perceptions of local natural environment. The study results are drawn from interviews conducted in three coastal communities: Solovetsky in Russia, Longyearbyen on Svalbard and Cambridge Bay in Canada. Despite the diversity in community settings and shipping trends, the study illustrates that the local engagement with the natural environment affects the way the communities are impacted. Hence, we argue that there is no 'one-size-fits-all' solution to the challenges associated with the increases in Arctic shipping. The study concludes that context-specific assessments may improve planning and decision-making surrounding shipping development in the opening Arctic.

growing ship traffic across the Arctic. Moreover, this context-dependent determinant varies in the way it is perceived across case communities.

Subjects: Kinship & Community; Environmental Anthropology; Transport; Sustainability; Regional Geography - HumanGeography; Environmental Geography

Keywords: Arctic; shipping; communities; environmental impacts; adaptive capacity

1. Introduction

Sea ice reduction is one of the most noticeable signs of a changing climate in the Arctic (Meier et al., 2014; see also AMAP, 2017). Since the start of Arctic sea ice monitoring in 1979, the data show a downward trend in its thickness and its extent (Barber et al. 2017; Stroeve, Markus, Boisvert, Miller, & Barrett, 2014). Despite year-to-year variation, its continuing decline affects the accessibility of coastal communities by marine traffic, as well as residents' use of the marine environment. The opening Arctic seas and changes in navigation seasons coupled with industrial expansion in the North (e.g. extractive industries, fishing, tourism) has affected shipping transportation patterns in several Arctic regions (e.g. Borch et al., 2016; Dawson, Pizzolato, Howell, Copland, & Johnston, 2018a; Farré et al., 2014). Consequently, several coastal communities across the Arctic have been experiencing the impact of the growth in ship traffic, both positive and negative. Typical shipping traffic in the Arctic includes tankers, bulk carriers, offshore supply vessels, passenger ships, tug/barge combinations, fishing vessels, ferries, research vessels, and government and commercial icebreakers (PAME, 2009, 3).

Given the heterogeneity of vessel types and seasonality in operations, their distribution varies temporally and spatially across the Arctic. For example, 80% of total ship traffic across the Arctic passes through Norwegian territorial waters (Ministry of Justice, 2016). Much of the recent shipping growth in the Norwegian and Russian Arctic is associated with oil and gas service vessels and tankers, marine cruises, and fisheries (Borch et al., 2016). Ship traffic in the Canadian Arctic is significantly less than in the European Arctic (Christensen, Lasserre, Dawson, Guy, & Pelletier, 2018), but nonetheless total traffic volume roughly tripled between 1990 and 2015—(from 364 179 km in 1990 to 918 266 km in 2015) (Dawson et al., 2018a). General cargo vessels, government icebreakers and research ships dominate in the region and by far, while pleasure craft (private yachts) present the fastest growing vessel type (ibid.). Most of that increase has occurred in Nunavut waters (ibid.; also see Dawson, Copland, Mussells, & Carter, 2017b).

Increased shipping in potentially advantageous for local communities by bringing new economic benefits to the region (Christensen et al., 2018; Meier et al., 2014), improving food security and community accessibility, while marine tourism development contributes to increasing awareness of natural heritage (Dawson, Kaae, & Johnston, 2018b; Olsen & Nenasheva, 2018). However, there may also be challenges related to new shipping distribution patterns. For example, an increased risk for accidents in the vulnerable Arctic environment, the disturbance of wildlife, and icebreaking activities (Christensen et al., 2018; Dawson et al., 2017a) which may result in negative outcomes for local communities who coexist with their natural environment (Davydov & Mikhailova, 2011; Wenzel, 2009).

Despite the increasing body of literature on Arctic shipping activities, Ng, Andrews, Babb, Lin, and Becker (2018) in their comprehensive literature review argue that the implications of increased marine vessel traffic for local communities and local ecosystems has received less attention. Less is known about how local environmental impacts affect the livelihoods of coastal Arctic communities. Moreover, as suggested in earlier studies, the impact of different types of shipping is likely to vary in scale and scope between different communities in the same Arctic region (Stewart, Dawson, and Johnston, 2015).

The goal of this study is to examine this assertion by assessing local perspectives on the ways in which the natural environment is affected by shipping activities across three Arctic communities

Figure 1. A map of the case communities.

located in three distinct regions: (1) Solovetsky in the Russian North, (2) Longyearbyen on Svalbard, Norway and (3) Cambridge Bay in the Canadian Arctic (Figure 1). Using findings from qualitative interviews and focus groups with residents and relevant community stakeholders, this study presents a variety of ways the natural environment is perceived to be impacted by shipping development, both directly and indirectly. By applying a theoretical and conceptual framework of adaptive capacity, the study further concludes that the natural environment represents a salient determinant of adaptive capacity. However, there is a need to expand on the meaning of the natural environment by inclusion of local perceptions within this determinant. Hence, the paper contributes new insights to the literature on the human dimensions of changing Arctic by discussing how shipping's impacts on the natural environment in turn affect a community's adaptive capacity.

2. Theoretical framework

2.1. Conceptualizing the natural environment

The concepts of "nature" and the "natural environment" vary across the disciplines, holding a range of legitimate meanings (McIsaac & Brun, 1999), some of which are related to other concepts that describe the local environment of a particular community. The traditional

understanding of the "nature" and or "natural" refers to something untouched by, separated from and/or threatened by human culture, (Lidskog & Sundqvist, 2013) also described as "wilderness" (e.g. Corbett, 2006). Johnson et al. (1997, 528) described "*natural as used in environmental contexts almost always means that which is neither made, changed, nor otherwise affected by humans*". In other words, there is a dichotomy between human culture and natural, usually toward the ideas of human superiority over nature (Rybråten, 2013,16).

However, this view is challenged by a number of scholars, arguing that there is no such thing as untouched nature due to various types of nature use, such as domestication, but also due to pollution, climate change and other environmental impacts from human activities on surrounding environment (Corbett, 2006; Lidskog & Sundqvist, 2013). There are only natural environments with little human impacts (Robbins, Hintz, & Moore, 2012). Referring to Ingold (2000), Rybråten (2013,16) argues that "…humans are never external to our physical surroundings…". This point is also integrated into Johnson et al.'s (1997) definition of natural environment as "one [that is] relatively untouched or undisturbed by human culture".

The precise understanding of "relatively untouched" nature and environment, however, differs between populations. Those differences in perception, according to Corbett (2006), are rooted in one's belief system about the natural world and is influenced by several factors, such as childhood experience, a sense of place, and historical and cultural context. To elaborate on this point, Ween and Lien (2012) present the example of the Finnmark county in Northern Norway. From the outside, Finnmark is understood as being pristine or remote natural environment, while local indigenous and non-indigenous peoples relate to and are engaged with nature via different practices. "Here, nature and nature activities remain central to peoples' identity, their belonging and heritage. Nature is regularly cited as the reason for staying when so many people move away" (Ween & Lien, 2012, 93; see also Freeman, 1976; Rybråten, 2013). Thus, the term natural environment can be interpreted in different ways, and as described in the example related to social construction of nature, including concept of wilderness (Robbins et al., 2012). This corresponds with Rybråten's (2013, 247) call for inclusion of multiplicity in nature investigations to consider new ways of accounting for particularities of nature.

The idea of multiplicity in viewing the natural environment is adopted here, and further inspired by literature focusing on human-nature interconnections (e.g. Lidskog & Sundqvist, 2013). This approach presents an integrative and holistic perspective on the construction of reality, and emphasizes the role of nature in forming social practices, values, traditions, and worldviews. By applying this concept of the natural environment to our study, we assess the ways local communities perceive the natural environment that surrounds them and how it is impacted by increasing shipping activities, as well as how the local environment's role and significance in community members' lives shapes local adaptive capacity.

2.2. Adaptive capacity framework

The rate and amplitude of climatic changes coupled with impacts from other socioeconomic shifts challenge communities' ability to adapt (AMAP, 2011). Even though Indigenous peoples and residents across the Arctic have demonstrated high flexibility in their practices and adaptability to multiple changes, including climate-induced, (ibid.), little is known about how the impact of shipping development on local natural environments affects communities' livelihoods.

This study adopts the conceptual framework of adaptive capacity to elaborate on earlier studies assessing the natural environment its role in shaping local communities' capacity to adapt to growing shipping activities (Olsen & Nenasheva, 2018). This approach derives from literature that assesses communities' perspectives on changing conditions in the Arctic, their capacities and response strategies (e.g. Hovelsrud, Karlsson, & Olsen, 2018; Hovelsrud & Smit, 2010; Smit & Wandel, 2006). This framework provides a useful tool to assess the significance of local factors that emerge in the context of increased shipping (Olsen & Nenasheva, 2018).

Adaptive capacity can be defined as one's ability (in this case, a local community) to cope or adjust to changing conditions in a certain place over time (adapted from Smit, Hovelsrud, Wandel, & Andrachuk, 2010, 5). Adaptive capacity is influenced by a range of determinants, described as aspects and capitals, such as social, natural, physical, economic, cognitive factors (Furness & Nelson, 2016). Smit and Wandel (2006, 288) underline that determinants of adaptive capacity vary in space and time and are context dependent. Hence, local communities will differ in their adaptive capacity to changing conditions.

Natural determinants are the focus of this study. Natural discourses in adaptation, adaptive capacity and resilience literature are usually related to an ecosystem domain, including ecological diversity and ecosystem health (Berman, Kofinas, & BurnSilver, 2017) and/or natural capital (Furness & Nelson, 2016). Natural capital—a stock of natural resources—is a context-dependent determinant of adaptive capacity and is linked to the concept of ecosystem services (Kofinas et al., 2013) that provide the necessary resources to sustain livelihoods (Mortreux & Barnett, 2017, 2). Such resources comprise land, water, and vegetation, but also non-renewable resources such as oil and minerals, in addition to recreational and cultural functions (Furness & Nelson, 2016; Kofinas et al., 2013; Mortreux & Barnett, 2017).

This way of conceptualizing natural determinant in the previous studies presents a starting point for this study. We challenge the dominant view on how nature is addressed in adaptive capacity literature by adding local perspectives on the significance of natural environment, and the way it is perceived and impacted by increasing shipping. By assessing the way local communities engage with the natural environment in the context of shipping growth, we aim to expand the meanings of this determinant in order to understand the way it shapes local adaptive capacity.

3. Methodology

3.1. Community based approach

This study was designed to understand how the environmental impacts from shipping activities become social concerns and shape local adaptive capacity. The methodology follows a bottom-up approach to examining local communities' perspectives on changing conditions and impacts (Hovelsrud & Smit, 2010; Kelley & Ljubicic, 2012).

Given the diversity of the Arctic region, this qualitative case study was conducted in three island-based communities in different Arctic regions that historically have been dependent upon shipping and currently experience a dramatic growth in shipping development (Table 1). They are the communities of Solovetsky in Northern Russia, the community of Longyearbyen on Svalbard, Norway, and the community of Cambridge Bay in Nunavut, Canada. Table 2 highlights the main characteristics of these case communities.

Given the remote island location of our case communities, their socioeconomic development has been heavily dependent on shipping which serves as an important transportation link to the main land, and enables communities' supply, mobility and subsistence activities. Sea ice has been the main barrier inhibiting shipping between the islands and the main land, but it is not always prohibitive. It has been both a factor in the community's isolation, but also a platform for communities' mobility in certain circumstances. The recent changes in hydrological regimes across the Arctic have impacted sea ice extent and navigation season in our case communities (e.g. Dumanskaya, 2014; Pizzolato, Stephen, Howell, Laliberté, & Copland, 2016; Vikhamar-Schuler, Førland, & Hisdal, 2016).

Extension of the navigation season has improved the Solovetsky community's accessibility, re-supply and local mobility options. However, this extension currently has no or limited impact on the traditionally established tourism season, which remains stable and lasts for four months

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Table 1. Main indicators for marine transportation for the Solovetsky Archipelago, Longyearbyen and Cambridge Bay[2]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	% Increase 2008–2016
Number of ship calls in Solovetsky	**466**	**410**	**516**	**490**	**563**	**545**	**540**	**595**	**596**	**128**
Number of passengers (thousands of people)	22,9	27,8	31,0	33,6	30,3	30,1	62,8	78,5	74,4	324
Number of ship calls in Longyearbyen	**771**	**799**	**814**	**773**	**777**	**802**	**1178**	**1163**	**1542**	**200**
Number of passengers	38,6	41,4	40,1	39,0	55,1	56,9	54,8	63,7	75,2	197
Number of transits past Cambridge Bay	**20**	**25**	**22**	**32**	**30**	**28**	**29**	**31**	**37**	**185**

Table 2. Main characteristics of the three case communities[1]

Characteristics	Solovetsky	Longyearbyen	Cambridge Bay
Geographic location	65 °N; Solovetsky Archipelago (also known as Solovki), White Sea, Arkhangelsk region, Russia	78 °N; Svalbard Archipelago, Barents Sea, Norway	69 °N; Victoria Island, Kitikmeot region, Nunavut, Canada
Settlement type	The transportation and administrative hub for the Solovetsky Archipelago	The transportation, administrative, and business hub for Svalbard	The transportation, administrative, and business hub for the Kitikmeot region
Demography	943 inhabitants, mostly native Russian, 10% are monks	2200 inhabitants from over 40 countries. Average residence period is 7 years	1,766 inhabitants, 80% art Inuit (Indigenous Peoples)
Employment	Museum, monastery, municipality, tourism combined with subsistence economy	Tourism, research and education, public sector, and different social services	Research center, public sector (municipality), tourism, combined with subsistence economy
Transport linkage with the mainland	Shipping (seasonal) and air transportation (year-round)	Year-round shipping and air transportation	Shipping (seasonal) and air transportation (year-round).
Type of shipping	Domestic (dominated by passenger and cargo/ supply)	Domestic and destination (marine tourism, cargo/ supply, research, fishing, Search and Rescue)	Destination and transit (re-supply, cruise and yacht tourism, research, government vessels, fishing)
Natural environment use	Recreation; fishing for subsistence and private income (year-round); and collecting local resources (berries, mushrooms, seaweed) for subsistence during summer season.	Recreation; fishing (year-round) and hunting (seasonal) for private purposes, not subsistence.	Recreation; fishing and hunting for subsistence. See Figure 2.
Important historical facts	• 1429 -Establishment of the Solovetsky Monastery • 1862—Ferry transportation with Arkhangelsk established • 1992- Solovetsky's Cultural and Historical Assembly on the UNESCO World Heritage list.	• 1596-Discovery of Svalbard. Marine area has been used for whaling and fishing and later marine tourism • 1906- Establishment of Longyearbyen • 2002- Gained protection under the Environmental Protected Act. • 2015—Heavy Fuel Oil-banned	• 1500 CE to present modern • Inuit 1920s RCMP and Hudson Bay Company outpost established • 1947 first permanent residents • 2012–2018 construction of Canadian High Arctic Research Station (CHARS).

between June-September (Olsen and Nenasheva, 2018). Recent increases in ship traffic and the number of visitors to Solovetsky can be better explained by growing tourism interest in the Archipelago and government programs for the Archipelagos' heritage development (Solovetsky Strategy, 2013).

The sea ice thawing and disappearance was the driving force behind an ever-lengthening navigation season, moving toward a year-round open water connection with the community of Longyearbyen. Summer seasons with less ice enabled fishing, tourism, and research vessels to access new remote areas in the Northern part of the Barents Sea. This development presents a challenge, particularly in terms of the protection of the environment, emergency preparedness,

and search and rescue activities (Borch et al., 2016) in addition to local port infrastructure. Tourism operators must reserve vessel space at the harbor one year in advance.

The correlation between changing sea ice conditions and shipping activity in Arctic Canada is limited, but appears to be increasing (Pizzolato et al., 2016). For example, the case community of Cambridge Bay experienced one of the highest increase in marine vessel activity within 50 km of the community in Nunavut (Dawson et al., 2018a). The marine areas that are most significant to community members' subsistence harvesting and livelihood activities are also located where the most significant increases in ship activity has also occurred (Carter et al., 2018).

3.2. Methods

This research applies a case study approach (Yin, 2014), using a mixture of qualitative methods to generate secondary and primary data (Blaikie, 2010). Secondary data are derived from existing scientific literature, documents and popular media. The main purpose of secondary data collection was to develop an interview guide, identify stakeholders and increase our knowledge of the case communities (presented in the Table 2). Media reviews via available online platforms (A-text in Norwegian and Polpred.ru in Russian) were particularly relevant to assessing the contextual characteristics for the communities of Longyearbyen and Solovetsky, which unlike the community of Cambridge Bay, do not necessarily have the same historical roots to the place.

The primary data were collected in 2017 in the three case communities using semi-structured, unstructured and focus group interviews. The interview guide was designed to explore shipping development trends, seasonal changes, impacts on livelihoods, natural environment, and challenges and opportunities associated with the development. Twenty-four stakeholders and community representatives were interviewed in the Solovetsky settlement and the regional administrate center of Arkhangelsk, 22 in Longyearbyen, and 24 in Cambridge Bay (Table 3). Results were validated with research participants (member-checking draft outputs e.g. reports and maps) which took place during in-person meetings with key stakeholders and community representatives in Longyearbyen in 2017 and 2018 and Cambridge Bay in 2018 (Carter et al., 2018). Several stakeholders from the Solovetsky community commented on preliminary results that were presented in a report form.

Interview data were audio recorded and field notes taken in the native language of each case community: Solovetsky in Russian, Longyearbyen in Norwegian (some in English), and Cambridge Bay in Inuinnaqtun. Where necessary, the transcribed interviews were translated

Table 3. Number and types of interviews

Community/codes	Type and number of interviews	Interviewees
Solovetsky (S1-S24)	19 semi-structured and 5 unstructured	Representatives from public bodies, shipping and marine tourism industry, Search and Rescue services and local population
Longyearbyen (L1-L22)	18 semi-structured and 4 unstructured	Representatives from public bodies, shipping and marine tourism industry, NGOs, Search and Rescue services, port authorities and local population
Cambridge Bay (CB1-CB24)	One focus-group interview with 8 stakeholders and 16 unstructured interviews	Representatives from Ekaluktutiak Hunters and Trappers Organization and local residents who were current, active users of local marine areas with expert knowledge of culturally significant marine sites and the impacts of shipping

into English. Empirical data were thematically analyzed using coding software, NVivo (Bazeley & Jackson, 2013). The codes and categories were derived from the interview guide and emerging points during the discussion. In line with ethical requirements, and to secure the anonymity of the interviewees, a participant number system is used for each case (Table 3).

4. Empirical findings

4.1. Natural environment and shipping impacts

In this section, we present the community members' understandings on the surrounding natural environment and describe the locally defined impacts from diverse shipping activities for each community. Given the variation in navigation seasons and seasonal cycles in the case of Cambridge Bay and the impacts from shipping development on the local natural environment, the communities' livelihoods vary through the year.

4.1.1. Solovetsky

According to the majority of interviewees, even though the navigation season lasts eight-nine months, the main impacts and pressure on the natural environment happens during the summer navigation season. During this time, hundreds of vessels, transporting thousands of tourists, pilgrims, seasonal workers and other community visitors arrive in the archipelago. One of the interviewees expressed concern, describing this situation the following way:

> If the population of the village is slightly less than 1000…then during summer it might be up to 2500 people at the same time, including tourists and seasonal workers. This is a great burden for both infrastructure and nature (S17).

The increasing number of visitors led several interviewees to question the island's natural and recreational capacity. Some interviewees suggested that the natural and recreational capacity need to be scientifically calculated (S5). Others supported more comprehensive measures to limit the number of individual tourists, such as establishing a nature reserve (S17) that may also limit the use of the natural environment by residents (S15). At the same time, several interviewees pointed out that weather and ice conditions limiting the tourism flow (S15, S20) thus resulting in a relatively stable tourism season duration. In fact, the first domestic cruise vessel of the 2017 tourism season could not approach the Archipelago due to ice conditions (S19). This ability of the natural environment to regulate the tourism flow was described by several interviewees as:

> Solovki [local weather and ice conditions] regulates the number of people themselves…we had a warm summer last year with a large number of people…Now, when it rains, there is nothing [no tourists] (S19).

One of the interviewees in Arkhangelsk accepted this natural force (weather) in their practices and the need for tourists to adjust to local weather conditions: "*The weather is another question. Sometimes tourists fly there but cannot return [due to weather conditions]*" (S12).

When talking about the potential impacts from shipping activities, the interviewees were concerned with animal disturbance, especially during private, non-organized excursions to the Beluga Cape, a migration spot for Beluga whales (S19). To limit the possible disturbance, the tourism industry underlines the importance of integration of local and scientific knowledge in planning the trips to the Beluga Cape:

> … we go there [to Beluga Cape] on smaller boats. We have been doing this for a very long time…[knowing] how to approach the area and so on. I was invited by these 'belyuzhniki' [Beluga whales researchers], to present our practical point of view (S21).

Among other concerns, the local population pointed to tourists' inappropriate use of and behavior in nature that contradict the established Solovetsky visiting rules. This inappropriate behavior included polluting, leaving garbage in natural areas, and lighting a fire in a place where it was not permitted (S8, S19). In addition to individual impacts from tourism, aggregate problems such as garbage management was a huge issue. The increasing volume of generated garbage from residents and community visitors bothered the local population: "*This [garbage] is a problem. We have landfill facilities, in 2 km away from the village and nothing has been done with it… it is already huge*". Only a small portion of the garbage generated on this island is transported to the mainland (S17).

At the same time, according to local stakeholders, international cruise vessels and tourists did not levy such impacts on the local environment. Compared to regular passenger traffic between the Archipelago and the mainland, international cruises were perceived as a form of tourism with limited impacts on the sites and nature due to organized nature of visits (S8). The sites were visited by smaller groups, all garbage was stored onboard vessels, and cruise boats usually anchored a desirable distance from the settlement (S18) thereby limiting disruption to the local population. This was also applicable to organized tourist groups, which according to one of the interviewees, compared to individual tourism thusly:

> …have a structured program…Despite all worries, they do not really harm nature, they use the same road [during every excursion]. Organized tourism, in terms of conservation of nature is the most optimal. Nothing is better (S19).

During the navigation season, the island is visited by supply and cargo vessels that are vital for community well-being; however, interviewees did not mention any impacts on the natural environment from those activities. The interviewees from the shipping sector acknowledged that:

> …the negative impacts from shipping has been reduced to the minimum. This is regulated by strict environmental laws, nothing can be thrown off the board…Ships themselves can deliver their waste to the port of the Arkhangelsk, for example. It is a bit harder on Solovetsky, which does not have waste facilities (S3).

Moreover, the vessels follow the recommended routes for navigation to avoid seals' rookeries and any types of mammals' disturbance (S3, S4). Mammals' locations are routinely communicated to vessels operating in the area (S4). The development of recommended routes coupled with White Sea charts lessen the chance for a vessel to be grounded (S3).

4.1.2. Longyearbyen

The community's engagement with and the use of the natural environment in Longyearbyen differs from other coastal Norwegian communities. One of the interviewees described that:

> It [the natural environment]is not used here as in other coastal settlements on the mainland [Norway] where you have fishing and where you have transport. Some use private boats and there are some transport options to Barentsburg and Pyramid and so on. Otherwise, we use the ocean too little here (L2).

At the same time, some from the Longyearbyen community expressed concern about dramatic changes in the surrounding natural environment. Those interviewees who had lived there for more than a decade have noticed marine environment changes, such as changes in marine species distribution and sea ice reduction nearing complete disappearance in Isfjorden and Adventsfjord (L11, L8, L21). One of the residents surprisingly told us that:

> I was on a fishing trip and caught species that were not here for 6 years ago, mackerel, for example. There must have been a dramatic temperature increase in the ocean. And … fjords, they do not freeze (L2).

The changes in sea ice conditions have led to year-round community accessibility by marine vessels. It was suggested by local residents that the past the winter season was quiet, with no shipping activities to and from community, when sea ice covered the fjords:

> ...we have less ice now, than for 20 years ago. 20 years ago we talked about the last boat and the first boat. We called it for the Christmas boat, the last boat in December, and it was the last, before the first one in May. It was like this because of the sea ice (L11).

Today the year-round navigation season is divided into two periods: the tourism period (also described as *cruise* tourism period), which is constantly extending, and "*the rest of the year*" described as a winter period (L2). Sea ice reduction has led to an extended marine tourism season, which in turn shortened the residents's quiet season (a period without ship traffic) and their options for use of nature (e.g. ability to be alone in nature) (L7). This was confirmed by a representative from shipping industry, who pointed out that the navigation season for day-long cruises and expedition vessels starts early in the Spring (L21). The increasingly early start of the shipping season has awoken a new concern on the west side of the Archipelago: the potential disturbance of sea-ice dependent species. One of the interviewees reflected on the prohibited ice-breaking activities in the fjords:

> They (the fjords) have dramatically less ice than usually. It affects ice-related species also polar bears and seals...icebreaking... must be avoided in areas that are important for marine species. And it's applicable for all areas with sea ice. There are monitoring activities...in those areas during March and April (L12)

Moreover, changes in snow conditions and increased avalanche risks have shifted land-based tourism activities, such as snowmobiling tours, toward sea-based (L5). This increasing use of the marine environment has been questioned locally. Although local community members do not use the natural environment for subsistence purposes, fishing and hunting are purely recreational. Compared to Solovetsky community, all types of vessels are regarded as potential threats to the natural environment. According to the interviewees, the described negative impacts are "*potential for accident, pollution and emission, spreading of invasive species* via *ballast water, disturbance of wildlife and damage of the vegetation and cultural heritage*" (L12). The impacts from commercial fishing activities in Svalbard waters and in the Barents Sea were noticeable to the local residents and visitors. Some observed a significant amount of marine litter (some of which was related to fishing industry) on Svalbard's beaches, even on those that have been previously cleaned (L8). At the same time, Svalbard's vulnerable natural environment was largely described as a "*wilderness area, no settlement, no infrastructure, little technical intervention*" (L12).

Similar to Solovetsky, the increased number of visitors in the community and at out-of-town sites during the summer season affected the local environment. In the Svalbard case, residents reported incidents of inappropriate behavior from visitors that included littering, picking flowers—prohibited on Svalbard—and disturbing wildlife (L7, L20). As a result, local residents were preoccupied with preventing the negative impacts of increased shipping and visitors. One of the interviewees underlined that locally they focus on the prevention of any types of accidents and fuel spills. "*It is important to prevent accidents. This is why there is a Heavy Fuel Oil ban for almost all territorial waters in Svalbard. Only Icefjorden does not have it" (L12)*. In addition to accident prevention, two interviewees mentioned that due to the dramatic tourism growth (including marine tourism) there is a need to determine how many tourists Svalbard can accommodate:

> This is a debate I would like to have in Longyearbyen... Some thinks it's probably exciting when a cruise ship with 2000 people arrives to the community. But there are maybe 20, 30, 40 vessels during the season, and if it happens every day, if we become Gibraltar then we have ruined ourselves. Then the destination is no longer exclusive (L2).

Much work has been done by local stakeholders to develop community guidelines regarding wildlife to mitigate the negative impacts, disseminating information about the vulnerability of local environment to the visitors (L4, L7, L8, L10).

4.1.3. Cambridge Bay

In Cambridge Bay, compared to the previous two communities, the well-being of community members, their cultural practices, and livelihood are closely connected to and dependent on the marine environment. The ocean is used daily, year-round for fishing, hunting and travel. The community's subsistence harvesting activities are seasonal, thus the potential impacts of marine vessel traffic on the natural environment varies across these periods (see Figure 2). Community members travel by boat when there is open water, but the sea ice also serves an important function for community members' mobility, as well as for migrating caribou, and as a denning area for seals and polar bears. Thus, several concerns were raised regarding current and potential impacts from ship traffic—both in open water seasons and from icebreaking vessels during the shoulder seasons.

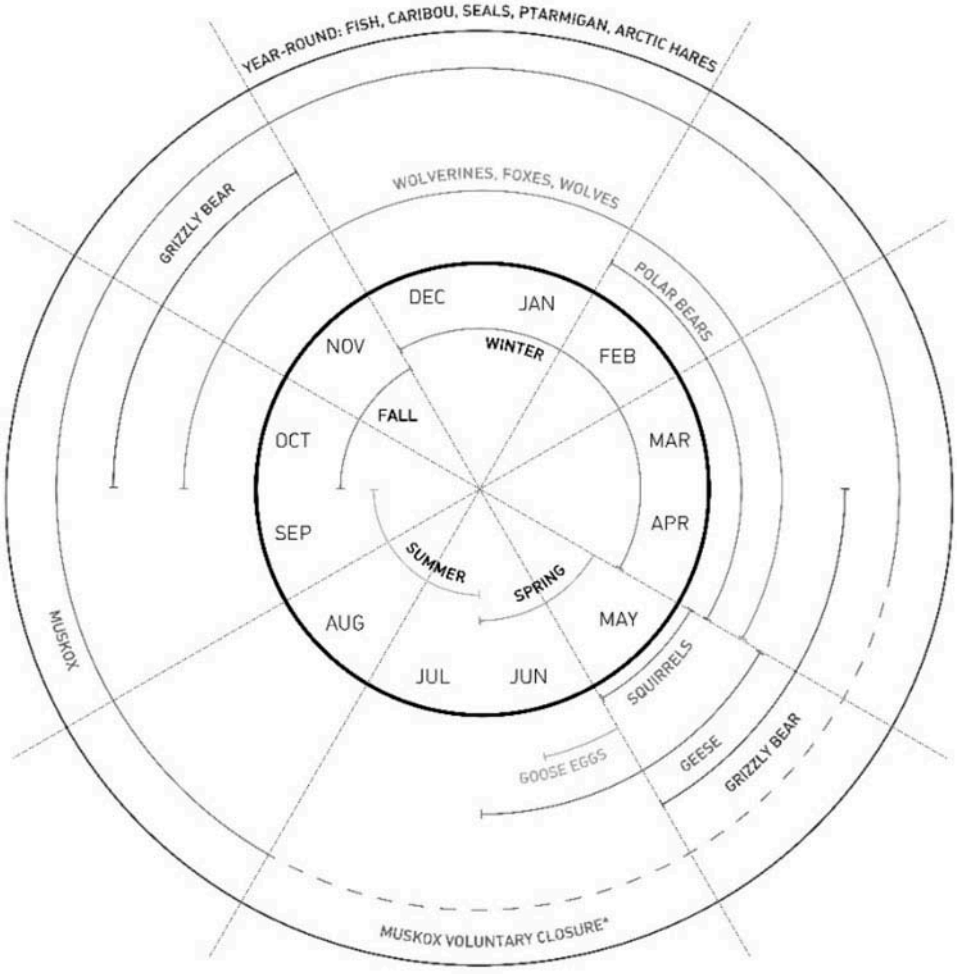

Figure 2. Seasonal cycles in Cambridge Bay.

*** Muskox hunting is legally open every month but at the time of publication Ekaluktutiak Hunters and Trappers Organization has voluntary closure from mid-April to July so that calves have time to grow and be strong.**

Regarding ongoing impacts, the interviewees explained that marine vessels disturb fish and marine mammals (e.g. spawning, feeding, and migratory routes) and animals move away. One of the interviewees expressed this fear in the following way:

> ...even if we put our foot in the water they [the marine species] go! ... And that's a very small impact. But with big cruise ships that can be a big impact to the wildlife out in the waters! And it can scatter them! (CB1).

In addition to wildlife disturbances, the interviewees feared the pollution in the marine environment, describing the marine vessels as a contributor to garbage, sewage, contaminants, oil and lubricants in the ocean. Community members underlined that shipping traffic causes those substances to accumulate in the Arctic water system (oceans, rivers and lakes) which negatively affects marine and terrestrial wildlife and people (CB8).

> ... [vessels] discharging some fluids into the water...Grey water and things like that is diluted in the water of course, but you get any kind of oils or chemicals that go in the water, that's going to go straight into the food chain that we eat. The fish, the seals, the bears. So, thinking ahead we have to try and prevent something like that happening in our waters (CB2).

Similarly, another interviewee mentioned his fear of local food being contaminated by ships transiting the Northwest Passage:

> With all the shipping anyone of them could run aground, anyone of them could have a fire, anything can happen so you know better to be prepared and save what little we can instead of losing our livelihood and I think that's a good example of food that we love to eat and we can't anymore because of modern things going on within our region (CB2).

The necessity of having clean waters to secure the quality of the country food was described in the following way:

> I grew up with country food [traditional wild foods] ...And it's very important for me to see that the ocean and the land be kept clean from any contamination ... that regulations be put in place for outsiders using our traditional land and our water sources (CB1).

Certain types of ship traffic also disturb the sea ice that serves as a platform for local mobility by people. Sea ice damage, according to one interviewee posed safety risks and limited mobility:

> ...hunters use these ice bridges to access routes to the mainland. In the fall a couple years ago [CB3] and I were on the mainland after freezing up and no sooner had we come back and the Coast Guard [icebreaker] went through where we had driven our snowmobiles. So, to us that's a big concern. Had we been on that ice coming home after that boat had gone through, we wouldn't be here as we speak. (CB2).

In addition to safety concerns, several interviewees underlined that ships disturb the caribou migration. Caribou are an important food source for community members, and one that is currently threatened due to a decrease in the caribou population:

> When ships go through in the early fall, they break up the ice and that could also make the caribou go through that. Because the caribou do migrate to and from the island to the mainland in fall time and spring time. You might already know that the caribou is declining and that could even make it worse with the ships going through in early fall; and caribou go through the ice! And that's another concern (CB1).

This idea that local coastal communities will be disproportionally impacted by the potential environmental damage from ships was evident in local resident perspectives:

> My feelings towards [cruise ships] is I feel I'm not with them or for them. It just benefits whoever owns these cruise ships…The thing that I'm concerned about is that they go through our passage and there's a risk every time they come through because they're so big that somethings going to happen; maybe not now, maybe not tomorrow but eventually. And when that does happen it's going to have a huge impact on us (CB2).

This impact, according to the interviewees, is dramatic for the area since: "*it's our home; it's our life… It's all we have*" (CB5). At the same time, residents consider Cambridge Bay's location as important to emergency and incident preparedness activities, critical in limiting the negative impacts from possible accidents in the NWP: "*…our livelihood depends on the water! Fish and seals. It would be nice to have one of those fuel responses here in Northwest Passage in the Kitikmeot*" (CB1).

5. Concluding discussion

5.1. Different perceptions about the same concern

As illustrated in the previous section, the case communities experienced an array of direct and indirect impacts from increasing ship traffic on their surrounding natural environment, which in turn affected their well-being. This is in line with Stewart et al. (2015), who argue that communities even in the same region are exposed differently to a certain type of shipping activities. Our research demonstrates that communities are concerned about a range of impacts and the way they affect livelihoods, but also that these concerns vary across the Arctic regions. Based on the analysis of empirical data, we argue that this diversity in identified impacts across the case communities relates to two main factors: local context (community characteristics and local shipping trends) and the way the natural environment is perceived and used locally (e.g. community engagement with the natural environment).

The role of the first factor, the local context, relates to the location, local economy, history and trends of ship traffic. The communities of Solovetsky and Svalbard, for example have a long experience with shipping activities including marine tourism (Maksimova, 2016; Nyseth & Viken, 2015). As a result, both communities have developed knowledge on shipping operations, resulting in the development of local institutional responses such as regulations and guidelines to mitigate the negative impacts. Given the lesser extent of shipping activities around Cambridge Bay, and the very recent increase in marine vessel traffic in that area (Dawson et al., 2018a) local and federal institutional responses are limited but desired (Carter et al., 2018). Moreover, as illustrated in this study, potential risks are still creating uncertainties and spurring the need for local responses, such as preparedness activities and information dissemination on icebreaking activities.

In addition to contextual characteristics, the locally identified impacts were generally related to the way in which the natural environment was perceived and integrated into the social life of three case communities. Table 4 presents the multiplicity of views on how the natural environment is locally perceived and used. Each of those perceptions has a different linkage to shipping growth and the way the natural environment is impacted. This explains why certain impacts from shipping activities become a concern for one community, while others do not attest to the same impact. Surprisingly, interviewees from Solovetsky described impacts from shipping development that did not necessarily happen offshore (as was the case for Longyearbyen and Cambridge Bay), but on their terrestrial environment because of increasing numbers of visitors. Solovetsky interviewees also perceived the natural environment as a force for controlling the growth of passenger shipping (see also Olsen and Nenasheva, 2018).

In all of the case communities, the impact of shipping on the natural environment affected livelihood practices, thus presenting a great concern for all case communities. Maintaining aspects of traditional livelihoods became a challenge for those Arctic coastal communities who rely on the environment for things like subsistence and mobility to a greater degree. Impacts from shipping in this context present an additional stressor to already changing natural environment (see also

Table 4. Local perceptions on impacts from shipping and implications for adaptive capacity (adopted from Olsen and Nenasheva, 2018)

Community	Perception and use of natural environment:	The impacts from shipping	Weaken adaptive capacity	Strengthen adaptive capacity
Solovetsky	• Natural boundary for the shipping and tourism seasons (e.g., sea ice and weather conditions) • Local natural capacity with limits for use • Natural capital (i.e. natural resources) • Natural heritage (an object for protection)	• Animal disturbance by tourists • Pollution and inappropriate behavior on sites • Infrastructure development may have trade-offs with the natural environment and heritage • Garbage collected on the island and not removed	• Protective measures can affect residents' and visitors' use of the natural environment (hunting is already prohibited) • Natural resources are collected by community visitors during summer navigation season (no conflicts are mentioned yet)	• Protective measures and guidelines reduce ecological footprint. • Extension of the navigation season improves food security • Sea ice and weather conditions limit the tourism season and number of visitors and thus their ecological footprint
Longyearbyen	• Vulnerable environment is exposed to climate change impacts and needs to be protected. Disturbance should be limited to its minimum. • Local natural capacity with limits for use	- Potential for accident, pollution and emission, both off- shore and on sites - Spreading of invasive species via ballast water by international shipping - Animal disturbance - Missing the sense of wildness, isolation and exclusiveness of Svalbard - Marine litter	- Protective regulations affect residents' use of the environment for recreational purposes (e.g. mobility restrictions) • The pollution of the pristine environment affects people's perception of "wilderness" that in turn affect sense of place	• Increased environmental consciousness among residents and visitors resulted in the response strategies (cleaning initiatives, knowledge sharing with community visitors)
Cambridge Bay	• Integrated part of the community livelihood (need to be protected) • Natural capital a part of food security (i.e. natural resources) • Sea ice and open water as platforms for animals and community mobility	• Vessels disturb marine species and fish (that move away) • Breaking sea ice affects people and animals' mobility and local ability to hunt • Noise pollution • Pollution to the water that also affect the quality of local food • Possibility for oil spills	- The describe impacts negatively affect community's subsistence (limiting the healthy food availability) and mobility options for people and animals	Protect marine environment, better information dissemination about icebreaking activities and improving of preparedness system are described as necessary to limit the negative impact on the natural environment

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Davydov & Mikhailova, 2011; Stewart et al., 2015). Hence, we can argue that the potential impacts can still be dramatic even in areas with lower shipping activities (see also PAME, 2009).

To elaborate on those arguments, Table 4 summarizes the communities' perceptions of the natural environment and the impacts of shipping activities, serving to assess their implications for local adaptive capacity.

5.2. Natural environment as a critical aspect of adaptive capacity

This study examines different meanings of the natural environment based on its local perceptions and use. In line with Ween and Lien (2012), we argue that the perception of and engagement with the natural environment is case-specific and, according to Corbett (2006), rooted in the sense of place and historical and cultural experience. The relationship between sense of place and the perception of the natural environment is especially interesting for the community of Longyearbyen, where given the high share of foreign residents and high rotation rate of the community, newcomers to Svalbard "adopt" new environmental beliefs via the experience of dramatic change in their environment and observing pollution of the "wilderness".

Based on the connection between place, perceptions of the natural environment and impacts on the communities' livelihoods that shapes their adaptive capacity (illustrated in Table 4), we argue that natural environment presents a salient determinant of communities' adaptive capacity in the context of increasing shipping development. This connection is also discussed in the broader literature investigating the impacts on the natural environment emerging from climate change, industrial expansion, and from increasing numbers of community visitors (e.g. Hovelsrud & Smit, 2010; Hovelsrud et al., 2018; Rybråten, 2013).

In line with those studies, we highlight how the local perceptions and use of the natural environment affect human understanding and concerns about possible impacts on the surrounding environment. Hence, not only the physical natural environment itself, but also perception and use by local communities influences adaptive capacity. Building on existing adaptation literature (Furness & Nelson, 2016; Kofinas et al., 2013; Mortreux & Barnett, 2017) our empirical evidence suggests expanding beyond conceptions of "nature" as a resource to be utilized that shapes adaptive capacity. This study illustrates that the natural environment is described in a broader, more inclusive way. The empirical evidence offers a way of understanding this phenomenon as a determinant of adaptive capacity that (1) influences, (2) is influenced by the scope of human activities, (3) presents a valuable capital for human well-being (e.g. local natural resources and enhancing the archipelago's attractiveness) and, (4) is thus an object for protection. We conclude that, the "natural environment" as a determinant of adaptive capacity presents an umbrella definition for several interconnected meanings of nature.

The study highlights the need to develop context-specific assessments of shipping impacts on the natural environment that are based on different forms of use of said environments. There is no one-size-fits-all solution to the challenges associated with the increases in Arctic shipping. Thus, such context-specific assessments may in turn improve planning and decision-making surrounding shipping development in the opening Arctic. The application of an adaptive capacity framework helped us to explore local characteristics, thereby illustrating how the impacts on the natural environments can become a social concern. The results of this study can be used to develop recommendations for managing shipping development in each case community. The theoretical and methodological approaches can be used for further studies assessing the local consequences of shipping development.

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Notes

1. Sources: Solovetsky Strategy (2013); Olsen and Nenasheva (2018); SSB (2016); Carter et al. (2018), Statistics Canada (2016).
2. Sources: Agency for Solovetsky Archipelago development, Port of Longyearbyen, and Cambridge Bay (based on ships transiting within 25 km of the community, no data on number of passengers is available).

Cover image
Source: Author.

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