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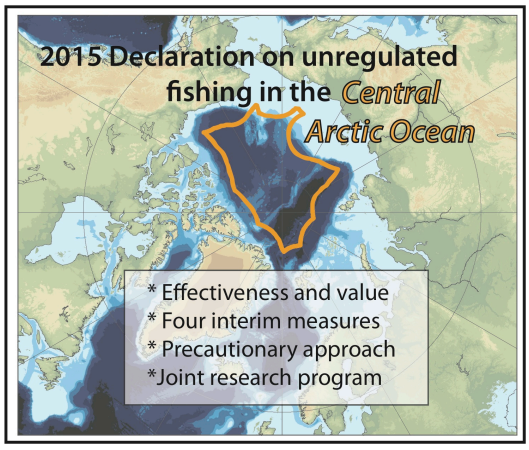

Assessing the added value of the recent Declaration on Unregulated Fishing for Sustainable Governance of the central Arctic Ocean

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Keywords

Arctic Ocean, Fishing, Resource Management, Arctic Five, Declaration

Highlights

- Discussion of Declaration on unregulated fishing in the central Arctic Ocean
- Declaration fills a policy gap of potential fish stocks but not regulation
- Precautionary approach underpins four interim measures
- Joint research program measure most imperative for effective implementation

Abstract

The ‘Declaration concerning the prevention of unregulated high seas fishing in the central Arctic Ocean’ signed by the Arctic 5 nations, limits unregulated high seas fishing in the central part of the Arctic Ocean, and holds potential social, economic and political impacts for numerous stakeholders. In this paper, the four Interim Measures in the Declaration are discussed and what value these measures bring beyond the existing international agreements is explored. It is found that even though the Declaration fills a gap in the management of potential fish stocks in the central Arctic Ocean, adopts an appropriate precautionary approach and encourages joint research activities, there are both opportunities and challenges connected to its implementation. The most valuable and urgent interim measure is that of joint scientific cooperation, which will facilitate more region-specific research and an increased understanding of the fisheries as well as the broader Arctic environment. Furthermore, the research generated by this measure will provide an important decision base for both regulation and management of human activity in the Arctic.

1. Introduction

One of the most recent developments in Arctic governance policy instruments is the ‘Declaration concerning the prevention of unregulated high seas fishing in the central Arctic Ocean’, hereafter referred to as the ‘Declaration’, signed in Oslo on the 16th July 2015 by Canada, the Kingdom of Denmark, the Kingdom of Norway, the Russian Federation, and the United States of America – namely the Arctic 5 (A5). The

overall purpose of the non-legally binding Declaration is to prevent unregulated high seas fishing in the approximately 2.8 million km^2 area that comprises the central part of the Arctic Ocean (Figure 1). However, the Declaration states that 'commercial fishing in the high seas portion of the central Arctic Ocean is unlikely to occur in the near future'[1]. Thereby the Declaration utilizes the precautionary approach to potential future fish stocks, as specified in Article 6 and Annex II of the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks [2] (hereafter referred to as 'UNFSA').

The signing of the Declaration was not an isolated event. A series of earlier meetings and documents including governmental, academic institutions and non-government organizations (NGOs) had addressed the potential issue of fishing in the central Arctic Ocean [3], including the 3rd meeting of Scientific Experts of Fish Stocks in the Central Arctic Ocean in Seattle in April 2015 [4], the Roundtable on Central Arctic Ocean Fisheries Issues held in Shanghai in January 2015, the Kitigaaryuit Declaration (2014) [5] signed at the 12th Inuit Circumpolar Council General Assembly by Alaskan, Canadian, Greenlandic and Russian delegates[1], and the 2014 Nuuk Meeting on Central Arctic Ocean Fisheries in Greenland [6].

Furthermore, unregulated fishing is not an issue restricted to the A5 signing nations nor is it unique to the central Arctic Ocean. The Declaration builds on previous

[1] Safe Shipping and Fisheries, 21: Direct ICC (Inuit Circumpolar Council) leadership to advocate for a precautionary approach in developing commercial fishing in international waters of the Central Arctic Ocean and support a moratorium until fish stocks have been adequately assessed and a sustainable management regime is in place that fully engages and involves the Inuit population

104 regional experiences in overfishing, population crashes as well as effective
105 management and practices, such as the Atlantic cod (*Gadus morhua*) in the Barents
106 Sea [7] [8] [9]. The context and nature of the Declaration is also tied to the projected
107 climatic conditions of the Arctic Ocean, the likelihood of the existence of a valuable
108 fishing population in the central Arctic Ocean, uncertainty and paucity of existing
109 scientific data, the dynamics of the broader Arctic ecosystem and the political context
110 and dialogue of both Arctic coastal (A5), and circum-Arctic states (A8), as well as
111 international stakeholders, as discussed further below. A comprehensive review of the
112 political issues at stake, the interests and incentives of the A5 with regard to future
113 management of living resources in the area, as well as of other influential actors such
114 as NGOs can be found in Wegge, 2015 [10].
115
116 In the following sections, this manuscript explores how effective the Declaration will
117 be in preventing unregulated fishing in the central Arctic Ocean. Specifically, in
118 discussing effective implementation, the manuscript focuses on the four Interim
119 Measures and includes a brief discussion about the environmental, social, and
120 political context in the implications of its provisions.
121
122 **1.1 Interim Measures**
123
124 Building upon the recommendations of Article 6 [2] of UNFSA, the undersigning
125 states of the Declaration [1] call for precautionary Interim Measures included in the
126 framework of four regulatory provisions:
127 • Measure 1: “We will authorize our vessels to conduct commercial fishing in
128 this high seas area only pursuant to one or more regional or subregional fisheries

management organizations or arrangements that are or may be established to manage such fishing in accordance with recognized international standards."

- Measure 2: "We will establish a joint program of scientific research with the aim of improving understanding of the ecosystems of this area and promote cooperation with relevant scientific bodies, including but not limited to the International Council for the Exploration of the Sea (ICES) and the North Pacific Marine Science Organization (PICES)."

- Measure 3: "We will promote compliance with these interim measures and with relevant international law, including by coordinating our monitoring, control and surveillance activities in this area."

- Measure 4: "We will ensure that any non-commercial fishing in this area does not undermine the purpose of the interim measures, is based on scientific advice and is monitored, and that data obtained through any such fishing is shared."

The undersigning States of UNFSA are obliged by Article 6 [2] to: a) obtain and share the best scientific information available and implement improved techniques for risk and uncertainty, b) apply stock-specific reference points and action to be taken if they are exceeded, c) take into account inter alia uncertainties relating to the size and productivity of stocks and d) develop data-collection and research programs to assess the impact of fishing. Points a), c) and d) are directly relevant to Interim Measure 2, whereas point b) is relevant to Interim Measure 3. UNFSA Article 8 [2], the "Cooperation for conservation and management," states that both coastal states and

states fishing on the high seas shall pursue cooperation in relation to straddling and highly migratory fish stocks either directly, or through appropriate subregional or regional fisheries management organizations or arrangements. This is directly relevant for Interim Measure 1, and while non-commercial fishing is not directly referred to, Article 8 holds implications for Measure 4. Thus all of the Interim Measures are more or less explicitly included in UNFSA. This manuscript examines the potential added value of the Declaration, apart from applying the principles laid down in the UNFSA and UNCLOS to a specific geographical region.

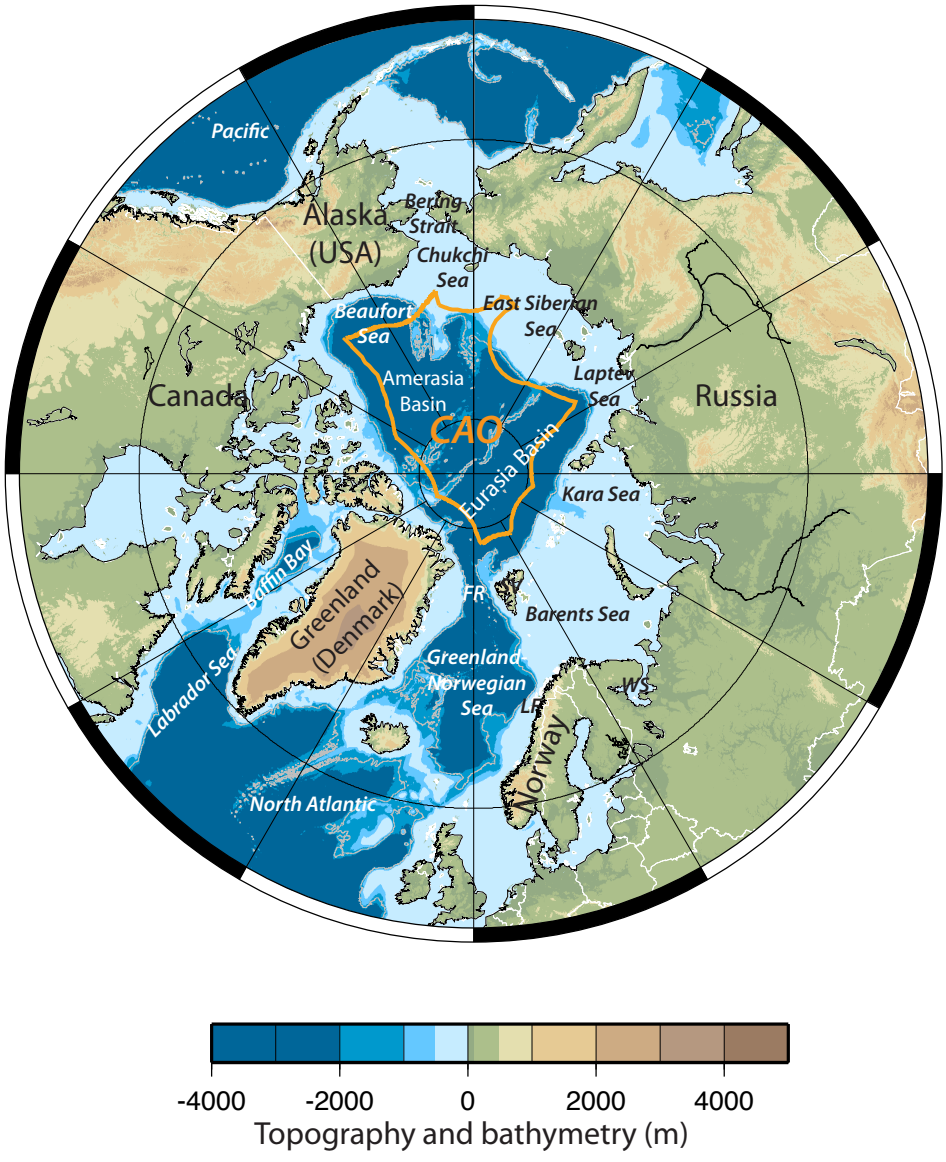

Figure 1. Topographic and bathymetric overview of the Arctic Ocean and surrounds, with major seas, features and Arctic 5 (A5) nations labeled (political boundaries not defined). Thick black defines the edge of the maritime boundaries in the high Arctic (EEZ; downloaded from marineregions.org) and edge of the 'central Arctic Ocean' (CAO). FR Fram Strait, LF Lofoten, SV Svalbard. Figure created using Generic Mapping Tools [11] (http://gmt.soest.hawaii.edu/).

1.2 The Arctic Ocean: fisheries and climate

The Arctic Ocean is the smallest of the world's five oceans with a surface area of approximately 14 million km^2. It is connected to the Pacific Ocean through the Bering Strait and to the North Atlantic Ocean through the Labrador, Norwegian-Greenland, and Barents seas, the deepest entry being via the Fram Strait (Figure 1). The Arctic Ocean has a complex ocean-atmospheric cycle and a significant portion of the ocean is ice-covered in autumn, spring and winter. Furthermore, the effects of climate change in the Arctic, including those due to anthropogenic effects as well as the natural inter-annual variability, are pronounced. Rising sea surface temperatures as well as reductions in the surface area and the volume of summer sea ice are amongst the most prominent indicators of change (e.g. [12]). In summer 2012, the sea ice was at its lowest on record, with a coverage of ~3.4 million km^2 [13] (equating to 40% of the central Arctic Ocean being open-water). Future changes in Arctic sea ice coverage and thickness, and related the ice-albedo feedback, represent some of the largest uncertainties in climate change predictions [14]. Estimates for ice-free summer conditions in the Arctic point to the first half of this century, including within the next two decades [15]. It is important to note that although several climate models indicate a decline in sea ice, none indicate that the winter sea ice cover will disappear

189 completely during this century [16] i.e. winter sea ice will still exist but will be
190 regionally and seasonally variable.
191
192 Warm Atlantic Ocean water flows northwards into the Arctic Ocean along the west
193 coast of Svalbard (Spitsbergen Current) as well as via the Barents Shelf Current. The
194 area of the Barents Sea where the cold, relatively fresh, Arctic water meets the warm,
195 saline Atlantic water is called the 'polar front' and is a particularly biologically
196 productive area [17]. It follows that over the last few centuries, extensive fishing
197 industries have developed in regions fringing the Arctic Ocean. Thus, any projected
198 changes to fish populations and their migration patterns and/or the development of
199 new, biologically rich regions under a changing climate scenario, such as the opening
200 up of the central Arctic Ocean, are of key importance and interest to numerous
201 international stakeholders.
202
203 **2 Interim Measures of the Declaration**
204 **2.1 Interim Measure 1: Regional or Sub-Regional Fisheries**
205
206 The development of commercial fishing in the central Arctic Ocean would be subject
207 to regional or subregional fisheries management organizations (herein RFMOs). In
208 this section it is discussed which stakeholders would be subject to the relevant
209 arrangements and how they would be bound to the RFMO regulations. Linked to the
210 development of future RFMOs and/or relevance of existing RFMOs, is the actual
211 distribution and population of fish stocks in the central Arctic Ocean, which is
212 discussed further in section 2.2.
213

2.1.1 Stakeholders

Politically, it may be argued that both the signing of the Declaration as well as its legal nature have sent mixed messages to the broader community. On the one hand, as a political statement, it signals that it is the responsibility of the littoral states to shape the resource management of the central Arctic Ocean. The exclusion of non-A5 members may manifest as impedance or a cause of tension regarding the further work of the Arctic Council in regional policy shaping. On the other hand, the Declaration still has a low profile in the foreign policy of the A5 due to its non-binding nature and the scientific uncertainty about commercial fishing in the central Arctic Ocean in the short, mid, or long-term. By including Interim Measures which signal the intention to include third parties in the future, the contracting Declaration parties are inclusive of the broader Arctic and international community, whilst preventing potential circumvention of the Declaration.

Whilst signed only by the A5, the actual text of the Declaration is of an inclusive nature. The Declaration recognises the potential interest of other state and non-state stakeholders, such as Arctic residents and indigenous people, in contributing to the preservation of fish stocks. However, similar to the 2008 Illusiat Declaration, the 2015 Declaration was criticized for excluding the three other member states of the Arctic Council, namely Sweden, Finland and Iceland, although only Iceland openly protested to not being included or consulted. Non-Arctic nations such as China, South Korea, Japan and the E.U. have been actively fishing in circum-Arctic regions, including the Bering, Barents and Chukchi Seas and Greenlandic waters. These

238 nations might have strong commercial interests in the central Arctic Ocean in the case
239 of northward fish stock migration.
240
241 At the GLACIER conference held in Anchorage, Alaska, 30-31 August 2015, the
242 inclusive nature of the Declaration materialized into an invitation to proceed towards
243 a larger international binding agreement. It follows that delegations from the A5,
244 Iceland, the E.U., China, Japan, and the Republic of Korea met for negotiations in
245 Washington D.C. from the 1st-3rd December 2015. According to the Chairman's
246 Statement [18], the meeting covered topics including the current state of scientific
247 knowledge and the need for research cooperation, monitoring and the use of the
248 precautionary approach. Suggestions to prevent unregulated fishing included
249 adjusting the Declaration to a broader statement, establishing one or more regional
250 organizations or arrangements and/or negotiating a binding international agreement.
251 The latter of which included a proposal by the U.S. to commit parties to at least three
252 conditions, which resembled those of Interim Measures 1, 2 and 4 of the Declaration.
253 Being the party that produced the proposal and instigated several meetings related to
254 the Declaration, it could be assumed that the U.S. is eager to play an active part in the
255 further policy and regulatory development for Arctic fisheries. Regarding the U.S.
256 proposal for a binding agreement, one may question why Interim Measure 3 was not
257 also included. Nevertheless, future progress towards a binding agreement will reveal
258 if there are potential issues of conflicts, or if the omission of Interim Measure 3 in the
259 proposed agreement is of less importance. Two follow-up meetings are tentatively
260 scheduled for 2016 in Norway and the U.S. for scientific and policy discussions,
261 respectively.
262

2.1.2 Regional Fisheries Management Organizations

In Interim Measure 1, the signatories underlined that they will only allow their vessels to conduct fisheries in the central Arctic Ocean pursuant to the relevant (sub-) Regional Fisheries Management Organizations (RFMO), or arrangements in accordance with recognized international standards. Several relevant existing RFMO or other regulatory arrangements could be applied to fisheries in the central Arctic Ocean.

Along with the general legal framework set out in the United Nations Convention of the Law of the Sea (UNCLOS) and UNFSA [2], the Declaration refers specifically to the well-established North East Atlantic Fisheries Commission (NEAFC).[2] The NEAFC adopts and enforces obligations and management measures for various fish stocks in the Northeast Atlantic, including control measures to ensure that the management measures are properly implemented. The NEAFC covers approximately 8% of the central Arctic Ocean (between 42°W and 51°E longitude), and relevant fish stocks are located mostly between the southern tip of Greenland, east of the Barents Sea, and south of Portugal.

Apart from NEAFC, several other RMFOs and arrangements (potentially) relevant for Arctic fisheries exist. These include the Joint Norwegian-Russian Fisheries Commission (JNRFC), the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP), Northwest Atlantic Fisheries

[2] The NEAFC consists of the Kingdoms of Denmark (partly due to Greenland) and Norway and the Russian Federation (signatories of the Declaration), as well as the E.U. and Iceland.

Organization (NAFO), North Atlantic Salmon Conservation Organization (NASCO), North Pacific Anadromous Fish Commission (NPAFC) and North Pacific Fisheries Commission (NPFC). Whilst the Declaration does not refer to these RFMOs or arrangements, the Interim Measures do not intend to interfere with them. However, as neither the NEAFC nor the other RFMO and arrangements cover the central Arctic Ocean as a whole (in terms of area or species), it is relevant to explore the need for an arrangement that can cover the entirety of any potential fisheries in this area – at least seen from a purely legal perspective.

Consequently, it could be argued that it is relevant to initiate the process towards a comprehensive regime for this area. It could even be seen as obligation for coastal and non-coastal states and not only an opportunity. So even though the Declaration states '*there is no need at present to establish any additional regional fisheries management organization for this area*', the coastal states must have considered that there was some sort of need or obligation to initiate the process. Whether jurisdiction should be extended to NEAFC and new members added, or if a new RFMO should be created, there are two main aspects that must be considered. Firstly, a given RFMO (already existing or to be created) must be comprised not only of the coastal states, but also of the distant waters fishing states ([2]; Article 8(4)); and secondly, that the effective area of management is clearly defined.

Fisheries management organizations at regional and international levels have a key role in preventing unregulated fisheries by providing regulations based on scientific advice. However, as the Arctic is a poorly understood region in various aspects of the natural sciences, the success and relevance of a given RFMO is tied to the current

311 scientific knowledge base. It follows that the four Declaration's Interim Measures are
312 fundamentally linked.
313
314 **2.2 Interim Measure 2: Joint Scientific Research Program**
315
316 Interim Measure 2 of the Declaration specifies the intention of a joint program of
317 scientific research to improve understanding of this region. Notably, states are already
318 obliged to cooperate to improve the scientific knowledge base under international law,
319 including UNCLOS and UNFSA [2]. The specific use of the precautionary approach,
320 terminology of which is explicitly included in the Declaration and Article 6 of
321 UNFSA [2], partly explains the motivation for the Declaration and the use of Interim
322 Measure 2.
323
324 **2.2.1 Merits of a precautionary approach**
325
326 A precautionary approach invokes measures to prevent damaging effects from what
327 has been identified as a dangerous human intervention, even without having clear
328 evidence as to whether damaging effects will eventuate, or of their long-term
329 consequences [19]. Until we know more about the effects of climate change and the
330 impacts of human activities to the central Arctic Ocean ecosystem, a precautionary
331 approach must be applied. A recent regional example of where such an approach was
332 applied is the Fishery Management Plan for Fish Resources of the Arctic Management
333 Area, pertaining to and approved by the U.S. Department of Commerce [20] in 2009.
334 The Plan prevents the expansion of commercial fishing into U.S. Arctic waters, which
335 equal approximately 515,000 km^2, and was justified on the grounds that more

scientific evidence on the effects of climate change on fish stocks was needed. Furthermore the Implementation Plan for the 2013 National Strategy for the Arctic Region commits the U.S. to preventing unregulated high seas fisheries in the Arctic [21].

Arguably, this Interim Measure is the most pertinent, as the establishment of scientific programs and the acquisition of data and processing of results is a yearly to decade-long process and should be initiated as soon as possible. Furthermore, the implementation of Measure 2 will provide a basis for the remaining three Interim Measures.

In the context of the Declaration, the two crucial scientific questions are: (1) whether there is a limit to the potential northward shift of species' geographic ranges and, (2) how likely it is that fish stocks will expand beyond the continental shelf seas into the central Arctic Ocean. Building upon the discussion in Interim Measure 1, this section discusses what existing programs are referred to in the Declaration as well as the challenges and status of knowledge regarding current and changing fish stocks under the projected climatic conditions. It is noted that future joint programs should not solely be targeted at fish and species-specific studies, as wider ecological and environmental research, including climate and oceanography, are relevant for understanding the Arctic as a holistic and dynamic system.

2.2.2 Need for both top-down and bottom-up Arctic research

Conducting research in the Arctic is practically and technically both expensive and difficult due to its remoteness and extreme environmental conditions. While remote sensing techniques are valuable for such isolated regions, and are particularly useful for surface monitoring, including sea-ice monitoring and primary production, deeper ocean monitoring requires more local, including ship-borne, observations including underwater acoustics, buoys and gliders. Cooperation through joint international programs is therefore imperative. The Declaration refers to several major international programs, which can be seen as classical top-down measures. However equally important is the bottom-up approach, such as the numerous university-level research programs that are also worthy of inclusion or addition to program development. As demonstrated in the field of climate governance and associated difficulties of establishing global climate treaties, a bottom-up approach can be a way to build domestic support, empower citizens and motivate leaders to take action [22]. On the other hand, a bottom-up approach could reduce momentum and the potential for grand bargaining [22], as well as free-riding and heightened concerns over economic competitiveness [23] [24].

Understanding the Arctic's complexity, in which commercially viable fishing is just one component, demands an interdisciplinary approach. It follows that the top-down approach, bringing international research programs together, and the bottom-up approach including bi- or multi-lateral cooperation on multiple governance and/or academic levels, are two equally necessary and important measures in order to increase the scientific knowledge base for the central Arctic Ocean.

As listed in the Declaration, the International Council for Exploration of the Sea (ICES) is one of the largest scientific programs specifically related to fish stocks. ICES operates across a network of research institutes and universities, and includes the A8. ICES research comprises subarctic fish stocks in the Barents Sea, Iceland and East Greenland regions, and some widely distributed and straddling stocks; climate change in the Arctic Ocean; environmental risks of shipping; oil and gas exploitation; and the spread of non-native species. Although ICES provides stock assessments for several species generally located in the European area of the Arctic, data for other stocks is scattered and discontinuous (Table S1). The North Pacific Marine Science Organization (PICES), representing the Pacific countries of the A5, promotes and coordinates marine research in the northern North Pacific and adjacent seas.

Future joint research should be integrated with existing programs, including those not limited to fish stock assessments, such as Arctic Monitoring and Assessment Program (AMAP) and Conservation of Arctic Flora and Fauna (CAFF). Additional information regarding Interim Measure 2, including the source of funding and dissemination of projects, and whether the Declaration signatories instigate a single multi- and trans-disciplinary coordinating body or several bodies, are yet to be seen. Interim Measure 2 underpins the other three Interim Measures; the current paucity in knowledge, combined with challenges in modelling biological and climatic changes, demands timely implementation if the Declaration is to fulfill its international purpose and value.

2.2.3 Challenges in predicting changes in fish stocks

Due to the significant economic value of commercial fish species, predicting changes in trophic interactions and ecosystem responses to future climate change in the Arctic is of great importance. Studies suggest that several important fish stocks might expand their distribution northwards as a response to projected climatic changes in ocean conditions [25], including a high rate of invasions by new species [26] [27], and a general increase in fish productivity [28]. It follows that the fishing industry would likely pursue this migration, driven by increasing demand and market pressures. However, to date, few attempts have been made to quantitatively assess climate effects on sub-Arctic and Arctic fish abundance [29]. Studies indicate that the potential of species to move northwards and successfully colonize new regions is determined by a wide array of factors (e.g. [29]), and that different species react variably to changing environmental conditions ([29] [30] [31]).

Recent research [32] shows that boreal species might displace and replace Arctic communities in some areas, especially those species that are dependent on the shelf habitat. A study [29] of the potential of fish and shellfish stocks moving northwards into the Arctic Ocean found that, from the 17 species analysed, only six were assessed to have a high potential for a northwards expansion or migration into the Arctic and for establishing viable resident populations.[3] These species have life history characteristics that allow them to cope with the challenging Arctic conditions that will prevail even under the projected climatic changes. Six stocks or groups were found to

[3] Species include polar cod (*Boreogadus saida*), snow crab (*Chionoectes opilio*), Bering flounder (*Hippoglossoides robustus*), Greenland shark (*Somniosus microcephalus*), Arctic skate (*Amblyraja hyperborea*) and beaked redfish (*Sebastes mentella*).

430 be potential candidates to expand northwards into the Arctic, whereas five stocks
431 were thought to have a very low potential.[4]
432
433 The seafloor of the high-seas portion of the Arctic Ocean is greater than 3500 m depth
434 in some localities (Figure 1), and the oceanographic conditions in these deep, central
435 regions vary strongly from the shallow continental shelf areas of the Arctic coastal
436 states' Exclusive Economic Zone (EEZ). Deep oceanic areas usually have low levels
437 of important nutrients, and a strong degree of stratification of the Arctic Ocean is
438 expected [33]. Until now, knowledge about this central area is extremely limited
439 owing, for example, to difficulties in data acquisition, and existing studies assessing
440 fish stock ranges (e.g. [29] [32]) are vague in spatial definitions.
441
442 Like all marine productivity, food availability depends on the built-up of biomass by
443 mostly photosynthesizing organisms, called primary production, and on the light
444 regime, nutrient availability, and stratification of the water column [17] [34]. There is
445 a high degree of uncertainty in how the primary productive regime will change in a
446 warming climate scenario, but changes are expected to differ considerably between
447 the deep central Arctic Ocean and the shelf areas [35]. Modelling changes in primary
448 production is uncertain, partly due to the limited amount of data available, as well as
449 limitations in predictive capabilities. With reduced sea ice or earlier thawing, the
450 period for primary production will increase; however, that does not necessarily equal

[4] Potential candidates include Alaska plaice (*Pleuronectes quadrituberculatus*), Yellowfin sole (*Limanda aspera*), Greenland halibut (*Reinhardtius hippoglossoides*), Atlanto-scandic herring (*Clupea harengus*), Capelin (*Mallotus villosus*) and other elasmobranchs. Least likely candidates include walleye pollock (*Theragra chalcogramma*), northern rock sole (*Lepidopsetta polyxystra*), Pacific cod (*Gadus macrocephalus*), Atlantic cod (*Gadus morhua*) and Pacific ocean perch (*Sebastes alutus*). Note, that this analysis was focused on commercial fish stocks in the Bering and Norwegian/Barents Sea areas and did not include stocks off the coasts of Newfoundland and Labrador or Alaska.

451 higher total production [36]. In addition to the amount of primary production, the
452 timing and the type of organisms can change with differing oceanographic conditions
453 and ice coverage, which in turn can support different food webs [34] [37]. It follows
454 that changes in regional productivity, combined with the seasonality and regional
455 variability in ice cover throughout the year, will dictate the potential fishing season.
456
457 Existing observations and predictions on range expansions have mainly focused on
458 changes in food availability and temperature (e.g. [29] [32] [38] [39]). Light
459 limitations due to ice coverage and the polar night might pose an additional limit to
460 northern fish distributions. With the projected increases in sea temperature and
461 reductions in sea ice coverage, these potentially limiting factors to species' expansion
462 are thought to diminish. To summarise, primary production in the central Arctic
463 Ocean is not expected to be able to support large fish stocks. An increase of primary
464 production might be expected along shelf breaks and shelf areas due to increased
465 upwelling and river discharge [17] but projections are spatially and ecosystem
466 dependent.
467
468 Findings resulting from a joint research program(s) applied to fisheries, and more
469 broadly, ecosystems and food webs, may also contribute to the regulation of other
470 economic activities such as shipping, tourism, and oil and gas. Furthermore, the
471 successful operation of other international regimes demonstrates that monitoring
472 systems also find significant cross-benefit in scientific research through the shared use
473 of data and infrastructure, and thus promote cooperation on both scientific and
474 political levels (e.g. [40]). Some future options include developing a full-fledged
475 RFMO or arrangement for the central Arctic Ocean, expanding the jurisdiction of

476 NEAFC (and others) to include the central Arctic Ocean, or upholding the status quo
477 (e.g. [41] [42] [43]).
478
479 **2.3 Interim Measure 3: Monitoring & Response for Compliance**
480
481 Interim Measure 3 concerns the compliance and monitoring of unregulated activities
482 in the central Arctic Ocean. This section highlights the operational perspective of
483 Measure 3 and includes examples which support the need for establishing monitoring
484 and compliance in the central Arctic Ocean.
485
486 **2.3.1 Operational perspective**
487
488 In order to support legal compliance instruments available to the regime, a monitoring
489 and response system, including remote sensing and the use of space-based Automatic
490 Identification Systems (AIS), must be operated. Its capabilities ought to allow the (a)
491 long-term routine monitoring and surveying of a defined area routinely; (b) alerting
492 response operators to irregular activities (e.g. unidentified vessels or unusual
493 activities); and (c) responding to suspicious events through onsite intervention and
494 specific data-gathering, in order to verify a violation of the Declaration.
495
496 Due to the vast size of the Arctic Ocean, it is not feasible to carry out monitoring by
497 means of boat or plane patrols. Primarily, remote observations including AIS will
498 have to be employed, in combination with radar- and visual imagery from satellites.
499 In recent years, several parties have launched space-based AIS satellites, which
500 provide a global view on ship traffic [44] [45].

However, it cannot necessarily be assumed that ships would operate their AIS equipment according to regulations [46] and therefore be compliant and not engage in unregulated activities. For meaningful interventions, emphasis may therefore be placed on detecting ships with inactivated AIS transceivers. Closer monitoring can then be provided by means of high-resolution optical satellite imagery for selected areas. Service providers operating in Arctic conditions already offer related detection products that integrate different raw data to combat pirate fishing [45, 47] for the South Indian Ocean, cf. [48]. The constituents of related monitoring programs, such as the E.U.'s Global Monitoring for Environment and Security (GMES), include stakeholders beyond the Arctic nations [49].

Suspected vessels may have to be inspected in-situ, or intercepted on their way to port or out of the fishing area. While response infrastructure is currently increasingly coordinated for Search and Rescue and Oil Spill Response, communications and other high-Arctic infrastructure are limited [50]. Furthermore, Search and Rescue services for both people and pollution must be in place. To support regime compliance, existing response systems can be used, but specific programs, technology, and actors would have to be coordinated and funded, e.g. in view of a joint operations or coordination centre.

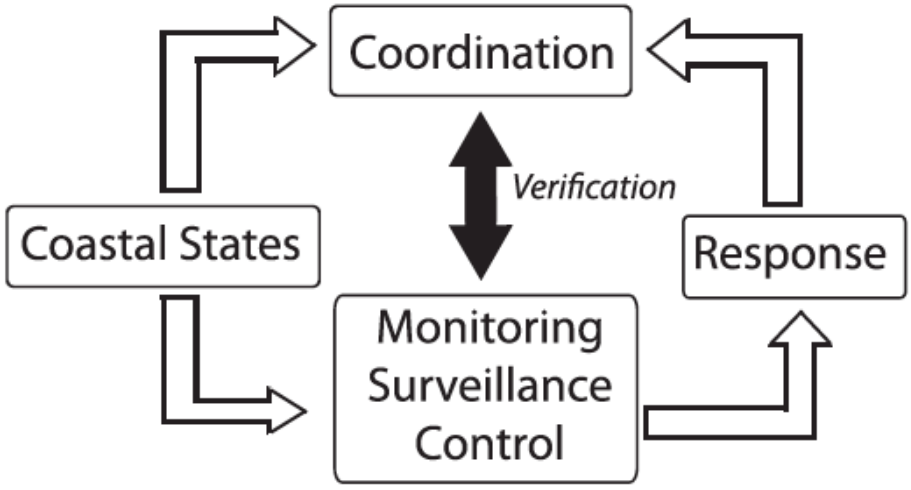

Figure 2. Operational perspective of compliance

2.3.2 Previous Regional Examples

Overfishing is often pointed to as the greatest source of fish stock crashes and several past incidents of illegal and unreported fishing have occurred within the circum-Arctic (Table S1). The Barents Sea, for example, has seen several cases of severely impacted fish stocks since multinational, open ocean fisheries first started in the beginning of the 20th Century [51] [52]. Around the year 2000, the Northeast Arctic cod was being illegally harvested by up to 20-25% of total permitted catches, resulting in management measures being violated as well as a series of other economic, ecological and political implications [53]. The North East Atlantic (NEA) cod stock harvesting is currently managed by the Joint Norwegian-Russian Fisheries Commission which has been attributed to the rebuilding of the NEA cod fishery with an increase of stocks by 400 % since the 1990s [52]. Despite the relative management success of capelin, NEA cod, haddock, and saithe, other Barents Sea species such as redfish and coastal cod are currently overfished ([52]; Table S1). Furthermore, there is a high uncertainty of actual catches and stocks (Table S1)

Additionally, in 1994, the U.S. and the former Soviet Union agreed to apply a joint regional effort in stopping uncontrolled high seas pollock catches. The result was the international Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea [54]. Despite similarities, it is worth highlighting that the 2015 Declaration focuses on protection and precaution whilst the 1994 Convention came after population crashes caused by Japanese, Korean, Polish and Chinese fishing vessels [55]. Such overfishing incidents seem to have urged coastal states to establish cooperation agreements, including for the central Arctic Ocean.

2.4 Interim Measure 4: Addressing Non-Commercial Fishing

Linked to section 2.3, monitoring and compliance will have implications for any potential non-commercial fishing. The use of 'any non-commercial fishing' could refer to scientific or 'experimental' fisheries. Non-commercial fishing is not explicitly addressed in the UNFSA. However, Article 8 [2] states that access to fishery resources, where conservation and management measures apply, should only be granted to states that are members of a subregional and regional organization or arrangement. If the states are not members or in an arrangement, they will have to agree to comply with the conservation and management measures of the organizations and arrangements in question.

According to the precautionary approach, commercial fishing shall not be conducted before the understanding of the central Arctic Ocean is improved. Interim Measure 4 aims at preventing a potential circumvention of the Declaration. By using the broad

565 term ‘any non-commercial fishing’, the contracting states intend to ensure that the
566 Declaration includes and is adhered to by third parties. Furthermore, the text of the
567 Declaration recognizes the importance of the ‘subsistence harvesting on the marine
568 resources’ by indigenous communities and mentions the integration of the traditional
569 local knowledge, though is not identified as a specific goal and is not of concern for
570 the non-commercial fishing measure.
571
572 **3. Conclusion**
573
574 Despite several partial arrangements, a comprehensive RFMO or other single,
575 unifying arrangement that covered fishing across the entire Arctic Ocean did not exist
576 prior to the Declaration. Due to the resulting potential gap in the management of
577 potential fish stocks in the central Arctic Ocean, and as required under the UNFSA, it
578 was an obligation for the Arctic coastal states and not only an opportunity to initiate
579 the process towards a regional comprehensive regime. With the current progress of
580 discussions amongst the parties, including at the GLACIER conference held in
581 Anchorage, Alaska, 30-31 August 2015 and the Meeting on High Seas Fisheries in the
582 Central Arctic Ocean in Washington D.C., 1-3 December 2015, further policy
583 development stemming from the Declaration must be expected. This includes the
584 potential development of an international binding agreement as most recently
585 proposed by the U.S.
586
587 Due to the limited scientific understanding of the ecological development of the
588 central Arctic Ocean under a changing climate, it is advantageous that a precautionary
589 approach be applied. In this respect, a positive, and arguably the most important

590 outcome of this Declaration is that joint research efforts are applied to the Arctic
591 region. This may trigger more research specifically addressing the unique and
592 dynamic Arctic environment, which is imperative for future regulation and
593 management of human activity in the region. Furthermore, the knowledge gathered
594 from future joint research efforts on fisheries will contribute to regulating other
595 potential economic activities in the Arctic region, and will facilitate trans-disciplinary
596 cooperation and coordination. It will also improve the understanding of the complex
597 Arctic environment, at present and in the future, in a comprehensive manner. Interim
598 Measure 2, regarding a joint research program, is therefore central to the effectiveness
599 of the Declaration, and the implementation of the other Interim Measures.
600

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602

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Abbreviations/Glossary

A5 Arctic Five, including U.S., Canada, Russia, Norway, Denmark

A8 Arctic Eight, including the A5 plus Iceland, Sweden, Finland

AIS Automatic Identification Systems

EEZ Economic Exclusion Zone

E.U. European Union

NEAFC North East Atlantic Fisheries Commission

RFMO Regional Fisheries Management Organizations

UNCLOS United Nations Convention on the Law of the Sea, 1982

UNFSA Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish species, 1995

U.S. The United States of America

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792 **SUPPLEMENTARY**

793

794 **Table S1:** Brief overview on stocks and fishing status and expected trends in the Arctic Ocean

SPECIES	***FISHING & CATCH STATUS***	***STOCK STATUS***	***EXCPECTED TRENDS & QUOTAS DEVELOPMENT***
Capelin *(Mallotus villosus)*	No fishing in Barents Sea during 2004-2008 due to stock poor condition [1][2]. Preliminary landings in 2011 and 2012 were 20 104 tonnes and 22 298 tonnes, respectively, (against a Total Allowable Catch (TAC) of 22 579 tonnes [3]).	Today the Barents Sea has potentially the largest capelin stock in the world, but there is a lack of stock information [4].	Quotas decreased in the past years (200 000 – 400 000 tonnes between 2009 and 2013; and 65 000 – 120 000 between 2014 and 2015) [1].
Coastal Cod *(Gadus morhua)*	Considered overfished [1]. High uncertainty in the estimation of the commercial catch. Recreational catch has been estimated to be around 12 700 tonnes [1]. Coastal cod is fished throughout the year. Except for the open fjords in eastern Finnmark, the quantities fished inside fjords are low [1].	The coastal survey in 2013 and 2014 showed some increased abundance indices compared to previous years [1]. The most recent survey estimate of spawning biomass is the highest since 1998, but is considered to be rather uncertain.	By the end of the winter/ spring fishery in 2015 the remaining quota for the autumn fishery is similar to what it was in 2013 and 2014. Then the expectation is that the catches of coastal cod in 2015 will be similar to 2013 and 2014 [1].
Haddock *(Melanogrammus aeglefinus)*	2012 landings amount to 315 627 tonnes – being the highest landings of haddock since 1973. In 2013 landings decreased considerably to 193 744 tonnes. Official landings for 2014 are slightly below the agreed TAC (178 500 t) [1].	This stock is classified as having full reproductive capacity. The exceptionally strong year-classes 2004-2006 have contributed to the strong increase to all-time high levels of stock size that has been seen in later years [1].	ICES classifies the Northeast Arctic haddock stock as having full reproductive capacity, but it is also in danger of being harvested unsustainably [1],[4].

Herring *(Clupea harengus*)	Catch is declining [4]. In 1977, the fishery was closed to safeguard the future of the stock.	Stock is declining [4]. During the 70s there was a massive decrease in the spawning stock biomass, largely caused by over exploitation, followed by periods of poor recruitment [5].	The quotas have decreased from 437 000 tonnes (2014) to 283 000 (2015).
Mackerel (*Scomber scombrus***)**	Fishing amounts to 370 000 tonnes. 10 tons (Barents sea)). In 2011 small catches of mackerel were for the first time reported in the Greenlandic EEZ [4].	Increased their feeding migrations north-westwards [1], [4]. This distributional change is likely resulting from changes in physical environment and zooplankton most probably [4].	Mackerel is boosting a great interest and risk of conflict due to lack of regulations. Since 1999, the fishery was regulated according to agreements between the Faroe Islands, EU and Norway. However, since 2009, there has been no coastal state agreement on management and allocation of mackerel [4].
Northeast Arctic (NEA) Cod *(Gadus morhua)*	NEA cod fishery is conducted all year, but most intense in the first half of the year. In winter/spring the southern Barents Sea and coastal areas are the most important exploited areas (while during autumn the main area is along the polar front, e.g. Bear Island–Open area) [4]. High uncertainty in the estimation of commercial catch [1]. Catches have increased in the last six years, reaching 986 000 tonnes in 2014 [1].	NEA cod is the world's largest cod stock [2],[6], and ICES classifies the Barents Sea cod stock as having full reproductive capacity and being harvested sustainably [4]. It is estimated to four times larger than it was 25 years ago [4]. The geographic distribution of this stock is expanding to the north and east. This is related to high temperatures observed in the Barents Sea during recent years as well as increased abundance [7].	The first rebuilding of the cod fishery in the early 90s started before the more recent development of management plans and precautionary reference points were introduced. Hence the early 1990s rebuilding of the fishery was largely an incremental management learning process aimed at limiting effort to better fit with the decline in Total Allowable Catch (TAC).
Redfish (*Sebastes mentella***)**	Considered overfished [1]. Since 1991, the fishery has been dominated by Norway and Russia [4]. ICES has recommended a ban on direct fishing since the mid-90's [1]. After having revised and updated all information on the stock and conducted an assessment with a new analytical population model, ICES recommended that the fishery for 2013 to be kept within 47 000 tonnes.	The stock has been considered depleted. Norway has taken the initiative for a meeting between the Coastal States to discuss a management regime for deep- sea redfish, including allocation of the stock.	ICES has advised on the basis of precautionary considerations that an annual catch in 2015, 2016, and 2017 should be set at no more than 30 000 tonnes, and the 44th Session of the Joint Norwegian-Russian Fisheries Commission decided to follow this advice and set the total TAC in 2015 at 30 000 tonnes [1].

Saithe (*Pollachius virens***)**	Over the last 51 years average annual catch has been 163 000 tonnes. The Norwegian fishery, accounts for more than 90 per cent of the landings. Total landings in 2011 was 157 000 tonnes [1].	Declined considerably from 2007 to 2011, then increased again and is presently (2015) estimated to be well above the precautionary reference point for spawning stock biomass [1].	ICES advised that catches in 2015 should be no more than 122 000 tonnes – and it was set a TAC of that amount. ICES evaluated the management plan and concluded that it is consistent with the precautionary approach [1].

795 Notes: [1] ICES 2015; [2] Durant *et al.,* 2014; [3] DFO, 2013, [4] Fisheries.org [5] www.thefishsite.com [6] Sundby, 2015; [7] IMR

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