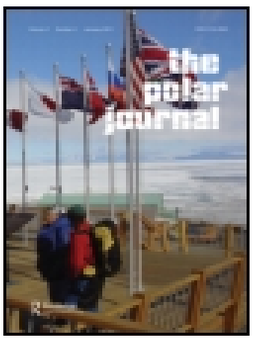

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Global governance in Arctic waters – new times. new stressors. catching up with pharmaceuticals

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ABSTRACT

Arctic ecosystems are increasingly under pressure, not only from climatic stressors, resource extraction, and long-range transport of Persistent Organic Pollutants (POPs), but also from an increased use and subsequent release of Pharmaceuticals and Personal Care Products (PPCP). In Svalbard, an archipelago under Norwegian sovereignty in the High North, urbanisation and expanded tourism has exacerbated the issue of PPCPs accumulation in the region. The primary source of its release into aquatic ecosystems stems from untreated sewage and lack of Wastewater Treatment Plants (WWTPs). This study applies the research surrounding sources of hazardous bioaccumulation and examines mitigation alternatives for PPCPs within a governance framework since today, few regulations regarding human waste disposal are enforced in the Arctic. We held in-depth interviews and a participatory stakeholder workshop in Longyearbyen and Ny-Ålesund in 2021 to learn from experts about their perceptions of challenges, opportunities and synergies in terms of PPCP governance in Svalbard. This study found that overall, governance is servery lacking at all levels of analysis, from local to global, to prevent the harmful release of PPCPs in the waters and environment surrounding Svalbard. An inclusive approach with co-production of policy options is necessary to find a suite of solutions that will ensure that this new emerging environmental threat is handled so that Arctic biodiversity is protected against it.

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PPCPs; Arctic ecosystems; governance; Svalbard; stakeholders; WWTPs

Introduction

There is known overlap of environmental issues in the Arctic, and corresponding institutional arrangements in place to govern these (Berkman, 2009 #16). Though the environmental challenges are many for the region, and the agreements and arrangements numerous, there is no overarching authority in place to ensure that there is no overlap or interplay between them. This also makes it difficult to find synergies between arrangements in the regime complex, and the density of this complex is likely to increase in time, as the ice melts and new challenges emerge (Young and Kim 2021). The Arctic has, as Young (2019) states, moved from the periphery to the centre in the last years and it is no longer

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a remote wilderness that does not impact, or is impacted by, the rest of the world. The lack of synergistic oversight makes in terms of governance within the context of growth in the regime complex of the region seem unsurmountable, especially considering increasing challenges brought forth by both climatic and non-climatic stressors, as well as new and emerging issues.

The release of untreated sewage into the environment is one such non-climatic stressor that is increasingly gaining attention from researchers, policymakers and the public alike. This is an emerging source of hazardous pollution that has come to fall under the term Chemicals of Emerging Arctic Concern (CEAC), which are still largely unregulated (Moiseenko et al. 2006; Sonne, Dietz, Jenssen, Lam, Letcher 2021; Brumovský et al. 2022) in the region. The 21st century has witnessed a rapid rise in the use of pharmaceuticals and personal care products (PPCPs) (Chow 2019), at the same time, people are living longer than ever before (Lichtenberg 2014). PPCPs are a large class of over 3000 chemicals used in typical drugs and products for human use such as, for example, fragrances, sunscreen, cosmetics, and over the counter drugs such as ibuprofen and nicotine. Previous studies have identified the presence of 112 PPCPs in the Arctic (Kallenborn 2016), 11 of which were observed in biological samples. The treatment of wastewater has been absent in the Arctic, though, and as such, contaminated waste from humans are being released directly into the surrounding environment continuously (Gunnarsdóttir, Jenssen, Jensen, Villumsen, Kallenborn 2013).

With the rapidness of polar ice caps melting (Kurniawan, Fatmawati, Miswanto 2021), and more land becoming available, the Arctic could also potentially see an increase in its population centres. Most likely of course is that there will be an increase in tourism, though. Both increases, however, will contribute to an increase in human waste, containing PPCPs (Gunnarsdóttir, Jenssen, Jensen, Villumsen, Kallenborn 2013). Unlike many other persistent organic pollutants (POPs), PPCPs have relatively short half-lives and are not expected to be transported far from the source. They are also generally confined to large population centres (Kallenborn 2016; Miller, Bury, Owen, MacRae, Barron 2018). However, they have a high potential to cause destructive effects on biota because they target specific biological pathways and are active at low concentrations (Kallenborn 2016; Miller, Bury, Owen, MacRae, Barron 2018). Knowing that globally, we are already causing undetermined harm with unknown consequences to global biodiversity (Moranta et al. 2021; Persson et al. 2022), this is alarming. In Longyearbyen, there are no wastewater treatment plants (WWTP), and ibuprofen levels in the surrounding environment were found to be similar to Tromsø's[1] (Weigel et al. 2004), despite its significantly smaller sized population. This is due to a complete lack of WWTPs, making the problem more severe in the Arctic, where pollution is allowed to flow directly into the local environment without treatment.

Arctic governance is complex, with several regimes and agreements in play, covering several different environmental issue areas, from ice melting, biodiversity protection, shifting fisheries, climate change, melting permafrost, energy production needs, and plastic pollution to name a few. To what degree can existing agreements and regimes at various levels of analysis absorb this 'new' pollutant, or does it need an agreement of its own – adding to the regime complex? The importance of

[1].Interestingly, caffeine levels were drastically higher in Longyearbyen than in Tromsø.

tackling marine pollution, such as PPCPs, is a global priority. To identify, reduce and remove chemical pollution in the Ocean is even stated in the implementation plan as a priority for the United Nations Decade of Ocean Science for Sustainable Development (United Nations General Assembly 2012).

Considering this, the current study examines the standard for governance of PPCPs in the Arctic region, looking to Svalbard as a case area. We aim to understand the adequacy of governance for PPCPs and utilise our results from in-depth interviews with local stakeholders and an expert participatory workshop from the fall of 2021 to help inform future policy. We first discuss the multi-level governance framework within the context of PPCPs, followed by our methodological framework, results and discussion. This study found that overall, governance of PPCPs and its release into the Arctic environment is servery lacking at all levels of analysis to prevent the harmful release of PPCPs in the waters and environment surrounding Svalbard. A stakeholder inclusive approach with co-production of policy options is necessary to find a suite of solutions that will ensure that this new emerging environmental threat is handled in a way that allows the Arctic biodiversity to be protection against these harmful chemicals.

Arctic governance

If the use of PPCPs is so persistent and hazardous - especially in the Arctic, why are they not properly regulated? Answering this will require an overview of the local – regional – and international governance schemes affecting the use of PPCPs from Svalbard to worldwide.

Local Arctic governance – Svalbard

Few regulations regarding human waste disposal in the Arctic are enforced, possibly due to the low population in the region and the difficulties surrounding waste treatment technologies in the remote cold environment. The local pollution on Svalbard, however, is regulated by the Svalbard Environmental Protection Act (Svalbardmiljøloven), which prohibits the release of pollutants to the environment. This law stems from the mainland of Norway. This is due to the Svalbard Treaty – the foundation for environmental governance structure of the archipelago (Hovelsrud, Kaltenborn, Olsen 2020). The signing of this treaty gave the Norwegian government the right to regulate all activities on the islands as the sovereigns of the archipelago (Svalbard Treaty 1920b). However, there are some limitations to this sovereignty by giving citizens and companies of the signatory nations equal rights in areas, such as maritime activities (Tiller 2009). Given that environmental governance of Svalbard is linked to its geopolitical location, the context differs from that of mainland Norway (Kaltenborn, Østreng, Hovelsrud 2020). Consequently, there is a long list of research into the extent of Norwegian sovereignty on Svalbard, resource development opportunities, environmental restrictions, military issues and governance (Pedersen 2008a; 2008a; Long, Minteer, Young 2013; Nyman, Galvao, Mileski, Tiller 2020; Nyman and Tiller 2019). The Svalbard Treaty itself does not directly address the emerging problem of PPCPs and lack of WWTPs. It also does not address tourism activities and the consequences this activity can have on the marine environment (Svalbard Treaty 1920a).

Years later in 2001, Svalbard got its own environmental law, the Svalbard Environmental Protection Act. This law had as its purpose to preserve the environment on Svalbard. More specifically, the act made it illegal for ships to release wastewater into the surrounding sea, and gave the Norwegian government the *right* to force buildings to be connected to the WWTPs (Ministry of Climate and Environment 2001). The Svalbard Environmental Protection Act is subject to different interpretations and there can be situations in which there will be disagreements and conflict (Pedersen 2008a; Kaltenborn, Østreng, Hovelsrud 2020). We also argue that due to the lack of WWTPs in Svalbard, and monitoring shortcomings with illegal dumping – this act has not protected the local environment from PPCPs.

In recent years, a new regulation Relating to Pollution and Waste in Svalbard also entered into force on 1 January 2021 (Ministry of Climate and Environment 2021). This regulation aims to make the existing rules more comprehensive and clear (Ministry of Climate and Environment 2021), and does mention sewage and wastewater, but it too lacks implementation discernment, as to date there are no WWTPs or plans in place to construct one, in the largest settlement on the Archipelago, Longyearbyen.

This local policy consideration implies a slow| decision-making process on issues concerning the archipelago (Kaltenborn, Østreng, Hovelsrud 2020). The recent Act does not include trace levels of pollutants from household waste and could therefore benefit from this addition, and even large-scale international agreements, such as the Stockholm Convention and International Convention of the Prevention of Pollution from Ships (MARPOL), are faced with limitations in terms of encompassing all harmful chemicals – known or unknown (WRI) and their points of pollution. As seen in Table 1. Therefore, action and additional controls must be addressed at all levels of government outside of that of the local governance of Svalbard.

Regional governance

The Arctic region already has several regional governance mechanisms in place, when one looks beyond the Svalbard treaty and other agreements protecting the environment in Svalbard (Stokke 2001; Stokke and Hønneland 2006; Berkman and Young 2009). From the Arctic Council to the Law of the Sea (UNCLOS) to MARPOL to various other individual treaties and agreements on specific issue areas (Tiller and Hansen 2013), the region has evolved into a regime complex with much overlap and interplay over the years. In the past decade, the Polar Code was even adopted under the International Maritime Organization (IMO), which claims to add an additional level of environmental safety to the polar regions regarding shipping and vessel operations (Sun and Beckman 2018). In the following section, we consider where the governance of PPCPs falls within the Arctic regional framework, outside of the realm of the archipelago itself.

Table 1. Local agreements in place on Svalbard to govern PPCPs.

Local/ National Instruments	Main pitfall
Svalbard Environmental Protection Act (svalbardmiljøloven)	The multi-level policy consideration implies a slow decision- making process (Kaltenborn, Østreng, Hovelsrud 2020).
Regulation Relating to Pollution and Waste in Svalbard	This is a new regulation and we have yet to see its results.

A natural place to start considering governance frameworks for PPCPs is within the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) as it includes pollution from both terrestrial and marine sources. This instrument facilitates cooperation on protecting the marine environment in the region and includes 15 governments and the EU (OSPAR Commission 2015).

Another forum that is especially important for the region is the Arctic Council, established in 1996 and consisting of the Arctic states, Arctic Indigenous Peoples and other Arctic inhabitants (The Arctic Council 2021). The Arctic Council is not an international organisation with independent legal character, but rather the leading intergovernmental forum for promoting, coordinating and interacting on Arctic issues, such as sustainable development and environmental protection (Rossi 2015). It has had a number of prominent successes, such as addressing marine oil pollution, and enhancing scientific cooperation -the agreements are, as stated by Berkman and Young (2009), '... *generating policy-relevant knowledge about the Arctic and bringing Arctic issues to the attention of global forums*.' A significant weaknesses and limitation of the Council is the lack of a permanent budget and all projects being funded on a case-by-case basis. In addition, the Arctic Council works via consensus, so controversial topics are unlikely to be addressed adequately in this forum, as exemplified in May 2019, when for the first time, the Arctic countries were unable to agree on the wording of a joint declaration unanimously (Smieszek 2019a). In recent times, we see that cooperation between member states can be tested leading to a halt of collaboration indefinitely. The council has six working groups, and two of these have relevance for PPCP governance, namely 1) the Arctic Monitoring and Assessment Programme (AMAP) and 2) the Protection of the Arctic Marine Environment (PAME).

The former has a mandate to monitor and assess pollution and climate change issues in the Arctic region, it has delivered assessment reports on POPs (Smieszek 2019a), but has not been concerned with PPCPs until quite recently (Kallenborn, Brorström-Lundén, Reiersen, Wilson 2018). The latter, PAME, was established in 1993 and focuses on the protection and sustainable use of the Arctic marine environment (PAME 2021). It has been argued that there is overlap between PAME and the Task Force on Arctic Marine Cooperation (TFAMC). The TFAMC itself is criticised for failing to deliver sufficient recommendation for improving the Arctic Ocean governance (Young 2021). Furthermore, the funding varies significantly in the numerous initiatives, and this insufficient funding for PAME, for example, may present barriers for the effectiveness of the working group (Barry, Daviðsdóttir, Einarsson, Young 2020).

The Polar Code is a more recent development in regional instruments to prevent pollution and increase safety in the harsh environments of both Arctic and Antarctic waters. Adopted in 2015 and entering into force 2 years later, the Polar Code aims to have stricter rules regarding pollution prevention from ships inside polar regions (IMO 2015). However, in the adopted text, the operational requirements of vessels still fall under MARPOL Annexe IV rules when it comes to sewage discharge. However, in the adopted text of the Polar Code, the operational. The additional requirement of sewage treatment plants onboard vessels built after 2017 is represented under 2012 guidelines of waste treatment, which the effects it has had on PPCP pollution is still of concern; Kallenborn, Brorström-Lundén, Reiersen, Wilson 2018 #452). These regional forms of governing PPCPs are witnessed in Table 2.

Table 2. Regional agreements for governing PPCPs.

Regional instruments	Main pitfall
OSPAR Convention	The implementation of Regional Seas Conventions varies in different regions due to for instance lack of political will, political instability in certain states, shortage of funding and inadequate enforcement mechanisms (Rochette and Billé 2013, Mead 2021).
Arctic Monitoring and Assessment Programme (AMAP)	Only recently focusing on PPCPs and therefore still undetermined effectiveness.
Protection of the Artic Marine Environment (PAME)	Overlap with the TFAMC and insufficient funding for PAME presents barriers for the effectiveness of the work group (Barry, Daviðsdóttir, Einarsson, Young 2020).
Polar Code (under the IMO)	Operates under the same MARPOL Annexe IV principles where untreated sewage can be discharged at 12 nm from any ice shelf or treated sewage at 3 nm from ice shelfs.

Global governance

Within the global governance arena, similarly, there are a number of different mechanisms with regulatory oversight that may be applicable to PPCP management in the Arctic. The focus for global governance of PPCPs falls under UNCLOS, UNEP, and the IMO.

The IMO is a special agency of the UN and a legitimate starting point when investigating ocean governance and pollution of our Ocean. It consists of five committees including the Marine Environment Protection Committee (MEPC), who is responsible for prevention and control of pollution from ships (International Maritime Organization 2019a). From the IMO, we received the MARPOL Convention, which consists of six Annexes. Most relevant in the case of PPCPs, is governed by Annexe IV *Prevention of Pollution by Sewage from Ships*. This annexe entered into force in September 2003 and is one of the newest annexes. In short, this annexe includes 'treatment requirements for the discharge of these residues on the basis of the distance from the coast' (Martínez-López, Ruiz-García, Pérez 2020). Under MARPOL, Resolution MEPC.157(55) provides guidelines on the rate of discharge of untreated sewage from ships (International Maritime Organization 1978). One major criticism is that land treatment is stricter than the on-board treatment in Annexe IV (Martínez-López, Ruiz-García, Pérez 2020). Although this resolution is expected to be the case globally, in smaller regions, such as Svalbard the land treatment of PPCPs, is non-existent and therefore not as strict as on-board treatment. Another limitation is that Annexe IV is an optional annexe and 15 states who are party to the mandatory annexes are not party to this one. However, the annexe has also been criticised for its lack of enforcement and there has been multiple requests put forward for a major reshaping of the agreement because of this (Chen 2020), though this lack of enforcement is witnessed in multiple agreements at all levels of governance (OECD 2012).

The second IMO instrument worth noting is the London Convention, or the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 – as it is formally named. This Convention is regarded as one of the first major global conventions based on the premise of protecting the marine environment, specifically from human activities (International Maritime Organization 2019a). The London Convention is meant to promote control over marine pollution and its sources and it has similar goals to the MARPOL 73/78 (Rothwell 2000). All

contracting parties, of which there are 87, are obligated to take measures that are effective in preventing the action of dumping in the sea, which naturally causes marine pollution, including PPCPs. The agreement works on a black-grey list basis, where black-listed items are not allowed to be dumped, and grey-listed items need a special permit (International Maritime Organization 2019a). Greywater is wastewater from the kitchen, laundry and bathroom, excluding the wastewater from the toilet, which is defined as blackwater. PPCPs can be found in both grey and blackwater (Yin et al. 2019; Arifin, Mohamed et al. 2021).

In addition to the IMO, there are other UN agencies and initiatives that address wastewater and sewage concerns in our oceans. For example, UNCLOS 'provides the overarching legal framework for the governance of the oceans' (Enright and Boteler 2020), and was adopted in 1982 (United Nations 1982). The Arctic focus was added largely as an afterthought by three major Arctic players; Canada, Russia, and the US. The result of their private negotiations was Article 234 of UNCLOS locates in Section 8. Ice-covered areas (Solski 2021). With relation to PPCPs, the article specifies that ice-covered areas around the globe could be affected by a legal regime that permits the coastal states to adopt and enforce laws for vessels travelling across any of these areas, if these are within their Exclusive Economic Zones (EEZs), with the intention of preventing marine pollution. Article 76 of UNCLOS may also be considered relevant, as it gives a definition of the continental shelf and regulates the coastal states capacity to declare a continental shelf beyond 200 NM. In other words, it regulates the rights to and ultimately the responsibilities of the seabed outside the EEZs.

The problem with these articles is that they are not specifically meant for the Arctic Ocean, but rather the entire Ocean. It also only applies to the marine Arctic, and its lack of terrestrial application possibilities will ultimately create problems for creating a legal framework for Arctic governance (Rothwell 2013). This entails that it is difficult to sort out disputes, govern, and regulate PPCPs based on an ill-equipped convention, especially as climate change challenges the Arctic environment (Postler 2020).

There are finally three UNEP conventions that also need to be assessed in relation to Arctic governance of PPCPs (MacAfee 2017). The first one is the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, adopted in 1989. Article 4 of the convention lays out the general obligations for the parties to minimise the generation of waste and ensure availability of disposal facilities where possible (UNEP 1989). Moreover, the Rotterdam Convention on the consent procedure for certain chemicals and pesticides in international trade is similar to the Basel Convention, however the Rotterdam Convention does not cover the issue of PPCPs, and the trade of PPCPs is not the main source of pollution. Finally, the Stockholm Convention of Persistent Organic pollutants aims to protect the environment from POPs (UNEP 2001). Originally, this convention covered 12 contaminants but throughout the years more have been added to the list. Not all PPCPs are on the list currently. However, MacAfee notes that '*. . . as the knowledge base from research continues to grow, more pharmaceutically active compounds will likely be included under this important international agreement*' (MacAfee 2017). The global agreements relating to governing PPCPs can be found in Table 3.

Table 3. International global agreements for governing PPCPs.

International instruments	Main pitfall
Annexe IV of MARPOL	Significant lack of enforcement procedures, and most PPCPs are hypothesised to be leaked from the local on land environment in Svalbard (Kallenborn, Brorström-Lundén, Reiersen, Wilson 2018).
London Protocol Basel Convention Rotterdam Convention	Not globally binding – fails at enforcement and monitoring of PPCP pollution. Pollution from PPCPs is from terrestrial sources as well, which these instruments do not cover.
Stockholm Convention	Not all PPCP chemicals are on the list of contaminants covered by the convention (MacAfee 2017)

The Arctic states are as such party to a significant amount of international environmental treaties as well as regional instruments that are consequently bound by international law (Koivurova, Kankaanpää, Stępień 2015). Much of the Arctic territory is under sovereignty of Arctic states and are therefore in addition international and regional governance are subject of national legislation. What is lacking is enforcement and monitoring mechanisms for this planetary boundary problem (Persson et al. 2022). Therefore, we turn to stakeholders local to Svalbard to determine best practices for preventing the harmful pollution of PPCPs, while current governance is failing them.

Methodology

Within this context of lack of regulations to address PPCPs, we decided to examine the perceptions of the local community, to assess to what degree it is possible to find a governance framework that can effectively take care of this challenge. The methodological backdrop of the in-depth interviews of the study had as such its aim to better understand where governance is failing PPCPs in the Arctic, as well as societal pathways for solving the pollution problem from the perspective of those who live and work there. Therefore, our involvement of a variety of stakeholders in this study is an important part of understanding how to best disseminate information and advocate for innovative solutions on how to beat PPCP pollution.

The concrete semi-structured interview methods, followed by an analysis using conceptual mapping, were based on the desire to quantify narrative-rich knowledgebase for the purpose of making management decisions (Cowan et al. 2021). Given the limitation on social gatherings during the global pandemic, which was still ongoing during Fall of 2021, and to reduce our travel, we held the interviews on the Microsoft™ Teams platform. For the purpose of this study, a participatory modelling approach called 'Systems Thinking' was utilised for the workshop, and semi-structured interviews based on an interview guide was employed for the individual interviews. This workshop methodology is an effective method for exploring real-world problems as identified by the stakeholders that inhabit a given system (Freeman 2010). This process takes the form of group conceptualisation or group modelling (Sterman) which has the aim to develop a stakeholder-driven representation of their own 'system'. This conceptualisation process allows scientists to investigate a given system (PPCPs and mitigation strategies in this case) by eliciting information from stakeholders (Freeman 2010). This study uses Freeman's definition of a stakeholder ' . . . any group or individual who can affect or is

affected by the achievement of the organization's objectives' (Freeman 2010) A benefit of utilising this methodological method is that it allows for exploration of a complex topic of system at a local scale (Tiller et al. 2014).

The systems thinking workshop took place during the summer of 2021 with research scientist who have dedicated their careers on the topic of PPCPs and their pollution. We developed conceptual system models based on stakeholders' perceptions using the freeware Vensim for developing the model, followed by analysing the narratives from the recorded sessions to validate the model. The Vensim model was conceptualised and presented to stakeholders with seven different pre-determined drivers.[2] The drivers were decided upon by the researchers in the PharmArctic project via a survey using the platform SurveyMonkey in the Spring of 2021. The drivers were selected based on researchers' expertise and the availability for drivers to influences each other, and they were later validated in a separate workshop. The researchers agreed upon the following drivers to lead the workshop discussion in Norway, with a focus on PPCPs mitigation, and the variables that affect this:

Tourism	Climate Change	Population	WWTP	Regulation	Scientific Knowledge	Public Awareness

Conceptual mapping and in-depth interviews

One of the main aims within the workshop was to develop the conceptual map. The process of creating this involved providing input to the science-policy interface with a bottom-up approach that included the opinions of the workshops stakeholders. The conceptual model provides feedback which relies heavily on qualitative and subjective interpretations of a system (Bredehoeft 2005). In addition to the conceptual map, we conducted in-depth interviews with relevant stakeholders living and working on Svalbard in the cities of Ny-Ålesund and Longyearbyen, during September 2021. The participants in the study were chosen due to their expertise in the various sectors local to Svalbard. During the in-depth interviews with relevant stakeholders, researchers followed a semi-structured interview guide.This meant that there were several questions of interest relevant to the study, and the questions could vary slightly depending on what stakeholder was in focus. We considered, for the purposes of this study, that a more qualitative and conversational approach was the best fit for a supplement of this study. The interview guide covers several different topics related to PPCPs, WWTP, and governance on Svalbard. It included various open-ended questions linked to each topic on PPCPs in the Arctic. The questions also slightly changed based on the sector and expert being interviewed.

[2].For a more detailed understanding of the methodology please refer to Tiller, R., J.-L. De Kok, K. Vermeiren, R. Richards, M. V. Ardelan and J. Bailey (2016). 'Stakeholder perceptions of links between environmental changes to their socio-ecological system and their adaptive capacity in the region of Troms, Norway.' Frontiers in Marine Science **3**: 267.

Table 4. Overview of the number of participants from each sector on PPCPs perceptions. Green marks the workshop, whereas the white boxes represent in-depth interviews.

Stakeholders	Norway/Svalbard	
Government	2	
Healthcare	1	
Tourism	2	
Scientific and research community	4	1

Stakeholder selection

We first mapped the stakeholders for the in-depth interviews by identifying all relevant stakeholders and sectors needed for the interviews (Table 4). This was followed by a stakeholder matrix assessment where the various organisations of interest were ranked in terms of their power and interest in the topic. This decided who to reached out to first, and who were the most relevant stakeholders to hold interviews with. We argue that because of this expertise, the results from highlighting the perceptions from this group outweighs potential low numbers of informants. This is often the case in qualitative research studies, where in some cases, large samples of respondents in a workshop setting can be ineffective and therefore not provide the detailed and contextual information wanted by the facilitator. The aim of the interviews was to analyse and understand perspectives from different sources of stakeholders in terms of *concrete policy action potentials* and future scenarios on the governance of pharmaceuticals in the marine environment around Svalbard specifically. We wanted to explore and explain what this entails in terms of policy action limitations and adaptation options of how these affects management and adaptive capacities at different governance levels of analysis.

The interviews were held in accordance with personal data regulations through permits from NSD, Data Protection Services, in Norway. The participants were given information about the purpose of the interviews before attending and were informed that they could leave the study at any time without any questions from the facilitator. The facilitator recorded the sessions and consent from the narratives from the semi-structured interviews and workshop. All participants gave their recorded oral consent to participate in the study.

Results

The following section provides an overview of the results from the workshop and semi-structured interviews. The analysis of the results will be examined in the following section. The following figure (Figure 1) illustrates the Systems Thinking conceptual model of the researcher's workshop. Their discussion was focused heavily on climate change, regulations and public awareness of the problem as main drivers.

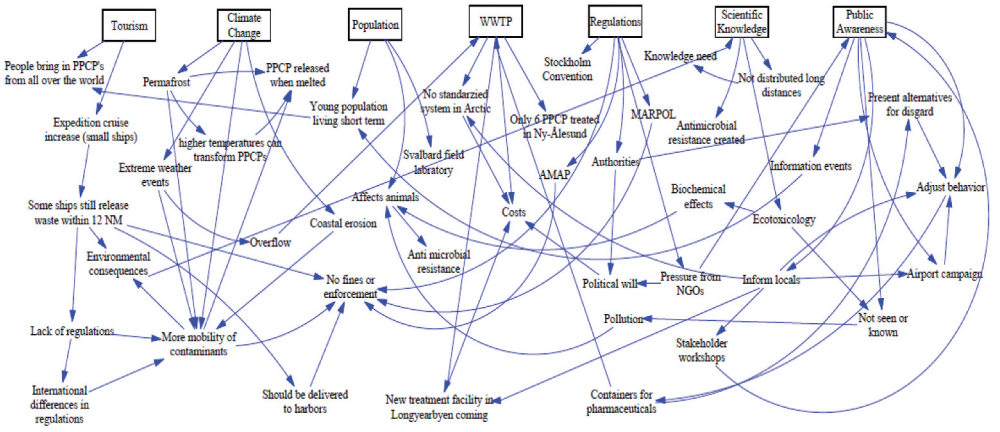

Figure 1. Vensim diagram of the expert workshop with the scientific and researcher community.

Scientific and research community

Throughout the workshop and in-depth interviews with stakeholders in Norway and on the island of Svalbard, researchers were able to provide their perspectives on important questions and cautionary tales regarding the release of PPCPs. The workshop which produced the above conceptual map, consisted of three men and one woman scientist. Some variables stood out as particularly important to the scientist. The following topics were identified as the most pressing variables:

1. Mobility of contaminants in water at various temperatures;
2. Lack of fines or strict enforcement of current regulations;
3. Costs associated with building up better infrastructure (i.e., WWTPs); and
4. Adjusting human behaviour.

The mobility of contaminants – or PPCPs – was seen as one of the more pressing issues that was a direct link to the climate change driver for these stakeholders. Climatic stressors such as melting of permafrost, extreme weather events and coastal erosion were all separate but related variables chosen by the stakeholders when examining climate changes' relation to PPCPs. The difference was that all these variables were also linked to an increased chance of PPCPs flexibility and movement from one location to another. The temperature of the water was theorised by the stakeholders to be a causation of PPCPs mobility as previously demonstrated in the lab, however researchers agreed that more studies in the environmental setting needed to be conducted before a conclusion could be reached. The compounds comprised of PPCPs create a cocktail of effects on nearby species and – '*we lack information about how these effects relay to species in the local environment under Arctic conditions*'. Finally, one aspect that had a broader agreement was that international differences in regulations of chemicals without standardisation at the global level, as described in earlier sections, can increase the mobility of PPCPs.

As witnessed in the government section of this article, regulating and even more challenging, enforcing laws are a difficult task to achieve. The lack of fines for polluting as well as even enforcement mechanisms has only weakened the governance of PPCPs, as

it is with most governance of the commons. Furthermore, there is a significant problem that governance tools rarely address the issues of PPCPs directly. While we are witnessing a slow change in this it is too early to conclude on the result. International differences when it comes to regulation and prescriptions of PPCPs are also a suspected reason behind why a larger spectrum of chemicals are found in the area around the airport on Longyearbyen rather than the release of waste from the municipality, according to the stakeholders. The scientist also alluded to the MARPOL 12 NM release of waste from ships rule – however, they were concerned that the same regulations do not apply for smaller sized vessels, and they are indeed even allowed to release outside the 12 NM margins. *'This is something that can be improved, all ships should deliver their waste into harbours and not let it go out into the seas'*. Ultimately having no strict fines or enforcements for regulations would eventually lead to the continued mobility of harmful PPCPs into the environment, they said. The researchers pointed to how WWTPs could help deviate the waste from the environment, however this infrastructure has its own barriers to implementation.

The government on Svalbard generates income from local taxes, as well as funds from the mainland. The costs associated with building a WWTP is one of the many hinderances for installing a plant in Longyearbyen. The biggest obstacle might be the fact that to date there is no standardisation for waste management in the Arctic in general (Hardenbergh 1949; Burns, Orttung, Shaiman, Silinsky, Zhang 2021). Finally, the political will is lacking for the authorities to justify spending money on a WWTP. To date there has not been verified pressure from NGOs even, which could have perhaps helped facility government action. Informed locals were also hypothesised as a potential motivation for pushing forward to political action to funding WWTP. However, for this to be successful it would require the full adjustment of human behaviour around the topic of PPCPs.

Adjusting human behaviour and having information campaigns was also considered an important avenue for mitigating the release of PPCPs into the local environment by the stakeholders. The first goal established by researchers was to adjust human behaviour by having a government that provides alternatives to waste. *'They [locals and tourist] need to be informed by some kind of information on the PPCPs packages, but also leaflets and information needs to be provided.'* The pharmacy campaigns of returning old PPCPs are lacking according to the researchers and in need of broader outreach to mitigate people throwing or flushing unused PPCPs down their toilets. However, pharmaceuticals are also brought in from around the world without an understanding of their effects on the local environment. *'. . . there is also an issue that ties in directly with tourism because people from many different countries come in and are using prescriptions. Norway has a very strict policy when it comes to this, and the tourists have access to a variety of different PPCPs.'* Overall shifting behaviours will therefore require informed locals as well as tourist via public awareness campaigns as well as clear alternatives for discard, they said. This has no way of working without the guidance and action of local government on Longyearbyen which is examined in the next section of the results.

Government

The research provided the opportunity to interview two stakeholders working in the local government on Svalbard. *'We have the need to do things better than yesterday, and when it comes to wastewater, we know our system is not perfect'*, one interviewee said. Although the move to a new system has already begun, it will only block solid waste and is therefore not strong enough to tackle the persistent build-up of PPCPs in human waste, he said. *'There is a problem with pollution and littering on Svalbard, and we are not doing enough when it comes to PPCPs'*, the second interviewee said. The government sector believed that it was a matter of funding that was responsible for the lack of a better WWTP. With relatively few residences living in Longyearbyen, the costs to build a treatment plant is a major obstacle. One interviewee suggested that it might be, in fact, a good solution to transport waste to mainland Norway if WWTP are not able to be properly built in the Arctic environment of Svalbard.

Even the people in government believe regulations are not enough, though, as the researchers had said. '*Normally we say we have the strictest regulations for wildlife, and that might not be true – it is strict on where you can and cannot go*.' the first interviewee said. The laws would be perfect if no one was living on Svalbard, in this case, but since people do live there, stricter regulations must be applied at all levels of governance the interviewees said. Similar to what the scientist stated, interviewees working in governance also believed that the shipping and tourism sectors were not regulated strongly enough to avoid pollution from these industries. As a third-party country to the EU, not all regulations apply either, and the second interviewee said that: *'We need to look at the direction the EU sets, the goal for Svalbard is to be at least as strict as the mainland'*.

The researchers who were interviewed in the workshop had pointed out the importance of information campaigns for locals and tourist to understand the impact of PPCPs raise public awareness. The local government stated that they did have movies and information clips for citizens shown at the local cinema and even on the place where all local information is found – Facebook. A bigger question was though, they said, how tourist could access this information? One interviewee stated that tourists were eager to learn more about Svalbard before arriving, and tourist websites could provide vital information. Moreover, one stakeholder in the governance sector suggested limiting tourism all together, especially when it came to large cruise vessels and the areas they travel into. '*Tourism has grown to a level that is too big*.'

Tourism

The semi-structured interviews within the tourism sector provided the opportunity to interview one male and one female employee in the sector and was important for the contextualisation of the challenges the governance sector saw with regard to this sector. Throughout the interviews with all stakeholders, the impression was that the relationship with the tourism sector on Svalbard was a love – hate relationship depending on who you talked to. One matter that cannot be denied is that cruise tourism alone brought in 12 million USD to the region in 2018 (AECO 2019). While the coal industry has been in

a constant decline, the tourism industry is viewed by many as a good economic alternative to bring in funds to Svalbard (Viken and Jørgensen 1998). In fact, '*. . . 60% of the market in Longyearbyen is thanks to its land-based tourism operations*' the first interviewee from the sector said.

The tourism sector in Longyearbyen is even looking to electrify its tours to limit CO2 emissions and appeal to a younger generation that demands change, the interviewees explained. The interviewees also were in shared agreement that '*. . . the local government needs to do more about the lack of WWTPs and the harm caused by PPCPs*'. There appeared to be an absence of mutual understanding between the government and tourism sectors, as such, since there are new laws in place on where tourism can, and more importantly cannot take place – nor is there a WWTP to mitigate the challenges in place. '*We need to find a balance between tourism and nature*' the first interviewee said. The balance could be found within the Svalbard Environmental Fund, they said. This is in the reference to a fund that is created based on a fee that is taken anytime someone flies to Svalbard from mainland Norway. The fee of 150NOK is added to their trip and that money is used towards protecting the environment. This fund was suggested to be put towards building up WWTP by the interviews, however there was also a priority que. To protect the environment from PPCP pollution the problem must be understood at the source – the products themselves.

Healthcare

The final part of the results section is centred on healthcare. One stakeholder who works in the healthcare sector on Svalbard was interviewed. In reference to the fund discussed by the tourism sector, they said that there was an understanding that as it stands today, PPCPs are not at the top of governments agenda. '*They [local government] are spending money making cities safe from catastrophes such as avalanches, so WWTPs are not a priority*' the healthcare interviewee said. The healthcare interviewee was in agreement with many of the others, in the problem being that there is no proper information or action of people disposing of their PPCPs correctly. '*I deliver my leftover [PPCPs] back to the pharmacy on Longyearbyen – however there is not much information on where to dispose of them to the general public*' the second governance interviewee said, for example. However, when we examined the healthcare experts' point of view the problem has different outcomes. '*People are good at delivering drugs at the pharmacy and we have a special waste place to burn them*' the interviewee said and went on to note that within the whole of Norway, there was a campaign five years ago to return leftover drugs back to the pharmacy, and since then, people had been returning more pharmaceuticals than ever before, the interviewee argued.

Tourism was also an interesting topic examined within the healthcare interview. Tourist almost always bring their own medicine, and if they arrive on a cruise ship, they have their own pharmacies on board. Therefore, trying to estimate the exact PPCPs leaked from ships and from tourist coming on land can be a near impossible challenge. The same can be said for locals, as many of the interviewees themselves stated that they bring their own medications from the mainland Norway. In that sense, products that are often never sold on Longyearbyen, such as anti-depressants, are likely all brought from aboard, and therefore difficult to estimate their full impact.

Regarding the comments made by one of the government interviewees about putting warning labels on PPCP packaging, the healthcare stakeholder also had a differed opinion on that. '*When people need medicine, I cannot give them a bad conscience about using it. You must be careful about this; you want people to use their medicine if it keeps them alive*' the interviewee said and went on to say that there was more to do with creating the infrastructure for WWTP than to go to the individual level to fight PPCPs. It is important to raise awareness about the issue, however, the person said, and there needs to be a balance.

Discussion and conclusion

PPCPs are truly one of the most highly unregulated sources of hazardous pollutants facing the Arctic, and they are literally being flushed down the toilet, without WWTPs available to hinder its release into the ecosystem. We have highlighted the gaps in governance surrounding PPCPs on various levels, while exploring stakeholders' perceptions of more direct mitigation efforts. To achieve this, qualitative semi-structured in-depth interviews and a workshop were carried out and transcribed. In total there were six independent interviews (government, tourism, healthcare, research), and one workshop with four PPCP experts. The Systems Thinking modelling approach offered a unique perspective of mitigation methods for PPCPs pollution in the Arctic environment of Svalbard. Although these results should not be viewed as an end-all-be-all, they nevertheless deliver a valid account of the obstacles within and throughout sectors that the region is facing when it comes to governing pharmaceuticals. The results also demonstrate the importance of stakeholder engagement from various parts of society when deciphering the best steps forward.

There are many agreements and regulations on the global, regional and local/national level that governs the coastal and marine ecosystems. The trend is that these instruments are lacking specific focus on PPCPs but are relevant in this context as they address pollution of the marine ecosystems generally. On the global level, the IMO has two key governance tools: MARPOL and the London Convention. However, both in the case of MARPOL and UNCLOS, include challenges in terms of PPCP management, specifically with enforcement. On a regional level, there are agreements governing the coastal and marine environment, such as for example OSPAR, which varies in different regions, due to for instance lack of political will, shortage of funding and inadequate enforcement mechanisms to name a few (Rochette and Billé 2013; Mead 2021). The Arctic Council is relevant in this context of course, with two of its six working groups AMAP and PAME having a particular relevance. However, these are criticised in terms of effectiveness due to insufficient funding (Barry, Daviðsdóttir, Einarsson, Young 2020). On the local level, one needs to consider the Svalbard Environmental Protection act and the newly introduced regulation Relating to Pollution and Waste in Svalbard. The Svalbard Environmental Protection Act is criticised for having a slow decision-making process (Kaltenborn, Østreng, Hovelsrud 2020). The Regulation Relating to Pollution and Waste in Svalbard was very recently introduced and it is therefore too early to know its results yet.

Looking more closely at how these multi-level governance arenas for marine pollution, wherein PPCPs would fall, affect specific local communities, results from the interviews and workshop did demonstrate that priorities change depending on which sector you work in. For researchers, the effects of climatic stressors will only aid in the transport

and release of new chemicals that continue to harm the environment, in turn having a negative consequence for biodiversity protection. Information campaigns and warning labels were understood by the local government in the region to be a starting point to engage people's awareness. These ideals and sentiments will need to be carefully constructed as warned by the healthcare stakeholder in that the burden is not merely placed on citizens. This has been demonstrated elsewhere in plastics, where decades ago the problem with clean-up and use was placed on consumers' conscience – which will not solve the source of the problem. Important aspects needing to be highlighted when it comes to tourism were many, as tourism brings in much of the funding to Svalbard and Longyearbyen specifically, the sector appears very adamant that governance should be the guiding force for change. The stakeholders working in the government sector mentioned that not enough is being done to prevent the harm of PPCPs on Svalbard in the first place, and most agreed that a WWTP in Longyearbyen could have a positive effect on hindering release of PPCPs.

Marine pollutants are a complex, wicked issue, which PPCPs contribute to. Further work should include bringing in more stakeholders and holding a joint workshop where policy action plans could be developed based on a selection of the 'best' scenarios identified from this study and the interviews. PPCPs would likely benefit from being governed at a global level when the production starts on land – much like the challenge of plastic pollution. Protecting biodiversity in the Arctic is important, and land-based pollution has to be curbed if we are to tackle the upcoming commitments signatories to the post-2020 global biodiversity framework. More research on how to further enhance WWPTs – and adapt them to Arctic situations – would go further towards reducing pollution than adding more layers to an already complex Arctic governance arena. The easiest solution is sometimes the best one.

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Bibliography

AECO. (2019, 11.November.2019). "Cruise Toursim Brought Svalbard NOK 110 Million in Earnings in 2018." from https://www.aeco.no/2019/09/cruise-tourism-brought-svalbard-nok-110-million-in-earnings-in-2018/.

Arifin, S.N.H., R. Mohamed, A. Al-Gheethi, C.W. Lai, and G. Yashni. "Heterogeneous Photocatalysis of Triclocarban and Triclosan in Greywater: A Systematic and Bibliometric Review Analysis." *International Journal of Environmental Analytical Chemistry* (2021): 1–19. doi:10.1080/03067319.2020.1863391.

Barry, T., B. Daviðsdóttir, N. Einarsson, and O.R. Young. "The Arctic Council: An Agent of Change?" *Global Environmental Change* 63 (2020): 102099. doi:10.1016/j.gloenvcha.2020.102099.

Berkman, P.A., and O.R. Young. "Governance and Environmental Change in the Arctic Ocean." *Science* 324, no. 5925 (2009): 339–40. doi:10.1126/science.1173200.

Bredehoeft, J. "The Conceptualization Model problem—surprise." *Hydrogeology Journal* 13, no. 1 (2005): 37–46. doi:10.1007/s10040-004-0430-5.

Brumovský, M., J. Bečanová, O. Sáňka, K.B. Løken, D.L. Baho, K. Sørensen, and L. Nizzetto. "Line Ferries and Cargo Ships for the Monitoring of Marine Contaminants of Emerging Concern: Application along a Europe-Arctic Transect." *Journal of Hazardous Materials* 424 (2022): 127232. doi:10.1016/j.jhazmat.2021.127232.

Burns, C., R.W. Orttung, M. Shaiman, L. Silinsky, and E. Zhang. "Solid Waste Management in the Arctic." *Waste Management* 126 (2021): 340–50. doi:10.1016/j.wasman.2021.03.021.

Chen, W. (2020). "Support for Major Reshape of MARPOL Annex IV." Retrieved 11. October, 2021, from https://www.maritime-executive.com/editorials/support-for-major-reshape-of-marpol-annex-iv.

Chow, R. "Purdue Pharma and OxyContin–A Commercial Success but Public Health Disaster." *Harvard Public Health Review*, 25 (2019).

Cowan, E., A.M. Booth, A. Misund, K. Klun, A. Rotter, and R. Tiller. "Single-Use Plastic Bans: Exploring Stakeholder Perspectives on Best Practices for Reducing Plastic Pollution." *Environments* 8, no. 8 (2021): 81. doi:10.3390/environments8080081.

Enright, S.R., and B. Boteler. *The Ecosystem Approach in Marine Environmental Law and Governance. Ecosystem- Based, Management, Ecosystem Services and Aquatic Biodiverity Theory, Tools and Application*. T.G. O'Higgins, M. Lago, and T.H. DeWitt. Cham, Switzerland: Springer Open. 333–52. 2020.

Freeman, R.E. *Strategic Management: A Stakeholder Approach*. Cambridge University Press, 2010.

Gunnarsdóttir, R., P.D. Jenssen, P.E. Jensen, A. Villumsen, and R. Kallenborn. "A Review of Wastewater Handling in the Arctic with Special Reference to Pharmaceuticals and Personal Care Products (Ppcps) and Microbial Pollution." *Ecological Engineering* 50 (2013): 76–85. doi:10.1016/j.ecoleng.2012.04.025.

Hardenbergh, W. "Arctic Sanitation." *American Journal of Public Health and the Nations Health* 39, no. 2 (1949): 202–04. doi:10.2105/AJPH.39.2.202.

Hovelsrud, G.K., B.P. Kaltenborn, and J. Olsen. "Svalbard in Transition: Adaptation to cross-scale Changes in Longyearbyen." *The Polar Journal* 10, no. 2 (2020): 420–42. doi:10.1080/2154896X.2020.1819016.

IMO (2015). Marine Environment Protection Committee Resolution MEPC, 264 (68) (May 15, 2015) International Code for Ships Operating in Polar Waters (Polar Code).

International Maritime Organization. *Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, 1973*. United Nations: U. Nations, 1978.

International Maritime Organization. (2019a). "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter." Retrieved 11. October, 2021, from https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx .

International Maritime Organization. (2019b). "Marine Environment Protection Committee (MEPC)." Retrieved 11. October, 2021, from https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-default.aspx.

Kallenborn, R., J. Fick, R. Lindberg, M. Moe, K. Nielsen, M. Tysklind, and T. Vasskog. "Pharmaceutical Residues in Northern European Environments: Consequences and Perspectives." *Pharmaceuticals in the Environment*. Berlin Heidelberg: Springer-Verlag, 61–74. 2008.

Kallenborn, R.B.L.E. *Pharmaceuticals and Personal Care Products*. AMAP, 141–72. 2016.

Kallenborn, R., E. Brorström-Lundén, L.-O. Reiersen, and S. Wilson. "Pharmaceuticals and Personal Care Products (Ppcps) in Arctic Environments: Indicator Contaminants for Assessing Local and Remote Anthropogenic Sources in a Pristine Ecosystem in Change." *Environmental Science and Pollution Research* 25, no. 33 (2018): 33001–13. doi:10.1007/s11356-017-9726-6.

Kaltenborn, B.P., W. Østreng, and G.K. Hovelsrud. "Change Will Be the constant–future Environmental Policy and Governance Challenges in Svalbard." *Polar Geography* 43, no. 1 (2020): 25–45. doi:10.1080/1088937X.2019.1679269.

Koivurova, T., P. Kankaanpää, and A. Stępień. "Innovative Environmental Protection: Lessons from the Arctic." *Journal of Environmental Law* 27, no. 2 (2015): 285–311. doi:10.1093/jel/equ037.

Kurniawan, E.A.D., Fatmawati, and Miswanto (2021). Modeling of Global Warming Effect on the Melting of Polar Ice Caps with Optimal Control Analysis. AIP Conference Proceedings, AIP Publishing LLC.

Lichtenberg, F.R. "Pharmaceutical Innovation and Longevity Growth in 30 Developing and high-income Countries, 2000–2009." *Health Policy and Technology* 3, no. 1 (2014): 36–58. doi:10.1016/j.hlpt.2013.09.005.

Long, J., K. Minteer, and S. Young. "Scramble for the Arctic: Layered Sovereignty, UNCLOS, and Competing Maritime Territorial." *SAIS Review*, 33 (2) (2013).

MacAfee, E. (2017). "Pharmaceuticals and Personal Care Products in the Marine Environment: An Emerging Issue."

Martínez-López, A., A. Ruiz-García, and I.J.S. Pérez. "Social Cost Benefit Analysis of Port Handling Plans for Annex IV Waste of MARPOL: A Case Study in Las Palmas Port." Sustainability. 12, no. 6 (2020): 2382.

Mead, L. (2021). "The "Crown Jewels" of Environmental Diplomacy: Assessing the UNEP Regional Seas Programme." Retrieved 12. October, 2021, from https://www.iisd.org/articles/crown-jewels-environmental-diplomacy-assessing-unep-regional-seas-programme.

Miller, T.H., N.R. Bury, S.F. Owen, J.I. MacRae, and L.P. Barron. "A Review of the Pharmaceutical Exposome in Aquatic Fauna." *Environmental Pollution* 239 (2018): 129–46. doi:10.1016/j.envpol.2018.04.012.

Ministry of Climate and Environment. *Lov om miljøvern på Svalbard (svalbardmiljøloven)*. Norwegian Ministry of Climate and Environment (2001).

Ministry of Climate and Environment. *Forskrift om forurensning og avfall på Svalbard*. Norwegian Ministry of Climate and Environment (2021).

Moiseenko, T.I., A.A. Voinov, V. Megorsky, N. Gashkina, L. Kudriavtseva, O. Vandish, A. Sharov, Y. Sharova, and I. Koroleva. "Ecosystem and Human Health Assessment to Define Environmental Management Strategies: The Case of long-term Human Impacts on an Arctic Lake." *Science of the Total Environment* 369, no. 1–3 (2006): 1–20. doi:10.1016/j.scitotenv.2006.06.009.

Moranta, J., C. Torres, I. Murray, M. Hidalgo, H. Hinz, and A. Gouraguine. "Transcending Capitalism Growth Strategies for Biodiversity Conservation." *Conservation Biology* 36, no. 2 (2021). doi:10.1111/cobi.13821.

Núñez-Rocha, T., and I. Martínez-Zarzoso. "Are International Environmental Policies Effective? the Case of the Rotterdam and the Stockholm Conventions." *Economic Modelling* 81 (2019): 480–502. doi:10.1016/j.econmod.2018.04.013.

Nyman, E., and R. Tiller (2019). "'Is There a Court that Rules Them All'? Ocean Disputes, Forum Shopping and the Future of Svalbard." Marine Policy: 103742.

Nyman, E., C.B. Galvao, J. Mileski, and R. Tiller. "The Svalbard Archipelago: An Exploratory Analysis of Port Investment in the Context of the New Arctic Routes." *Maritime Studies* 19, no. 1 (2020). 1-13.

OECD. *Recommendation of the Council on Regulatory Policy and Governance*. OECD, 2012.

OSPAR. *Marine Litter in the North-East Atlantic Region: Assessment and Priorities for Response*. R. L. Lozano and J. Mouat. London, United Kingdom: OSPAR. 127. 2009.

OSPAR Commission. (2015). "About OSPAR." Retrieved 12. October, 2021, from https://www.ospar.org/about.

PAME. *PAME Main Achievements Summary Report 2019- 2021*. Iceland: Arctic Council, 2021.

Pedersen, T. "The Constrained Politics of the Svalbard Offshore Area." *Marine Policy* 32, no. 6 (2008a): 913–19. doi:10.1016/j.marpol.2008.01.006.

Pedersen, T. "The Dynamics of Svalbard Diplomacy." *Diplomacy & Statecraft* 19, no. 2 (2008b): 236–62. doi:10.1080/09592290802096299.

Persson, L., B.M. Carney Almroth, C.D. Collins, S. Cornell, C.A. de Wit, M.L. Diamond, P. Fantke, M. Hassellöv, M. MacLeod, and M.W. Ryberg. "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities." *Environmental Science & Technology* (2022).

Postler, A. (2020). "UNCLOS in the Arctic: A Treaty for Warmer Waters." Retrieved 12. October, 2021, from https://georgetownsecuritystudiesreview.org/2020/02/24/unclos-in-the-arctic-a-treaty-for-warmer-waters/ .

Rochette, J., and R. Billé. "Bridging the Gap between Legal and Institutional Developments within Regional Seas Frameworks." *The International Journal of Marine Coastal Law* 28, no. 3 (2013): 433–63. doi:10.1163/15718085-12341277.

Rossi, C.R. "The Club within the Club: The Challenge of a Soft Law Framework in a Global Arctic Context." *The Polar Journal* 5, no. 1 (2015): 8–34. doi:10.1080/2154896X.2015.1025490.

Rothwell, D.R. *Global Envionmental Protection Instruments and the Polar Marine Environment. Protecting the Polar Marine Environment: Law and Policy for Pollution Prevention*. D. Vidas, Cambridge University Press, 57–77. 2000. https://www.oecd.org/governance/regulatory-policy/49990817.pdf

Rothwell, D.R. (2013). The Law of the Sea and Arctic Governance. Proceedings of the ASIL Annual Meeting, Cambridge University Press.

Smieszek, M. "Evaluating Institutional Effectiveness: The Case of the Arctic Council." *The Polar Journal* 9, no. 1 (2019a): 3–26. doi:10.1080/2154896X.2019.1618554.

Smieszek, M. *Policy Dialogue on Global-Arctic Interactions: A Perspective from an Early Career Researcher. The Arctic in World Affairs: The North Pacific Dialogue on Global-Arctic Interactions: The Arctic Moves from Periphery to Center*. R.W. Corell, J.D. Kim, Y.H. Kim, et al. Busan, Korea Maritime Institute. 2019b. https://www.eastwestcenter.org/system/tdf/private/2019_npac_proceedings.pdf?file=2011&type=node&id=37446

Solski, J.J. "The Genesis of Article 234 of the UNCLOS." *Ocean Development & International Law* 52, no. 1 (2021): 1–19. doi:10.1080/00908320.2020.1835026.

Sonne, C., R. Dietz, B.M. Jenssen, S.S. Lam, and R.J. Letcher. "Emerging Contaminants and Biological Effects in Arctic Wildlife." *Trends in Ecology & Evolution* 36, no. 5 (2021): 421–29. doi:10.1016/j.tree.2021.01.007.

Sterman, J. *Business Dynamics: Systems Thinking and Modelling for a Complex World*. Boston: McGraw Hill Higher Education, 2000.

Stokke, O.S. *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*. New York, USA: Oxford University Press on Demand, 2001.

Stokke, O.S., and G. Hønneland. *International Cooperation and Arctic Governance: Regime Effectiveness and Northern Region Building*. London, UK: Routledge, 2006.

Sun, Z., and R. Beckman. *The Development of the Polar Code and Challenges to Its Implementation*. Global Commons and the Law of the Sea, pp. 303–25. Brill Nijhoff, 2018.

Svalbard Treaty. "Treaty between Norway, the United States of America." *Great Britain and Ireland and the British Overseas Dominions and Sweden Concerning Spitsbergen Signed in Paris*. 9th February 1920a Denmark, France, Italy, Japan, the Netherlands. 1920.

Svalbard Treaty. "Treaty between Norway, the United States of America." Great Britain and Ireland and the British overseas Dominions and Sweden concerning Spitsbergen signed in Paris. 9th February 1920b Denmark, France, Italy, Japan, the Netherlands: United Nations, www.lovdata no 1920.

The Arctic Council. (2021). "About the Arctic Council." Retrieved 11. October, 2021, from https://arctic-council.org/about/.

Tiller, R.G. "New Resources and Old Regimes: Will the Harvest of Zooplankton Bring Critical Changes to the Svalbard Fisheries Protection Zone?" *Ocean Development & International Law* 40, no. 4 (2009): 309–18. doi:10.1080/00908320903076862.

Tiller, R., and S.T. Hansen. "International Regime Analyses in the Northeast Atlantic." *Journal of Environmental Studies and Sciences* 3, no. 2 (2013): 217–31. doi:10.1007/s13412-013-0113-4.

Tiller, R., R. Richards, H. Salgado, H. Strand, E. Moe, and J. Ellis. "Assessing Stakeholder Adaptive Capacity to Salmon Aquaculture in Norway." *Consilience: The Journal of Sustainable Development* 11, no. 1 (2014): 62–96.

Tiller, R., J.-L. De Kok, K. Vermeiren, R. Richards, M.V. Ardelan, and J. Bailey. "Stakeholder Perceptions of Links between Environmental Changes to Their socio-ecological System and Their Adaptive Capacity in the Region of Troms, Norway." *Frontiers in Marine Science* 3 (2016): 267. doi:10.3389/fmars.2016.00267.

UNCLOS (1982). United Nations Convention on the Law of the Sea of 10 December 1982. Division for Ocean Affairs and the Law of the Sea. http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf, United Nations.

UNEP. *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal*. Geneva: UNEP, 1989.

UNEP. *Stockholm Convention on Persistent Organic Pollutants (Pops)* Stockholm. (2001).

United Nations (1982). "United Nations Convention on the Law of the Sea of 10 December 1982."

United Nations General Assembly (2012). Resolution Adopted by the General Assembly on 27 July 2012: The future we want. https://www.un.org/en/ga/search/view_doc.asp?symbol=%20A/RES/66/288.

Viken, A., and F. Jørgensen. "Tourism on Svalbard." *Polar Record* 34, no. 189 (1998): 123–28. doi:10.1017/S0032247400015266.

Weigel, S., U. Berger, E. Jensen, R. Kallenborn, H. Thoresen, and H. Hühnerfuss. "Determination of Selected Pharmaceuticals and Caffeine in Sewage and Seawater from Tromsø/Norway with Emphasis on Ibuprofen and Its Metabolites." *Chemosphere* 56, no. 6 (2004): 583–92. doi:10.1016/j.chemosphere.2004.04.015.

WRI, W.R.I. (2021). Climate Watch Historical GHG Emissions.

Yin, H., M. Xie, L. Zhang, J. Huang, Z. Xu, H. Li, R. Jiang, R. Wang, and X. Zeng. "Identification of Sewage Markers to Indicate Sources of Contamination: Low Cost Options for Misconnected non-stormwater Source Tracking in Stormwater Systems." *Science of the Total Environment* 648 (2019): 125–34. doi:10.1016/j.scitotenv.2018.07.448.

Young, O.R. "Is It Time for a Reset in Arctic Governance?" *Sustainability* 11, no. 16 (2019): 4497. doi:10.3390/su11164497.

Young, O.R., and J.-D. Kim. "Next Steps in Arctic Ocean Governance Meeting the Challenge of Coordinating a Dynamic Regime Complex." *Marine Policy* 133 (2021): 104726. doi:10.1016/j.marpol.2021.104726.

Young, O.R. "What Can We Learn about Ocean Governance from the Performance of the Arctic Council's Task Force on Arctic Marine Cooperation?" *The Polar Journal* 11, no. 2(2021): 269–283.