Resilience to exogenous shocks in environmental management regimes in the Arctic – lessons learned from survivors

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A changing climate will impact not only the environment but all levels of governance thereof, including the context of the close to 400 multilateral environmental management agreements signed since the year 2000. For the Ocean, researchers project that the increasing sea surface temperatures will facilitate large changes in the marine food web, including large shifts in distribution patterns of marine life towards the north and cooler waters. These new distributions of marine resources have political consequences. But to what extent will these climatic stressors act as an external "shock" to existing management regimes in the Arctic? How resilient are the current Arctic management regimes? We illustrate these questions with a particular on-going case of the sharing of the Northeast Atlantic mackerel quota. The negotiation difficulties among Norway, the EU, Faroe Islands, Iceland, Greenland and Russia initiated by the the vast expansion its distribution pattern gives us a hint of what is to come if business-as-usual scenarios of the International Panel on Climate Change (IPCC) come to pass. We further focus our analysis on the Svalbard Fisheries Protection Zone, to learn from other environmental management regimes that have lived through exogenous shocks. Finally, we discuss the impact exogenous shocks have had on three different environmental management regimes: the impact of the ozone hole on the ozone regime, the impact of Black Forest death (“Waldsterben”) on the Convention on Long-range Transboundary Air Pollution, and the impact on Regional Fisheries Management Organizations of the creation of Exclusive Economic Zones under the United Nations Convention on the Law of the Sea.

Keywords: Svalbard; regime resilience; exogenous shocks; Arctic; climate change

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Introduction

Between the years 2000 and 2017, almost 400 multilateral environmental management agreements and amendments thereto were signed around the world[1]. These ranged in issue areas from the development and exploitation of navigation on the Senegal river to the prevention of marine pollution from oil spills and beyond. As the worldwide consensus on climate change culminated with one of these agreements, the ratification of the Paris Agreement in 2015, sea surface temperatures were at record highs in many areas, and for most of the Norwegian Sea (ca 1.38 million km^2) and the Barents Sea (ca 313,000 km^2) [2, 3].

For fisheries, research suggests that if we continue with business as usual scenarios (RCP8.5)[4], more than 800 species of marine fish and invertebrates will shift towards the poles 65% faster than if we fall under the low-emission scenario of 2 degrees Celsius suggested by the Paris Agreement [5, 6]. In fact, warming waters have already made changes to the habitat of phyto- and zooplankton, and forced these temperature-sensitive species to move farther north, with the stock of the Northeast Atlantic mackerel following these crucial food sources. Researchers have been studying this northward shift of the mackerel, as well as other important commercial fish species like cod, capelin and haddock. These are now all present to one extent or another as far north as the Svalbard archipelago in the Arctic, in the waters of the Svalbard Fisheries Protection Zone (SFPZ)[7, 8, 9].

Another marine resource moving towards Svalbard is the snow crab that has become a highly valuable species for commercial fishery. In the Barents Sea, the distribution pattern of the snow crab is west of Novaya Zemlya. However, based on the yearly stock assessment cruises carried out by the Institute of Marine Research of Norway (IMR), the prediction is that the snow crab stock will move west in the Barents Sea towards most areas around Svalbard and Franz Josef Land. In addition, estimates suggest that the value of the snow crab fishery on the Norwegian continental shelf may exceed the Norwegian cod fisheries in the future, with annual catch values of 1-5 billion NOK by 2020[10].

In light of a number of different climatic stressors such as these, that have uncertain effects on ecosystem goods and services, and the management thereof, we explore scenarios of resilience of environmental institutions and management regimes in the Arctic by looking specifically at some of these examples and how they affect the arguably[11, 12] vulnerable

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[1] Mitchell, *International Environemntal Agreements (IEA) Databse Project*, ibid.
[2] Polyakov et al., 'Warming of the Intermediate Atlantic Water of the Arctic Ocean in the 2000s'.
[3] Berge et al., 'First records of Atlantic mackerel (Scomber scombrus) from the Svalbard Archipelago, Norway, with possible explanations for the extension of its distribution'.
[4] IPCC, *Climate Change 2014: Synthesis Report. Contribution of Working Gorups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*
[5] Gattuso et al., 'Contrasting futures for ocean and society from different anthropogenic CO2 emissions scenarios'.
[6] UNFCCC, *Paris Agreement*.
[7] Berge et al., 'First records of Atlantic mackerel (Scomber scombrus) from the Svalbard Archipelago, Norway, with possible explanations for the extension of its distribution'.
[8] Svenning et al., 'First records of three-spined stickleback Gasterosteus aculeatus in Svalbard freshwaters: An effect of climate change?'.
[9] Haug et al., 'Future harvest of living resources in the Arctic Ocean north of the Nordic and Barents Seas: A review of possibilities and constraints'.
[10] Hvingel and Sundet, *Snow Crab - a new substantial resource in the Barents Sea (In Norwegian: Snøkrabbe - en ny stor ressurs i Barentshavet)*.
[11] Tiller and Nyman, 'Having the cake and eating it too: To manage or own the Svalbard Fisheries Protection Zone'.
[12] Tiller and Nyman, 'The clear and present danger to the Norwegian sovereignty of the Svalbard Fisheries Protection Zone: Enter the snow crab'.

governance regime in place in the marine territory surrounding the archipelago of Svalbard in the High North. We ask what may happen to environmental regimes in the Arctic such as this one that may undergo exogenous shocks in the future, brought forth by either climatic or non-climatic stressors, and how do they adapt – if they do?

To explore this scenario, the following paper looks to institutional theory and compare our case of Svalbard with environmental management regimes that have persued through exogenous shocks in the past to analyze what lessons can be learned and applied to the Svalbard regime. The change in distribution of both mackerel and snow crab is already testing the political waters of multi-lateral sharing of marine resources in the area based on historical quotas and fishing rights. To discuss how these changes may or may not become an "exogenous shock" to governance mechanisms already in place when affected further by climatic stressors such as rising sea surface temperatures, we will assess the experiences to exogenous shocks of three management regimes and their responses to exogenous shocks, or external “stressors”: 1) The impact of the ozone hole on the ozone regime (Montreal protocol), 2) the impact of Black Forest deaths (“Waldsterben”) on the Convention on Long-range Transboundary Air Pollution (LRTAP), and 3) the impact on North East Atlantic Fisheries Commission (NEAFC) of the creation of Exclusive Economic Zones (EEZs) under the United Nations Convention on the Law of the Sea (UNCLOS). In doing so, we gain an understanding on how regimes under influence of strong external forces lead to changes in the original functionalities of said regimes, and discuss to what extent the management regimes in the Arctic under external climatic stressors are robust enough to withstand the effects of the external environmental “shocks” to come, if it can adapt, and what it can learn from the experiences of those that have experienced similar externalities to their regime functionalities.

We first discuss theories of institutional change in general, followed by a short description of the three management regimes and the exogenous factors that led to the changes in their functionalities and issue areas. We then introduce the water colund and continental shelf cases of mackerel and snow crab, and explore to what degree the insights from institutional theory and the three cases apply to the current case and the effects of the exogenous factors of increased sea surface temperature and resultant changes in marine stock sizes and distribution on the governance of the marine area and protected zone.

Institutional theory

Climate change and the resultant effects thereof may challenge existing environmental institutions[13, 14, 15]. One of the ways in which this may happen is through the effects of stressors from climate change acting as exogenous environmental processes, or a critical junctures, for the given regime[16]. In doing so, these resultant stressors could in some cases be strong enough to challenge the premises upon which a given management regime was created in the first place and refashion the institutional policy choices of said institutions. Exogenous shocks, or punctuated equilibriums, such as these, usually come about after a period of institutional stability, where continuity and reproduction of the institution in question has taken place. Some argue that only a radical change can destabilize such a system, and cause the institutional

[13] Gattuso et al., 'Contrasting futures for ocean and society from different anthropogenic CO2 emissions scenarios'.
[14] Hull, 'Ocean Acidification: Legal and Policy Responses to Address Climate Change's Evil Twin'.
[15] Magnan et al., 'Implications of the Paris agreement for the ocean'.
[16] Pierson, *Politics in time: history, institutions, and social analysis*.

structure to be refashioned[17]. However, others argue that since not all changes to institutions are brought about by shocks to the system[18, 19], processes of change that are irrespective of institutional breakdown are also important to explore.

An overview of some important concepts in institutional theory is in order. Kathleen Thelen is a researcher that introduced, defined and developed a number of explanations to mechanisms of incremental institutional changes over time[20, 21, 22, 23], including that of the concept of institutional layering, which is relevant to the case of Arctic governance under climate change. This concept explains the gradual transformation of institutions whereby new elements are attached to existing structures which steadily changes their original functions. We can see evidence of institutional layering in for instance the amendments to a number of major regimes, such as that of the International Convention for the Prevention of Pollution for Ships 1973 and its 1978 Protocol (MARPOL), which came into force in 1983[24]. This treaty was an answer to increasing marine pollution from the shipping industry, and attempted to strike a balance between the needs for marine protection as well as the need for economic efficiency of the shipping industry[25] [23]. This environmental agreement has since had six annexes to its original text, and ninety-four amendments throughout the years until 2016, updating its original content with up to date information and new realities[26]. Similarly, the United Nations Convention on the Law of the Sea (UNCLOS)[27] has also undergone gradual changes over the years, as evidenced by the 1995 Fish Stock Agreement[28] supplement to the agreement, and the current UN high level negotiations (2018–2019) on the protection of Biodiversity in Areas Beyond National Jurisdiction (BBNJ)[29]. The former was a layering of new issue area after it became clear that the original agreement did not address the issue of straddling fish stocks and highly migratory fish stocks well enough, resulting in a second major international agreement, which together with the original now constitute the Law of the Sea regime[30]. In these cases, the regime is undergoing incremental changes resulting from changes in society and in the technological innovation which enabled commercial fishers to change their exploitation patterns and behaviours that challenged the existing treaties. As such, from these examples, we

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[17] March and Olsen, *Elaborating the "New Institutionalism"*.
[18] Thelen, *How Institutions Evolve: Insights from Comparative Historical Analysis*.
[19] ---, *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States, and Japan*
[20] ---, 'Historical Institutionalism in Comparative Politics '.
[21] ---, *How Institutions Evolve: Insights from Comparative Historical Analysis*.
[22] ---, *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States, and Japan*
[23] Mahoney and Thelen, 'A theory of gradual institutional change'.
[24] Mankabady, *THE INTERNATIONAL MARITIME ORGANIZATION, VOLUME 1: INTERNATIONAL SHIPPING RULES*.
[25] Griffin, 'MARPOL 73/78 and Vessel Pollution: A Glass Half Full or Half Empty?'.
[26] Mitchell, *International Environemntal Agreements (IEA) Databse Project*.
[27] UNCLOS, 'Official Records'.
[28] Juda, 'The 1995 United Nations agreement on straddling fish stocks and highly migratory fish stocks: a critique'.
[29] Preparatory Committee BBNJ, *Report of the Preparatory Committee established by General Assembly resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction*.
[30] Asgeirsdottir, *Who gets what?: domestic influences on international negotiations allocating shared resources*.

understand that institutional layering emphasizes that the existing institution is not replaced but has new elements layered onto its existing structure.

Though the concept of institutional layering itself has also changed over time, and appears to have some flexibility of interpretation as well, we choose, for the purposes of this study, to use Thelan's 2004 definition establishing that *"layering...involves the crafting of new elements onto an otherwise stable institutional framework"*[31]. It offers us the opportunity to explore, when considering our three cases of institutional change, not what changed in and of itself, but *how*, *when* and *why* it changed - and what the real meaning of this change was for the institution in question. It also opens up the discussion to what actors or instruments were layered onto existing institutions to develop a gradual change in its framework[32].

Given that we do not know yet how gradual or sudden climatic and non climatic stressors may be in the Arctic, or how either of these scenarios will affect the institutions in place, we also need to discuss exogenous shocks. It is often institutions that can be considered functionalist, in terms of being created for solving collecting action problems[33], that are most affected by shocks that rock their system. This is because these institutions often are path dependent. This latter expresses the self-reinforcing process that is created by the dynamics of the institutional rules of the game. Often, the particular path chosen on the development of a given regime renders it difficult, if not impossible, to make reversals and choose differently with regards to the institutional choice of said regime. This is because the capabilities of a given institution, which is the framework within which the policy maker must work, were decided at a different time in a different place, when there were different environmental pressures in place and as such, the regime is not prepared for sudden changes that impact the rules of the game[34]. This theory therefore suggests that the institution in question under this scenario will continue and persist, until there is an external or internal shock to the system that breaks down this path, creating a punctuated equilibrium[35] and forces it towards institutional change. These punctuated equilibriums usually take place very fast, after a long period of institutional stability[36], and as such can have a great effect on the regime in question and the ecosystem goods and services for which they were initially created to protect.

Case studies: International treaties responding to change

The importance in differentiating between these two particular branches of institutional theory – gradual layering and exogenous shocks - is to develop the framework within which we will discuss and explore the scenario of institutional change in the Arctic under climate change. Using these theories and concepts as a baseline for our discussion and as frameworks for looking at comparable cases, we explore three institutions that changed because of external events, both environmental and institutional, and explore how resilient they were to change and how they adapted to external factors. We then look at ongoing and potential changes to the governance regime of the Svalbard fisheries protection zone in the Arctic and compare it to how other regimes have responded to different external factors that ended with institutional changes.

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[31] Thelen, *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States, and Japan*

[32] Van der Heijden, 'Institutional layering: A review of the use of the concept'.

[33] Thelen, *How Institutions Evolve: Insights from Comparative Historical Analysis*.

[34] Krasner, 'Sovereignty an institutional perspective'.

[35] Pierson, *Politics in time: history, institutions, and social analysis*.

[36] Krasner, *International Regimes*.

The Montreal protocol

An infamous and often referenced international agreement that is considered successful is from the early 1970s, when the first scientific publications on ozone depletion as a result of ozone-depleting substances such as chlorofluorocarbons (CFCs) and other were published[37], leading to the now well known Montreal protocol. The “hole” in the ozone layers that led to global outrage came about because of the public fear of millions of new cases of skin cancer patients and other human health effects from less ozone in the atmosphere. Besides skin cancer, other health fears included infectious diseases, suppression of the immune system, and eye disorders. Due to these ill health effects related to the decrease of the protective ozone layer, the topic of ozone depletion started to be taken seriously in public and political arenas[38]. This also demonstrates how environmental norms gained strength and diffused as the scientific evidence on the negative effects mounted[39], [40]. This agenda setting happened despite anti-regulatory campaigns by the CFC-producing industries and industries using CFCs in the United States. By the mid- to late 1970s, several countries had in fact banned the use of CFCs in aerosols, including the United States, Canada, Sweden, Norway and Denmark[41]. In 1985, the *Vienna Convention for the Protection of the Ozone Layer*, ratified by 193 parties, officially declared the need to protect the ozone layer, though there were no obligations yet concerning the use and production of CFCs. The window was open to resume negotiations, though, and shortly thereafter, the Antarctic Ozone hole was discovered[42]. This led to a new sense of urgency which increased pressure both nationally and internationally to resume negotiations,.

Two years later, in 1987, the Montreal Protocol On Substances that Deplete the Ozone Layer, was signed[43], making it the first global environmental treaty addressing a still only theoretical environmental challenge[44], since, at the time of the Montreal Protocol, the cause of the Antarctic ozone hole had not yet been proven. It nevertheless had a tangible impact on public opinion, in that that the hole was observable on model visualizations and a powerful symbol, which in the end galvanized public opinion at the global level on the importance of banning CFCs[45]. Ironically, there was never an actual "hole" in the ozone layer above the Antarctic. The term was used as a metaphor to describe areas where ozone concentrations had dropped below historical thresholds. Measurements of this "hole" started in 1979, when the concentration was at 194 Dobson units, just below the historical threshold of 220 Dobson units. In 1983, the concentration fell, and it continued to fall rapidly to 124 in 1985. In 1991, the concentrations fell below 100 Dobson units for the first time. The lowest measured concentrations were in 1994 when they fell to 73 Dobson units. After the ratification of the Montreal protocol, though, 90% of global production of CFCs was eradicated within a decade[46],

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[37] Molina and Rowland, 'Stratospheric sink for chlorofluoromethanes: chlorine atom-catalysed destruction of ozone'.
[38] Morrisette, 'The evolution of policy responses to stratospheric ozone depletion'.
[39] Haas, 'Introduction: epistemic communities and international policy coordination'.
[40] Dauvergne, 'The power of environmental norms: marine plastic pollution and the politics of microbeads'.
[41] Morrisette, 'The evolution of policy responses to stratospheric ozone depletion'.
[42] Farman et al., 'Large losses of total ozone in Antarctica reveal seasonal ClOx/NOx interaction'.
[43] Mitchell, *International Environemntal Agreements (IEA) Databse Project*.
[44] DeSombre, 'The experience of the Montreal Protocol: Particularly remarkable, and remarkably particular'.
[45] Morrisette, 'The evolution of policy responses to stratospheric ozone depletion'.
[46] Solomon, 'The hole truth'.

and the area and depth of the Antarctic ozone "hole" has since stabilized, and scientists predict that it will recover to a natural state around 2040[47].

This metaphorical "hole" in the ozone layer was the catalyst, or perturbation, that pushed the international community from the non-committal initial Vienna Convention to the new and successful Montreal Protocol. This “shock” to the system drove public perception, and there through influenced the institutional change by galvanizing the world opinion on its importance. In 1987 the Montreal Protocol on Substances that Deplete the Ozone Layer was adopted, and it entered into force in 1989 and has since been ratified by 193 nations. The Montreal Protocol was the first international agreement that looked to solve global atmospheric challenges[48], with a specific goal of a 50% reduction in consumption and production of CFCs by 1999 but with a 10 year grace period granted developing countries.

The Convention on Long-Range Transboundary Air Pollution (LRTAP)

Rather than experiencing a shock, like the Vienna protocol did, the 1979 Convention on Long-range Transboundary Air Pollution (LRTAP) had a number of changes through gradual institutional layering over the decades since the treaty was signed, including 15 amendments and eight protocols[49]. The agreement has a regional focus and is based on cooperation between 49 parties that are members of the United Nations Economic Commission for Europe.

The formation of the LRTAP was a result of concerns about acid rain, focusing on emissions of sulphur oxide (SO_2), which were initially primarily linked to the acidification of Scandinavian lakes and rivers and put on the agenda by Norway and Sweden, and an unlikely ally, the Soviet Union. In its initial form, the original agreement was a compendium of broad principles and promises of joint research activities, but it lacked any kinds of concrete measures that would actually curb acid rain[50]. In fact, it was not until the 1985 *Protocol On The Reduction Of Sulphur Emissions Or Their Transboundary Fluxes By At Least 30 Per Cent To The Convention On Long-Range Transboundary Air Pollution* that concrete measures were taken to curb these emissions. Prior to this, the problem of acid rain was not deemed serious enough by the European nations, with the exception of Norway and Sweden, since only the Scandinavian countries were affected by the results and Germany was a major producer of sulphur oxides.

The LRTAP did not become a priority for most signatory countries[51] until 1982, when it was found that long-range air pollution was damaging the German forests as well, and not only Scandinavian lakes. These deaths were coined "Waldsterben" (forest deaths) by the German biologist Bernhard Ulrich. In a New York Times article from 1984, the author describes the phenomena in the following way:

> *"As fir needles turn yellow and spruce branches sag limply, the industrial poisoning of West Germany's forests is assuming the dimensions of a spiritual, as well as an environmental, catastrophe."*[52]

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[47] Lindsey, *Antarctic Ozone Hole*.
[48] Velders et al., 'The importance of the Montreal Protocol in protecting climate'.
[49] Mitchell, *International Environemntal Agreements (IEA) Databse Project*.
[50] Levy, 'International cooperation to combat acid rain'.
[51] Sliggers et al., *Clearing the Air: 25 Years of the Convention on Long-range Transboundary Air Pollution*.
[52] Markham, *In a 'dying' forest, the German soul withers too*.

A "Green movement" ensued, and consequently influenced the environmental narratives of most German political parties. The German government therefore announced at the 1982 Stockholm Conference on Acidification of the Environment, that they, too, were joining the Norwegian, Swedish and USSR efforts to seek SO_2 reductions. This was a great win for the consortium, that not only gained a powerful ally, but also gained the commitments and support of one of the largest producers and polluters of SO_2[53]. In addition to the outrage and the green movement, technological solutions were also developed at that time that would allow governments and industries to solve the problems of not only sulphur oxides but also nitrogen oxides. *The Sulphur protocol*, signed by 19 parties in Helsinki in 1985, had clear goals and it was easy to verify that parties upheld their obligations of a 30% reduction of SO_2 emissions. In fact, all parties combined reduced their emissions by more than 50%.

The North East Atlantic Fisheries Commission (NEAFC)

UNCLOS is a major international agreement signed in 1982 after nine years of intense negotiations. The Law of the Sea established the concept of Exclusive Economic Zones (EEZs)[54] that extended the state´s sovereign rights to explore, exploit, conserve and manage the natural resources located within the water column, on the seabed, or under the soil 200 miles beyond its land territory. This gave a state the right to hinder foreign fishing vessels from exploiting resources within their 200 mile zone, but also brought with it the responsibility of the state to enforce the Law of the Sea by boarding and inspecting foreign ships traveling within their EEZs if these were considered suspicious[55].

Prior to the establishment of EEZs, however, this was a job undertaken through collaborations between coastal states that started already in the 1930s. Meetings in ICES from 1936-1947 led to the 1953 establishment of a management organization named the ´Permanent Commission´, which in 1963 changed its name to NEAFC. The organization originated from a number of conferences on fishing activities and gears, starting with an international conference aptly names the “Overfishing Conference”, focusing on mesh regulations and size limits for fishing, arranged in London in 1936. A follow-up conference was held the following year, in 1937, but progress was interrupted by WWII. In 1943, an international fisheries conference was again held, in London once more, where the purpose was to “… update and extend the scope of existing fisheries agreements relating to policing of fishing grounds, rules of navigation for fishing vessels, and the prevention of disputes between fishermen of different countries”. At this time, there were a number of conventions in place for fisheries in the North East Atlantic, and one of the aims was to develop a new document that could encompass all of those before it, and be more holistic. In 1946, after the war, the third “Overfishing Conference”, later named the Overfishing Convention, was held in London. The regulations established in this convention included landing size for demersal fish species, as well as minimum mesh sizes, and it led to the establishment of a management committee that was the pre-cursor of NEAFC, namely the “Permanent Commission”. In 1953, the 1946 Convention for the Permanent Commission held its first meeting, and ten years later, its name was changed to the North East Atlantic Fisheries Commission. The responsibilities of NEAFC were then further extended to pelagic fisheries[56].

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[53] Levy, 'International cooperation to combat acid rain'.
[54] United Nations, *United Nations Convention on Law of the Sea (UNCLOS)*.
[55] Asgeirsdottir, *Who gets what?: domestic influences on international negotiations allocating shared resources*.
[56] Engesaeter, *The importance of ICES in the establishment of NEAFC*.

The current form of NEAFC was established by the Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries, which entered into force in 1982, replacing the North East Atlantic Fisheries Convention of 1959, which in turn had replaced the 1946 Convention for the Regulation of Meshes and Fishing Nets and the Size Limits of Fish. After the 1995 Fish Stock Agreement, a number of changes were made within NEAFC to adapt to its role as a Regional Fisheries Management Organization (RFMO) and role as regulators of straddling fish stocks[57]. The establishment of the 200 mile EEZ in 1977 marginalized the role of NEAFC in fisheries management by depriving it of its main functions in terms of resource management with the majority of its original management area being placed under state control, and as such, though it was a gradual process, it nevertheless was an institutional shock in that it had such large implications. The Fish Stock Agreement[58], however, reinstated some of this lost significance and gave back some control and enforcement measures to NEAFC that improved its legal foundation in terms of fisheries resource management and gave more resilience in the adaptation to the new ocean regime[59].

Comparing "survivors" to future scenarios in the Arctic

These three examples of management regimes that have undergone change either through layering (Montreal protocol), exogenous shocks (NEAFC) or a combination thereof (LRTAP) serve as comparative cases to the scenario of potential institutional changes because of climatic and non climatic stressors in the Arctic. The distance to the Arctic fisheries is great, from any nation. Vessels wanting to travel to Svalbard must for example be in transit for two days and travel "...400 nautical miles extra to and from the fishing grounds."[60]. A high catch rate is therefore critical in order to offset the travel costs for the fishers. This catch rate and the value of it could be a result of warming waters, with an increase in valuable marine species migrating to these waters. However, the two examples of mackerel and snow crab also touch on two different aspects of the marine resource harvesting in the area, namely the water column and the continental shelf, either of which alone, or together, can act as exogenous shocks forcing new branches or completely break the one on right now.

We examine the case of Svalbard Fisheries Protection Zone (SFPZ, initiated in 1977) as an example of a management regime that could be changed because of the effects of climate change. We hypothesize that climate change will affect the resilience of the SFPZ regime and possibly change it into a different version of itself or something entirely new. We emphasize however that this is different from the Svalbard *Treaty* itself, which is a Treaty that is applied to the archipelago itself and the surrounding territorial waters[61], and not the 200 nm zone surrounding this area. In light of this, we introduce two examples of exogenous shocks, or punctuated equilibriums, that could impact national and international policies. These two shocks are 1) IPCC projections of increased sea temperature and melting ice cover in the Arctic and

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[57] Bjørndal, 'Overview, roles, and performance of the North East Atlantic fisheries commission (NEAFC)'.

[58] Juda, 'The 1995 United Nations agreement on straddling fish stocks and highly migratory fish stocks: a critique'.

[59] Gezelius, *Implementation of resource conservation policies in the Norwegian fisheries: a historical outline*.

[60] Misund et al., 'Norwegian fisheries in the Svalbard zone since 1980. Regulations, profitability and warming waters affect landings'.

[61] Svalbard Treaty, *Treaty between Norway, The United States of America, Denmark, France, Italy, Japan, the Netherlands, Great Britain and Ireland and the British overseas Dominions and Sweden concerning Spitsbergen signed in Paris 9th February 1920.*

subsequently 2) migrations of fish stocks and marine resources further north facilitated by these warmer, ice-free waters. We postulate that these cases are significant tests to the SFPZ that is likely to change the current institutional collaboration in the Arctic and apply institutional theory and the comparative cases of the Montreal Protocol, LRTAP and NEAFC to illustrate this.

The Northeast Atlantic mackerel dispute – the water column shocks

The water column shock under climatic stressors refers to the implications of new commercially valuable fish stocks migrating or changing distribution patterns from previously agreed upon areas, leading to a necessity of reallocation of quota rights both between nations, and within nations. An example of this is the multi-billion mackerel industry, where the stakes are high for a piece of the total allowable catch. Serious international conflicts in fisheries are not new, however: In the 1950s and 1970s, Iceland's "Cod Wars" with the United Kingdom on fishing rights of North Atlantic intensified with the deployment of military frigates. This time around, mackerel is the high-stakes species. No military frigates have been deployed, but that's not to say the conflict is not serious, both politically and ecologically.

Starting in 2007, the Northeast Atlantic mackerel fish stock increased its distribution area[62, 63, 64] in dramatic ecological and political fashion. The current scientific consensus is that the distribution expansion is a result of warmer waters and more suitable habitat for mackerel and their preferred prey.

The expansion of the prevalence of mackerel beyond Norwegian and EU EEZs and into Icelandic, Faroe Islands, and Greenland waters provoked an interstate conflict, still ongoing at the time of this writing. This relates especially to Iceland and Greenland, two countries who historically never had a quota for the stock, and their blatant exclusion from the fisheries agreement that currently includes Norway, the EU and the Faroe Islands. However, with the advent of the species in their EEZ waters, Iceland claimed their right to harvest it despite protests from the historical fishing rights owners Norway, Faroe Islands and the European Union. An important institutional aspect here is the fact that the International Concil for the Exploration of the Sea (ICES), the world’s oldest inter-governtmental science organization (founded in 1902) delivers one overall scientific quota, or total allowable catch, for the entire NEA mackerel stock annually. This scientifically-based quota, a collaboration among ICES member states, including Norwegian, European and Icelandic scientists, must be shared by all the coastal states.

The start of the current mackerel quota dispute occurred in 2009[65] when Iceland unilaterally decided to increase their mackerel quota to 130,000 tons from a normal level of 2,000 tons, which constitutes a 6500% increase. Iceland still stands outside the TAC sharing agreement that includes the EU and Norway (since 1999) and now also the Faroe Islands (since 2014), but Iceland still fishes mackerel within its EEZ (legally according to the UNCLOS). Thus, NEA mackerel has been systematically overfished since 2009. At the time of this writing,

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[62] Spijkers and Boonstra, 'Environmental change and social conflict: the northeast Atlantic mackerel dispute'.
[63] Spijkers et al., 'Marine fisheries and future ocean conflict'.
[64] Pinsky et al., 'Preparing ocean governance for species on the move'.
[65] Spijkers and Boonstra, 'Environmental change and social conflict: the northeast Atlantic mackerel dispute'.

the projected catch for NEA mackerel in 2019 is 160% over the ICES scientifically-advised quota[66].

This continued overharvesting practice could lead to an economic and ecological collapse of this commercially and ecologically important species, as infamously experiences in the collapse of the Atantic cod in East Canada and the herring in the North Sea[67, 68, 69, 70] . The root cause of the overfishing of mackerel lies with the failures of international agreements governing it, including the United Nations 1982 Law of the Sea Convention, the 1995 Straddling Fish Stocks Agreement, the 1980 North East Atlantic Fisheries Convention and the Coastal States' bi- and trilateral agreements. All these agreements fail to prescribe how to share the current widely distributed mackerel stock with new states[71, 72, 73], in this case Iceland, when the distribution patterns change from previously accepted positions. This is just a taste of what may come in the future, when new species are projected to continuously enter an area where there are decades of stability in fisheries negotiations between nations[74, 75].

Snow crab and the continental shelf shock

Where the water column shock is known and discussed often as consequences of higher ocean temperatures, the Continental Shelf shock. is not equally infamous, as it is a more quiet shock that is slow moving, but still has enormous implications if challenged. The Continental Shelf principle and its relation to the Svalbard has been discussed in detail earlier[76]. However, we will mention the main points that are important to keep in mind when considering the exogenous shocks to the path dependency of the institution. The Continental Shelf treaty, as opposed to the Svalbard Treaty specifically, is linked to the necessity of securing and allocating rights to oil and gas (hydrocarbon) deposits sub-soil or seabed. After a number of nations unilaterally had made claims to the continental shelf in their areas[77, 78, 79], preparatory work towards an international management regime commenced in 1950s. This resulted in the 1958 Geneva Convention on the Continental Shelf[80]. Claims to the continental shelf offers an exclusive right of the coastal states to resources on and below the sea floor on the shelf, specifically, mineral

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[66] Lindbæk, *Makrellkvoten overfiskes trolig med 160 prosent i år (In English: "The mackerel quota is likely overfished by 160 percent this year")*.
[67] Charles, 'The Atlantic Canadian groundfishery: Roots of a collapse'.
[68] Boreman et al., *Northwest Atlantic Groundfish: Perspectives on a Fishery Collapse*.
[69] Dickey-Collas et al., 'Lessons learned from stock collapse and recovery of North Sea herring: a review'.
[70] Dickey-Collas, *Longer term perspective on management science behind the boom, collapse and recovery of the North Sea herring fishery*.
[71] Ørebech, 'The "Lost Mackerel" of the North East Atlantic—The Flawed System of Trilateral and Bilateral Decision-making'.
[72] Dankel et al., 'Allocation of Fishing Rights in the Northeast Atlantic Ocean: Discussion paper. TemaNord.2015:546, Nordic Marine Think Tank.'.
[73] Jensen et al., 'Game theory and fish wars: The case of the Northeast Atlantic mackerel fishery'.
[74] Gattuso et al., 'Contrasting futures for ocean and society from different anthropogenic CO2 emissions scenarios'.
[75] Pinsky et al., 'Preparing ocean governance for species on the move',---.
[76] Tiller and Nyman, 'The clear and present danger to the Norwegian sovereignty of the Svalbard Fisheries Protection Zone: Enter the snow crab'.
[77] United Kingdom, *TREATY between His Majesty in respect of the United Kingdom and the President of the United States of Venezuela relating to the SUBMARINE AREAS OF THE GULF OF PARIA*.
[78] United States of America, *Proclamation 2667 of September 28, 1945: Policy of the United States with Respect to the Natural Resources of the Subsoil and Sea Bed of the Continental Shelf (Acronym: Truman Proclamation)*.
[79] Persand, *A Practical Overview of Article 76 of the United Nations Convention on the Law of the Sea*.
[80] United Nations, *Convention on the Continental Shelf, done at Geneva, on 29 April 1958*

resources such as oil and gas, as well as sedentary fish species, a category to which snow crab has been found to belong to[81].

The second resource that has recently emerged within the Svalbard Fisheries Protection zone, and causing governance instability, is the snow crab, or the Queen Crab (*Chionoecetes opilio*). A commercial fishery for this species started in Canada in the 1960s and grew exponentially between 1997 and 2004. Today, Canada has the largest snow crab industry in the world, and commercial fishers landed approximately 100,000 tons of snow crab in 2013 in Canada's northwest Atlantic. This is the equivalent to two thirds of the entire global supply of the crab, and the fishery is also the second largest behind lobster on the East Coast of Canada[82, 83]. The species has not customarily inhabited the Barents Sea, and it was very surprising for scientists when the first snow crab was registered in the Barents Sea in 1996. The first speculation centered on the crab having been brought there with ballast waters[84]. This first registration consisted of five individuals (five males and one female), and they were caught in trawl catches at the Goose Bank in the eastern part of the sea within the Russian EEZ by Russian fishers[85, 86]. In 2003 then, two snow crabs were caught in Norwegian waters near the northernmost region of Finnmark[87]. It has since then regularly been caught as bycatch in trawling (commercial and scientific) as well as by coastal gillnet fisheries in the central and northern Barents Sea[88, 89].

In the Barents Sea, snow crab is today mostly spread west of Novaya Zemlya. However, based on the yearly stock assessment cruises carried out by the Institute of Marine Research of Norway, the prediction is that the snow crab stock will continue growing and spreading in the Barents Sea towards most areas around Svalbard and Franz Josef Land. Estimates suggest that the value of the snow crab fishery may exceed the Norwegian cod fisheries in the future, though, with annual catch values of 1 - 5 billion NOK by 2020[90]. Given that this is a new resource that does not have a fisheries management plan, the Norwegian Ministry of Trade, Industry and Fisheries has put a total ban on Norwegian vessels harvesting snow crab within the Norwegian EEZ and the Svalbard Fishery Protection Zone. The same ban holds in international waters, with the exception of vessels that have been given special dispensation from the Norwegian Directorate of Fisheries[91]. The ban on harvesting the snow crab in the SFPZ presses pause on possible objections from other signatories of the Svalbard Treaty while the Norwegian government discusses possible strategies. These relate to not only a precautionary limit for sustainable exploitation of the species, but also a consideration of both legal frameworks and

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[81] Provincial Court of Newfoundland and Labrador, *Canada v. Perry (CanLII 52758)*.
[82] Fisheries and Oceans Canada, *Snow Crab*.
[83] Murray and Ings, 'Adaptation in a time of stress: A social-ecological perspective on changing fishing strategies in the Canadian snow crab fishery'.
[84] Agnalt et al., *The Snow Crab, Chionoecetes opilio (Decapoda, Majoidea, Oregoniidae) in the Barents Sea*.
[85] Ibid.
[86] Sundet, *The snow crab (Chionoecetes opilio) in the Barents Sea*.
[87] Alvsvåg et al., 'Evidence for a permanent establishment of the snow crab (Chionoecetes opilio) in the Barents Sea'.
[88] Pavlov and Sundet, 'Snow crab'.
[89] Dvoretsky and Dvoretsky, 'Commercial fish and shellfish in the Barents Sea: Have introduced crab species affected the population trajectories of commercial fish?'.
[90] Hvingel and Sundet, *Snow Crab - a new substantial resource in the Barents Sea (In Norwegian: Snøkrabbe - en ny stor ressurs i Barentshavet)*.
[91] Directorate of Fisheries, *Regulation about prohibition of snow crab harvesting (In Norwegian: Forskrift om forbud mot fangst av snøkrabbe)*.

diplomatically strategic paths given the historical disagreements internationally over the legality of Norway's pursuits in the zone.

Some issues are critical to consider for the snow crab case. The first, with regards to the Norwegian claim of a continental shelf area that includes Svalbard, Article 48, Article 121, and paragraph 3 of UNCLOS specify that archipelagos and islands are also entitled to continental shelves[92, 93]. Most nations, however, consider that Svalbard has its own continental shelf, which falls under the Svalbard Treaty provision. These states made reservations about the extent to which Norway was able to claim the continental shelf around Svalbard immediately after the submission to the Commission on the Limits of the Continental Shelf (CLCS) on the 27th of November 2006[94, 95, 96, 97]. Russia specified this in its response to the Norwegian claim, in consenting to the Commission examining the application, but specifying that:

> *"Nothing in this note shall prejudice the position of the Russian Federation towards the Spitsbergen archipelago and its continental shelf. The recommendations of the Commission in regard to the submission made by Norway shall be without prejudice to the provisions of the Treaty concerning Spitsbergen of 1920 and, accordingly, to the regime of the maritime areas adjacent to Spitsbergen."*[98]

Spain, likewise, also emphasized the Svalbard Treaty, and referred to a Note Verbale sent to Norway expressing their position of Svalbard maritime zones. In the aforementioned note, they explicitly said that: "*...principles of liberty of access and non-discrimination are applicable to any maritime zone that might be defined from Svalbard, including, as appropriate, the continental shelf, both within and beyond a distance of 200 nautical miles...*". They further emphasized in their letter that *"...Spain considers that the Paris treaty fully applies to those regions and reserves its right to the resources of the continental shelf that may be defined around Svalbard, including the extension thereof*"[99].

Discussion and Conclusions

In the current aricle, we have explored the experiences to exogenous shocks and gradual changes of three management regimes and their responses to these external “stressors to better understand on how regimes under influence of strong external forces that force changes to their original functionalitie. The discussion is then applied to two cases of external shocks to management regimes in the Arctic, namely the mackerel and snow crab cases, to explore how

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[92] United Nations, *United Nations Convention on Law of the Sea (UNCLOS)*.
[93] Suarez, *The Outer Limits of the Continental Shelf: Legal Aspects of their Establishment*.
[94] Commission on the Limits of the Continental Shelf (CLCS), *Outer limits of the continental shelf beyond 200 nautical miles from the baselines: Submissions to the Commission: Submission by the Kingdom of Norway*.
[95] Pedersen, 'Denmark's Policies Toward the Svalbard Area'.
[96] ---, 'International Law and Politics in U.S. Policymaking: The United States and the Svalbard Dispute'.
[97] Molenaar, 'Fisheries Regulation in the Maritime Zones of Svalbard'.
[98] The Permanent Mission of the Russian Federation to the United Nations, *Reaction of States to the submission made by Norway to the Commission on the Limits of the Continental Shelf: Russian Federation, Note dated 29 January 2007*.
[99] The Permanent Mission of Spain to the United Nations, *Reaction of States to the submission made by Norway to the Commission on the Limits of the Continental Shelf: Russian Federation, Note dated 3 March 2007.* .

these regimes may be resilient and adaptable to climatic stressors, and what we can learn from how our case examples adapted.

Before discussing the cases, we acknowledge that the types of shocks and distrubances to the agreements discussed in this article are not identical. In the case of Svalbard and the snow crab, we explored whether or not the regime is resilient enough to withstand the disturbance of a new species that does not have a management plan yet but that potentially may have great commercial value and is coveted by many commercial fishing nations. The same species is furthermore a complication in that it also is a proxy for mineral extraction in the same area. In the case of mackerel, on the other hand, we look at an example of an already valuable fishery that is changing its fishing grounds and moving through the water column into areas that are goverened by other states than those that originally shared it, causing difficulties in management. Both of these events are examples of what researchers project under climate change in the Arctic – new species move in and old species start moving around to new areas – making current regimes unstable and uncertain, and under pressure.

The Montreal protocol and the LTRAP cases are comparative cases that, though they are not about fisheries, represent examples of how new regimes were created or evolved from old ones and as such, proving their initial states were not resilient to the shocks they experienced. NEAFC, similarly, experienced a similar shock with the creation of the EEZs decimating the managmenet area over which it was originally intended, and the regime had to adapt to this to still have a role in ocean governance in the North East Atlantic.

The regime creation angle is one of the scenarios we are exploring with the Svalbard fisheries protection regime and the snow crab as well as that of mackerel, as examples of how regimes can adapt to future stressors from changing fish stocks distribution patterns. Our analysis centers on the questions of to what degree the experiences of the ozone treaty, the LRTAP, and NEAFC can give us an indication of potential effects institutional (creation of EEZs) or environmental (ozone and forest deaths) “shocks” may have on ocean governance in the Arctic under the effects of climatic stressors.

In the case of the continental shelf shock, and snow crab in the Svalbard fisheries protection zone, this is further complicated by the fact that neither Iceland nor Russia acknowledge the rulings of the International Court of Justice[100]. In this case, one may argue that a political solution, namely the creation of international management regimes for marine species in the area since the initial state of the current regime may not be resilient to the shock it is experiencing with the snow crab entereing the area. This may not lead to changes in the Svalbard Fisheries Protection Zone per se; just a bypass, or a re-naming thereof; an institutional conversion in terms of name only and not functionality.

Arctic states may furthermore avoid the challenges with existing agreements by negotiating an independent international cooperative ecosystem-based regime for all new marine resources whose distributions patterns have changed, making them available for harvest in the North Atlantic. This could be an advantageous option to states, since avoidance of outright conflict is critical, and the scarcity of fish in many areas of the world, as a consequence of climate change[101, 102], may be a catalyst for conflict when other nationals search for fish in the high north[103]. Therefore, in order to avoid outright conflict with some of their closest

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[100] Pedersen, 'The Svalbard Continental Shelf Controversy: Legal Disputes and Political Rivalries'.
[101] Cheung et al., 'Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change'.
[102] Cheung et al., 'Large benefits to marine fisheries of meeting the 1.5°C global warming target'.
[103] Homer-Dixon, 'Environmental Scarcities and Violent Conflict: Evidence from Cases'.

neighbors, and to maximize their profits regarding the harvest of these new marine resources, an international regime may be in the best interest of many.

We have seen that institutional theory opens the door to other scenarios in addition to a regime specifically designed for these new species and resources. Institutional layering would add new elements to the management of marine species in the future. Norway may for example bypass the current self-imposed decision to use the Svalbard Treaty element of historical fishing rights as a criterion for quota allocations. The zone itself has over the years become institutionalized as a management zone under Norwegian authority, and there are few dangerous signs of a negative tendency to this trend that will challenge this management regime. The years of Norwegian presence as sovereign in this area has created a situation of stability that, we argue, no nation wishes to challenge or disturb. This has also been proven historically, with countries who have tried to come up with a peaceful solution for centuries for the Archipelago. Informal understandings regarding the appropriate behavior of the actors in a given setting are critical, as are activities that have sprung out as a result of implementation attempts[104].

Therefore, instead of ignoring the problem and creating exogenous institutions, the institution can adapt to the change and layer new elements on top of existing structures. For example, states could use institutional layering to incorporate new resources into the annual discussions between Norway and Russia over quotas amongst others in the Svalbard Fisheries Protection Zone, if mackerel and snow crab (and all other species that may become climate migrants) were only to be harvested in the zone and the Barents Sea. However, given that the distribution patterns of these fish will likely lead them in and out of economic zones as well as international waters on their migratory route, the issue goes beyond a Norway-Russia discussion, and must include more nations.

Given the earlier mentioned uncertainty about fish distribution and migratory patterns under different climate change scenarios, however, creating a separate regime for managing the up-and-coming species may still be the only solution that most nations can live with. This would be similar to the changes that the ozone regime underwent when it went from a non-committal regime to one in which the environmental challenge was treated seriously by all actors at a global level. In this case, it would change the functionality of the regime in place, and develop one that is different in that the area would not be unilaterally managed by Norway but by a number of countries acting together.

In face of a rapidly changing climate in the High North, current treaties and regimes will no doubt be challenged and new models of resource allocation among coastal states and treaty signatories should be developed to promote stewardship instead of conflict. Future research on the topic should therefore concentrate on what type of regime these migratory trends must allow for, and how it can be effective in protecting not only the species themselves, but all other ecosystem goods and services they depend on. It is a task that will demand a lot of interdisciplinary research that encompasses the integrated ecological, economic and geo-political complexities necessary to ensure the future of the High North as a rich sustainable fishery area for future generations that is accessible to more than just the few climate change "winners".

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[104] Young, *The institutional dimensions of environmental change: fit, interplay, and scale*.

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