



Greenland's offshore Greenland halibut fishery and role of the Marine Stewardship Council certification: A governance case study

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ABSTRACT

The Marine Stewardship Council (MSC) certification is the market-leading seafood eco-label, including in deep-sea fisheries, about which there are growing concerns around sustainability. Greenland is economically dependent on deep-sea fisheries, including for Greenland halibut (*Reinhardtius hippoglossoides*). The offshore halibut fishery, which employs demersal trawls (800–1,400 m), obtained MSC certification in 2017. This provides an opportunity to critically assess the governance of deep-sea resources, with reference to the MSC certification. The Marine Protected Area Governance (MPAG) framework, originally designed to analyse MPAs and adapted for this study, finds an effective system of state-led governance, supported by scientific, certification and industry actors. Arising from its socio-economic importance, the industry's considerable influence is used to align management with the MSC certification. Outcomes directly attributable to engagement with the MSC certification include the introduction of a management plan and new benthic research programmes. However, questions are raised about the certification, providing case study examples of existing criticisms. Assessments are weak with respect to benthic habitats and over-reliant on the definitive, expert judgement of Conformity Assessment Bodies (CABs), whose independence is questioned. Separate MSC assessments of Greenlandic and German vessels in the fleet provided an opportunity to consider the consistency and robustness of the process, which raised serious concerns. Two different CABs found the benthic impact of vessels using the same gear in the same area to be sustainable, by employing fundamentally different and conflicting logic. This represents a serious failing of certification process, undermining the assurance it is intended to provide.

1. Introduction

The over-exploitation of continental fish stocks, growing demand for seafood and advances in fishing technologies have driven fishing into deeper waters [1–3]. Covering ~65% of the earth, deep-seas (depths >200 m) [4] are low productivity ecosystems: species typically exhibit high longevity, slow growth, late maturation and low fecundity [2,5]. Consequently, deep-water stocks are vulnerable to over-exploitation, whilst benthic habitats can be significantly and even irreversibly impacted [2,6]. The sustainability of deep-sea fisheries has been repeatedly questioned, with calls for improved fishery management and conservation measures [1,3,7].

Eco-labelling has been identified as a market-based mechanism with the potential to promote sustainable fishery management [8], including in the deep-sea. The most established seafood eco-label, the Marine Stewardship Council (MSC) certification, was founded in 1997 and now

certifies 13% of global wild-capture seafood [9]. However, there are growing and high-profile criticisms from environmental NGOs [10,11], including original founders WWF [12] and scientists [13–15]. A key concern is the habitat impacts of certified fisheries, particularly those employing towed demersal gears, especially in poorly known deep-sea ecosystems where recovery can be extremely slow [10,16]. There is therefore a need to critically assess the role of the MSC certification in the governance of deep-sea fisheries.

Greenland's fisheries sector accounts for 80–95% of the country's export income [17–19]. The most important fisheries are for prawns (*Pandalus borealis*) and Greenland halibut (*Reinhardtius hippoglossoides*), which both operate in deep-seas and account for 45% and 30% of Greenland's fisheries export income respectively [19]. The deeper of these, the offshore halibut fishery, employs demersal trawling gear in depths of 800 to 1400 m [20] from Greenlandic and foreign vessels. The Greenlandic portion of the fleet obtained MSC certification in May 2017

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[21], followed by the German vessels in June 2019 [22].

The Marine Protected Area Governance (MPAG) framework was developed to provide a structured, empirical approach for critically analysing the governance of Marine Protected Areas (MPAs) [23]. There is a need for an equivalent tool and approach for assessing the governance of fisheries. As both MPAs and many fisheries are discrete areas subject to management, this study tests the applicability of the MPAG framework to a fishery, with specific reference to the role of the MSC certification.

2. Methods

The MPAG framework has been applied to over 50 case studies [24], yielding insights into the effectiveness and equity of marine governance with applications for managers. The structure of the MPAG framework [23] is adopted here and provides the headings for Sections 3-9, inclusive. A key component of this framework is the use of empirical data to identify the incentives adopted within the area being governed. The MPAG framework described by Jones [23] and further discussed elsewhere [25], identifies 36 potential incentives from five categories (Economic, Communication, Knowledge, Legal and Participation). The framework and methodology are detailed and discussed by Jones and Long (in prep, this issue), where the findings of multiple case studies are also compared.

The framework was previously applied to the Ankobohobo crab fishery, Madagascar, an area without any formal MPA designation [26]. In both this study and the prior example, only minor adaptation of the MPAG framework is required to address the governance of a fishery. Specifically, in the absence of formal MPA objectives, the objectives of the Greenlandic government and industry are considered (see, '4. Objectives').

The analysis was conducted using primary and secondary empirical data. Primary data was collected through interviews and observation. Secondary data was obtained from reviews of publicly available documents related to MSC certification, peer-reviewed articles, grey literature and legislation.

Qualitative interview data were collected, following the method employed by Jones [27]. Semi-structured interviews were used to capture the perspectives of actors with knowledge and experience related to the fishery, the governance context and/or the MSC certification. Interviewees were snowball sampled [28] from initial informants from six broad categories of actors (Table 1). A total of 19 interviews were conducted in English, between October 2017 and March 2019, with a median duration of 79 min (range: 35–150 min). On two occasions, at

Table 1

The number of interviews and interviewees by category. Categories of interviewees are, Scientist (SC), Fishing industry (FI), environmental non-government organisation (NGO), State actors, Conformity Assessment Body (CAB) and Marine Stewardship Council (MSC). The category 'CAB' includes permanent employees and assessors contracted by CABs. The category 'FI' includes individuals representing both commercial entities and Greenlandic fishers. Three of the interviewees (SC1, SC2 and SC3) categorised as 'SC' worked in a scientific capacity for a state funded research organisation and so had a dual perspective. Reference codes are used to attribute quotes.

Category	Number of interviews	Number of interviewees	Reference codes
Scientist (SC)	5	5	SC1 – SC5
Fishing industry (FI)	4	5	FI1 – FI4
eNGO (NGO)	2	2	NGO1 and NGO2
State actors (ST)	2	3	ST1 and ST2
CAB (CAB)	2	2	CAB1 and CAB2
MSC (MSC)	4	4	MSC1 – MSC4
ALL	19	21	

the request of the interviewees, the interview was conducted with two people from the same organisation present. All interviews were recorded with prior permission and were anonymised in accordance with the study's ethics approval. A summary of each interview was prepared from a recording, which interviewees were given the opportunity to review and amend, as a means of verifying that their views had been correctly captured and represented. The summaries include *verbatim* quotes, which are reproduced here where pertinent. This process ensured the resulting summaries best represented the interviewees' considered opinion, drawing on their in-depth knowledge and gave them the opportunity to add further detail, clarification or emphasis. The verified summaries were coded in NVivo [29] to collate insights into the governance approach, identify emergent themes and highlight divergent perspectives. For example, text was given an incentive specific code where it provided evidence of one of the 36 potential incentives being employed and/or being in need of strengthening. Additional codes were introduced as key issues emerged. This coding approach allowed all information pertaining to a particular topic to be readily reviewed and compared.

The first author participated in the Greenland Institute of Natural Resources' (GINR) halibut and coldwater prawn stock assessment cruises between 2017 and 2019. During these cruises, benthic habitats were also surveyed, including in the fishery and adjacent areas. Involvement in this research served as an opportunity to develop an understanding of the fishery and the stock assessment process, and also acted as gateway to actors. In August 2018, the first author attended, the first MSC surveillance audit of the West Greenland Offshore Greenland Halibut Fishery (WGOGHF) [30], as both an observer and participant, at the invitation of the fishery client, Sustainable Fisheries Greenland (SFG). The first author presented a preliminary report [31] on habitat surveys, on behalf of the Zoological Society of London (ZSL). The first author's dual role was explicitly stated at the start of the meeting and the informed prior consent of all participants was deemed to have been gained.

The first author's active engagement with benthic habitat research, collaboration with GINR, relationship with SFG and participation in the MSC assessment process are explicitly recognised. The perspective offered in this study is therefore that of both an observer and participant. Naturally, this positioning influences the analysis presented here, but also resulted in insights and access that could not otherwise be obtained. Furthermore, the MPAG framework provides for a broad analysis of the governance of the Greenland halibut fishery, which helped avoid any perceptual biases by a single observer and analyst.

3. Context

Greenland, a constituent part of the Kingdom of Denmark, has a small population of ~56,000, which has been stable since the early 1990s [32,33]. The Home Rule Act 1979 and Self-Rule Act 2009 transferred legislative and executive power to Greenland, granting the right to manage all natural resources in Greenland and its exclusive economic zone (EEZ) [34]. The state capacity in 2018 calculated as a mean of scores (–2.5 to +2.5) for six dimensions of governance indicators was 1.4 (Denmark: 1.6), with an average percentile ranking of 89.5% [35, 36]. This indicates a relatively high state capacity for governance.

Greenland left the European Union (EU) in 1985, principally to secure management of, and access to, fish stocks within its EEZ [32,37, 38]. Economically, Greenland remains dependent on Denmark, relying on an annual grant of 3.4 billion DKK (~500 million USD) set in 2009 and adjusted annually for inflation, which supports nearly half the public spending budget [32]. In 2016, this subsidy accounted for 20.3% of the GDP [39]. In 2015, GDP was 2.4 billion USD, since 2014 annual GDP growth has been positive, fluctuating between 0.3 and 7.7% [39]. Despite a relatively high GDP per capita of 41,800 USD (Purchasing Power Parity), some 16.2% of the population live below the poverty line [40]. Around 10% of the workforce is unemployed [33], with half the

population (men 57%; women 42%) not having received education beyond primary school [32]. These challenges are exacerbated by the isolated nature of many Greenlandic communities.

3.1. Fishing in Greenland

The economic, political, social and cultural importance of fishing in Greenland cannot be overstated. The past century has seen a transition from subsistence hunting and fishing to an economy based on the public sector and commercial export fisheries [33]. Over 80% of the country's export income comes from prawn and halibut fisheries [18,37,41].

Fisheries are divided into the inshore and offshore sectors, which are spatially separate and have different management and social-economic contexts [18].

The labour intensive inshore fishery employs small vessels with catches landed and processed locally. Conversely the high-capital, high productivity, offshore fishery consists of factory trawlers [42], which land the majority of catch overseas. The increasingly modernised industry employs a decreasing share of the population, with only 4.8% employed directly in fishing and a further 3% in the wider industry [41, 43]. Nevertheless, inshore fisheries are a vital income source, especially for the 8000 people living in the smaller coastal settlements, many of

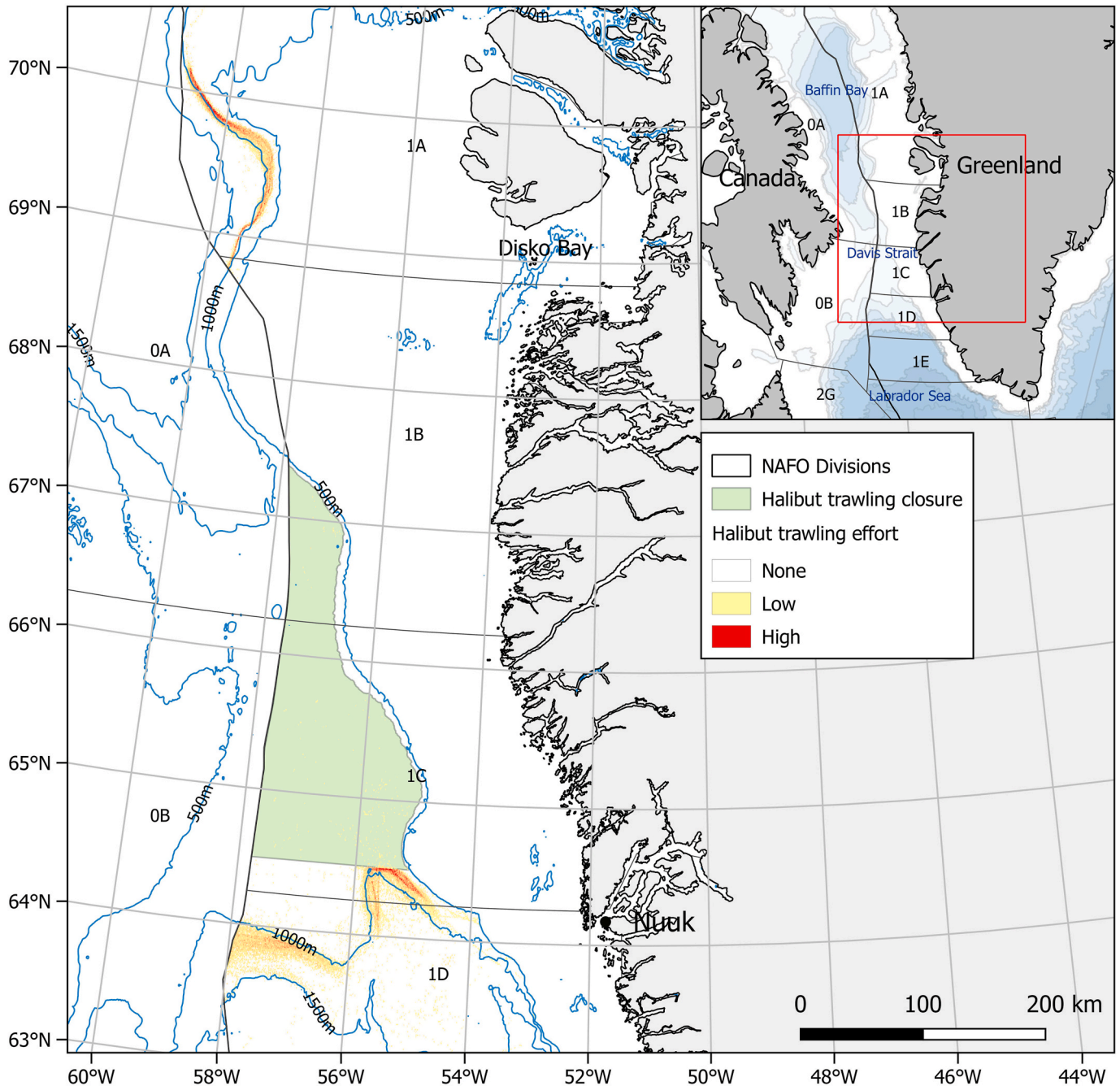


Fig. 1. Map of trawling effort in the Greenland halibut fishery, west Greenland. Fishing effort data was obtained from Global Fishing Watch (GFW) and represents hours of trawling effort at depths >600 m in the Greenlandic EEZ, from 2012 to 2016 inclusive, normalized to a 500 m grid [51]. The closure to halibut trawling between 64°30'N and 68°00'N is shown (green polygon) [48]. For clarity, this is clipped to the 600 m bathymetric contour, as trawling is permitted for other target species, predominantly prawns, this trawling occurs at depths <600 m. Thus the area shown (green) represents the area not subject to any commercial trawling. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

whom directly or indirectly rely on fishing [43]. The offshore industry is dominated by two companies, Polar Seafood and Royal Greenland, the latter of which is 100% government-owned. These two companies share the vast majority of the offshore quota. Further, they own processing plants for handling catch, including from coastal fisheries, where they have invested in the inshore fleet. These separate but intertwined fishery sectors present complex issues around equity, productivity and sustainability, both economic and environmental, which are explored by Snyder et al. [38]. Bi-lateral agreements permit vessels from Norway, Russia, Faroe Islands and some EU member states to operate offshore in Greenland's EEZ [21,39,44,45].

3.1.1. The offshore Greenlandic halibut fishery

As a high-value species, halibut is the second most important fishery target in Greenland (after prawns), accounting for 14% of the total catch by weight between 1990 and 2010 [46] and 20% of export revenue in 2010 (prawns: 50%) [32]. The inshore fishery accounts for a greater proportion of the halibut catch [47]. In 2017, Greenlandic vessels landed 38,192 tonnes of halibut, of which 24,790 tonnes was from inshore (13,402 tonnes offshore) [39].

Greenland's offshore Greenland halibut fishery operates in two spatially discrete areas, northern (NAFO 1B) and southern (NAFO 1CD) (Fig. 1) [20]. Vessels >75 tonnes Gross Registered Tonnage (GRT) must fish >3 nautical miles (nm) offshore and fishing for halibut is prohibited by Executive Order between 64°30'N and 68°00'N to protect juveniles [48]. Reportedly, the fishery footprint (Fig. 1) has remained static [21, 22], because these areas continue to be productive, with minimal risk of gear loss, rather than due to regulatory restrictions. Vessels employ bottom trawls with rock hopper gear and heavy (>2 tonnes) trawl doors [21]. Nets must use a minimum of 100 mm mesh in the wings and 140 mm mesh in the cod-end [48]. Twin-rigged nets separated by a roller clump are used by some vessels.

Additionally, the WGOGHF is seeking to extend the scope of its MSC certification to include a single longline vessel. This may mean an increased footprint, as longline gear is deployed in new areas to avoid gear conflicts [49]. To date, there has only been limited irregular longlining [50], mainly by Norwegian vessels.

The Greenlandic vessels, represented by SFG, form the WGOGHF, which obtained MSC certification in May 2017 [21]. SFG is a tax-exempt organisation, formed for this purpose, whose members include: Royal Greenland; Polar Seafood; other smaller commercial entities; Grønlands Erhverv/Sulisitsisut (Greenland Business Association, GE) and Kalaallit Nunaanni Aalisartut Piniartullu Kattuffiat (the Fishers' and Hunters' Association of Greenland, KNAPK). The Doggerbank Seefischerei West Greenland Halibut Fishery (DSWGWF) is formed of German vessels and was certified in June 2019 [22], operating only in the southern area (NAFO 1C + D) (Fig. 1). Hereafter, unless otherwise specified, 'the fishery' refers to all offshore halibut fishing in the western Greenlandic EEZ, whilst WGOGHF and DSWGWF refer to the MSC certified Greenlandic and German components of the fishery, respectively.

3.1.1.1. Stock. The North Atlantic Fisheries Organisation (NAFO), which is the regional fisheries management organisation (RMFO), considers the halibut stock in NAFO 0 + 1 to be part of a larger population complex, distributed throughout the Northwest Atlantic [52]. Uncertainties remain concerning the population structure, larval dispersion, migration and spawning [53,54]. The prevailing assumption is that individuals entering fjords become resident, with limited emigration, particularly from Greenland's north western fjords [55]. Hence, the inshore populations are considered 'dead-end stocks', although recent research is challenging this assumption [56]. It is thought the offshore stock is relatively stable and the current levels of exploitation are sustainable [21,22].

3.1.1.2. Historic management (stock assessment, TAC and landings). The

commercial catches of halibut were first reported in the Davis Strait in the mid-1960s [50,52], with significant increases in the early 1970s [47]. Quota regulation was introduced in 1976 for NAFO Subareas 0 + 1, with a total allowable catch (TAC) of 20,000 tonnes [52]. Comprehensive stock assessments led by NAFO were introduced in 1994, amid concerns about declining stocks, which saw the TAC lowered from 25,000 to 11,000 tonnes [50]. Since then, offshore catches have followed the TAC in NAFO 0, 1A (offshore) and 1B–F, which has been increased in a step-wise fashion, with 34,661 tonnes landed in 2017 [52].

3.1.1.3. Current management (stock assessment, TAC and landings). In NAFO Subareas 0 and 1, two separate stock assessment surveys are conducted by the Department of Fisheries and Oceans Canada (DFO) and GINR respectively. The NAFO Scientific Council advises on the TAC for NAFO 0 + 1, this is divided 50/50 between Greenland and Canada, based on a non-binding agreement (Table 2) [21,57]. Since 2002, this stock advice has been provided separately for the northern area (0A and 1AB, excluding 1A inshore) and the southern area (0B and 1C–F). The Greenlandic Government then sets the TAC in consultation with the Fisheries Council (see, 6. Governance Framework) and divides this among the Greenlandic fleet and non-Greenlandic vessels according to bilateral agreements. Quotas for the Greenlandic fleet are distributed on the basis of historic fishing rights, capacity and through consultation with the Fisheries Council [57].

4. Objectives

The explicit aim of the management authorities is to ensure the ecological and economic sustainability of the fishery. The Fisheries Act 1996, states that its purpose 'is to ensure appropriate and biologically responsible use of fish stocks' and that attention should be given to 'economic and employment considerations in the fishing industry, the processing industry and other related industries' [61]. This is closely aligned with NAFO's objective for the NAFO Convention Area: 'to ensure long term conservation and sustainable use of the fishery resources in the Convention Area and, in so doing, to safeguard the marine ecosystems in which these resources are found' [62].

4.1. Industry objectives

The primary objective of the industry in seeking MSC certification was to maintain access to markets. The MSC certification seeks to use market forces to promote sustainable fishing [63–65], where certification costs are balanced by competitive advantages [66], such as, price premiums and access to markets [15]. The latter has become increasingly important since the MSC helped mainstream fisheries sustainability and develop the market for sustainable seafood [67]. The clear consensus among interviewees was that, rather than seeking a price premium, the driver was to secure access to the lucrative European market, as previously reported by Jacobsen et al. [50]. CAB2 explained that 'if you want to sell your fish on the European market then you need MSC certification' and therefore the industry's response was 'ok if that's the commercial conditions in which we have to operate then we'd better get the stamp' (CAB2).

A secondary objective may be to achieve corporate social responsibility (CSR) goals, specifically concerning environmental sustainability. Sustainable sourcing is now well-established in the CSR strategies of global seafood industry actors [14]. Indeed, Royal Greenland (WGOGHF), Polar Seafood (WGOGHF) and Parlevliet & Van der Plas, the parent company of Doggerbank Seefischerei (DSWGWF), all have CSR statements that make explicit reference to fishing sustainably. MSC3 reported 'one of the most important drivers for certification now is ... the corporate social responsibility of the big retailers ... they want to be seen to be being responsible, it's something their shareholders will demand of them'.

Table 2

NAFO Scientific Council Greenland halibut stock advice for NAFO Subdivisions 0 + 1, from 2010 to 2019. The Greenlandic share of this advice (50%, by bilateral agreement), Total Allowable Catch (set by the Greenlandic Government) and catch is provided for the northern and southern areas of the halibut fishery, west Greenland. Inshore fisheries are excluded for NAFO 1A but included for all other areas (NAFO 1B–F). Where information was not available in the public domain this is indicated ('n/a').

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NAFO advice^a										
0A + 1A (offshore) + 1B	13,000	27,000	13,000	13,000	16,000	16,000	16,000	17,150	17,150	- ^a
0B + 1C–F	14,000	27,000	14,000	14,000	14,000	14,000	14,000	15,150	15,150	- ^a
0 + 1A (offshore) + 1B–F	27,000	27,000	27,000	27,000	30,000	30,000	30,000	32,300	32,300	36,370
Greenlandic share (50%)										
Northern Area (Baffin Bay), 1A (offshore) + 1B										
Advised (tonnes) ^b	6500	6500	6500	6500	8000	8000	8000	8575	8575	n/a
TAC (tonnes) ^c	6500	6500	6500	6500	8000	8000	8000	8575	8575	n/a
Catch (tonnes) ^d	6462	6472	6459	6513	7985	8016	8335	8655	n/a	–
Southern Area (Davis Strait), 1C–F										
Advised (tonnes) ^b	7000	7000	7000	7000	7000	7000	7000	7575	7575	n/a
TAC (tonnes) ^c	7000	7000	7000	7000	7000	7000	7000	7575	7575	n/a
Catch (tonnes) ^d	7256	6902	7432	8250	8511	8432	8849	9616	n/a	–

NAFO Scientific Council stock advice [58].

^a From June 2018 the NAFO Scientific Council no longer provides separate advice for 0A+1A (offshore)+ 1B and 0B + 1C–F [59].

^b The advised TAC is 50% of the NAFO advice by bi-lateral agreement between Greenland and Canada. Data: 2014 to 2018, Government of Greenland [60]; 2011 to 2013, Cappell et al. [21].

^c The TAC is set by the Greenlandic Government in consultation with the Fisheries Council. The figures presented from 2014 to 2018 are provided by the Greenland Government [60]. The figures presented from 2011 to 2013 are from the MSC assessment of the WGOGHF [21].

^d Data: NAFO [59].

5. Drivers/conflicts

5.1. Economic dependence

In Greenland, fishing is important at the macro-economic level, accounting for 80% of exports [18] and generating significant tax revenues. At the micro-economic level it provides employment, household income and cash for subsistence hunters in isolated communities [68]. Interviewees described how 'it is not a normal economic situation in Greenland' (FI1), when you are dealing with fisheries in Greenland you are 'dealing with the economy [interviewee's emphasis]' (CAB2).

This dependence explains why efforts since 2003 to reform the existing Fisheries Act have yet to reach a conclusion. Politicians have been unable to reach a consensus position that balances calls for a more equitable distribution of quotas, whilst maintaining an efficient and productive industry. The revision is 'such a sensitive and controversial area' (FI2) that progress has not been made and has become 'a never-ending story' (NGO2). This demonstrates the challenge of governance in this context.

5.2. Industry influence

In a country dependent on fisheries, the industry exercises considerable influence, which arises from several factors. Firstly, Royal Greenland and Polar Seafood exercise a near duopoly, accounting for the majority of production in the fisheries sector, reportedly 77% in 2011 [42]. Secondly, the larger of these, Royal Greenland, is 100% government-owned, which some interviewees suggested is an obvious conflict of interest for the government. Lastly, the industry has a dual positioning. On the one hand it sustains the national economy, generating revenue from the highly productive offshore fisheries. Simultaneously, these companies support inshore fisheries and communities by operating processing plants, which are of 'lifeline significance' [38], making the industry indispensable mediators of coastal development [18].

The industry is able to exercise influence at a policy level. Jacobsen et al. [43] identified an influential 'grand reform network', with the fishing industry and banks at the centre, lobbying for the introduction of individual transferable quotas (ITQs) in the prawn fishery. This successfully led to a paradigm shift in Greenlandic fishery governance, towards economic profitability and closer adherence to biological advice,

associated with a new government in the period 2009–2012 [37,69]. Interviewees confirmed that the industry, 'share the rationality with the banks ... and the Ministry of Finance' (SC4), which collectively are a powerful lobby.

5.3. Unknown impacts on deep-sea habitats

The paucity of knowledge on deep-sea ecosystems presents significant challenges to evidence-based management. MSC3 acknowledged, 'in terms of having a quantitative basis and scientific basis to underpin any policy decisions it is almost impossible for most of the deep-sea' (MSC3). The halibut and prawn fisheries are not exceptions. At the point the industry in Greenland first engaged with the MSC certification, 'there had been no research at all about the seabed before that time' (FI4). Another interviewee stated 'we did not have much knowledge about seabed ... [and] impact on the seabed' (ST1).

5.4. Inshore over-exploitation

In contrast to the offshore fishery, quotas routinely exceed advice and are often raised during the season in response to pressure from fishers [37]. SC1 confirmed that, 'generally the rule is that in the inshore areas the advice is not followed'. This is driven by overcapacity in the inshore fleet and limited other employment opportunities, 'there are so many fishermen there and they all need enough [quota] to fish' (MSC1). Inshore fishers are a key source of votes and thus are successful when lobbying to raise TACs and exceed scientific advice [37]. Over-exploitation is most pronounced in Disko Bay, where catch per unit effort (CPUE) is declining [70]. FI3 described the inshore fishery as 'hopelessly overfished'. However, the current understanding of halibut stock dynamics suggests over-exploitation inshore will not negatively impact the offshore stocks.

Nevertheless, the inshore fishery is impacting the offshore fishery. The inshore Nuuk fjord halibut fishery is not subject to assessment or quotas, with only a licence required to enter the fishery. Following past collapse, catches were <500 tonnes prior to 2013. Subsequently, catches have increased, varying between 1000 and 2000 tonnes, due primarily to increased effort [52]. Catches are recorded in the totals for NAFO 1C–F. Currently the offshore fishery utilises the entire TAC for NAFO 1C–F. The combination of offshore and (unlimited) inshore catch has resulted in the TAC being exceeded in NAFO 1C–D since 2013 (Table 2)

[21]. The certifications of both the WGOGHF and DSWGHF include specific conditions requiring this situation to be addressed (see, 6.1 MSC Certification) [21,22]. It is unclear whether this will be resolved by reducing offshore catches and/or increasing inshore regulation. The recent surveillance audit of the WGOGHF noted that progress to address this issue was behind schedule [71]. The MSC certification is a pre-requisite for accessing the European market. Failure to address this condition, resulting in withdrawal of the certificate from either the WGOGHF, or the DSWGHF, would have significant adverse financial impacts.

5.5. Reliance on non-binding bilateral stock sharing agreement

The NAFO Scientific Council advises on the TAC for NAFO 0 + 1, based on a non-binding understanding that this is divided 50/50 between Greenland and Canada (Cappell et al., 2017, Ministry of Fisheries Hunting and Agriculture, 2016). The resilience of this arrangement has not been stress tested as the advised TAC provided by NAFO has been steadily increasing over the past decade (Table 1). In contrast, the combined Greenland-Canada prawn catch exceeds the NAFO advised TAC, as the parties are unable to agree to agree on a bilateral sharing arrangement and so unilaterally set TACs separately. This issue was subject to a condition in the MSC certification of the West Greenland Coldwater Prawn Fishery in 2013 but has not yet been resolved [44,72].

6. Governance framework

The fishery is governed by the state, with co-operation from Canada and Denmark (Fig. 2). The legal framework for fisheries management is

provided by the Fisheries Act, 1996 [61] and subsequent amendments. Executive Orders introduce further regulation relating to: gear requirements; spatial closures [48]; bycatch [73]; an observer programme [74]; and reporting requirements for offshore vessels [75]. Specific to the halibut fishery, a halibut management plan has been in place since July 2016 [57].

Fisheries management is the responsibility of the Department of Fisheries in the Ministry of Fisheries Hunting and Agriculture (MFHA). The Ministry of Environment and Nature ‘has very little’ (ST2) involvement in the management of fisheries and their environmental impacts. Greenland Fisheries Licence Control (GFLK) is a subsidiary of the MFHA responsible for: the issuing of licences; recording catch statistics; inspecting landings; reviewing and managing logbook data; and overseeing observer programmes. GFLK also contribute to the development and implementation of new regulations. Interviewees agreed that whilst GFLK nominally sits within the MFHA, it is ‘rather autonomous’ (SC2) and an ‘entity of their own’ (SC4). In addition to the state, the MSC certification, industry and scientific actors play significant roles in the governance structure, formally and otherwise (Fig. 2).

6.1. MSC certification

The MSC Standard complies the UN FAO’s Code of Conduct for Responsible Fishing, Global Sustainable Seafood Initiative (GSSI) guidance, ISEAL codes and relevant International Standards Organisation (ISO) standards. The Standard consists of three principles: sustainable target stocks (P1), environmental impact (P2) and effective management (P3) [76]. The three principles are assessed by 28 performance indicators (PIs), for which a score between 0 and 100 is given. Scoring

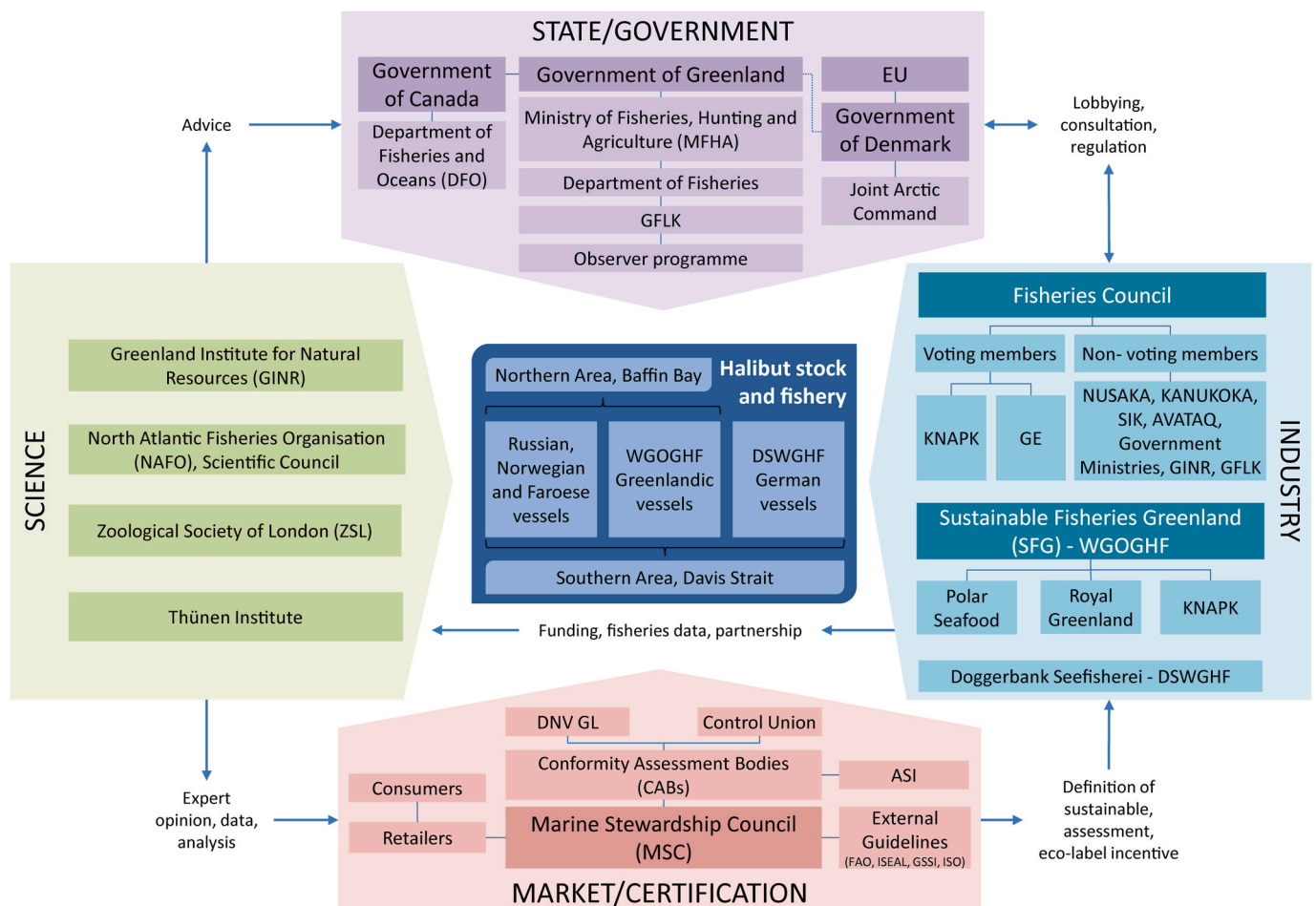


Fig. 2. Representation of the governance framework for the offshore Greenland halibut fishery, west Greenland.

below 60 for any PI results in failure, whilst scores from 60 to 79 attract a condition requiring a specified improvement within a set timeframe. The average of PIs for each principle must exceed 80 for a fishery to be certified. Following initial certification, an annual surveillance audit is conducted, followed by a full re-assessment after five years.

Assessments, annual audits and re-assessments are conducted by Conformity Assessment Bodies (CABs), who are responsible for assembling a team of assessors with the required background, training and experience. Draft assessments are subject to peer review, technical oversight by the MSC and stakeholder comments. CABs are contracted by the fishery client and subject to oversight by Assurance Services International (ASI). The fishery client represents the components of the fishery seeking certification. In this fishery these are SFG (WGOGHF) and Doggerbank Seefischerei (DSWGHF).

The Standard requires that where there is overlap between an existing certified fishery and a fishery under assessment, the CAB is responsible for harmonising the new assessment to ensure the consistency of outcomes between fisheries. This was the case for the DSWGHE, which was assessed subsequent to the certification of the WGOGHF. Conditions are summarised for the WGOGHF and DSWGHE (Table 3).

6.2. Industry

The Fisheries Act established the Fisheries Council, which the government is obliged to consult on matters of fisheries policy, including the setting of TACs [37,61]. The Fisheries Council has two voting members, GE and KNAPK, representing the industry and fishers respectively. Additionally, representatives from the following are non-voting

Table 3

Summary of certification conditions for MSC certified fisheries in the offshore halibut fishery, west Greenland. The Principle (P), performance indicator (PI), condition and timeline for resolution are summarised based on the MSC public certification reports (PCRs).

Principle	PI	Summary of condition	Timeframe
West Greenland offshore Greenland halibut fishery (WGOGHF), certified 2017 [21]			
P1 - Stock	1.2.2	Ensure the TAC advised for Greenland halibut for NAFO stock in SA OA, 1a (offshore) and 1B–1F (including inshore catches) is not exceeded.	2020
P2 - Ecosystem	2.4.1	Ensure commonly encountered habitats are highly unlikely to reduce structure and function to a point where there would be serious or irreversible harm.	2021
P2 - Ecosystem	2.4.2	Introduce management provisions to ensure footprint of the fishery is such that habitat outcome score is maintained.	2020
P2 - Ecosystem	2.4.3	Improve information on nature, distribution, vulnerability and impact of the fishery on main habitats.	2021
Doggerbank Seefischerei West Greenland Halibut Fishery (DSWGHF), certified 2019 [22]			
P1 - Stock	1.2.2	Tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules (HCR).	2023
P2 - Ecosystem	2.4.2	Management should include provisions for managing the extent of the fishery interactions with commonly encountered habitats. The fishery should encourage and help improve the knowledge base on the distribution of VME indicator species, and encourage protection where they occur in concentrations.	2023
P2 - Ecosystem	2.4.3	Improve understanding as to the vulnerability of the main habitats, with regards to the gears used and recovery times. Implement appropriate habitat sampling in the area where the fishery operates, which allows the possibility of trends to be determined.	2022

contributors: MFHA, Ministry of Finance, Ministry of Nature and Environment, GINR, GFLK, Association of Municipalities (KANUKOKA), Employee's Union (SIK), Employer's Association (NUSUKA) and the Nature Protection Association (AVATAQ, an environmental NGO). The Fisheries Council meets regularly but does not necessarily always formally assemble, instead members can be consulted by email [21,37]. Polar Seafood and Royal Greenland can liaise directly with the MFHA and apply their considerable influence (see, 9.2 Is the industry driving governance?).

The industry has promoted research to improve knowledge of the nature and distribution of habitats and the impacts of trawling. SFG have engaged ZSL, whilst Doggerbank Seefischerei has engaged the Thünen Institute (see, 6.3 Scientific Advice). These actions by industry were directly attributable to the requirements of the MSC Standard and conditions of certification (Table 3).

6.3. Scientific advice

Scientists at GINR are responsible for conducting stock surveys and serve as experts in the NAFO Scientific Council. NAFO is responsible for undertaking halibut stock assessments and delivering TAC advice to Greenland and Canada. This advice is based on data from both surveys and fisheries in the respective EEZs.

GINR advises the government directly and through participation in the Fisheries Council. GINR has also developed a programme of benthic research, combining stock assessment bycatch data, beam trawl sampling and seafloor imagery. The latter is collected by means of a towed benthic video sled in partnership with ZSL. To address knowledge gaps that represented a potential barrier to certification, SFG engaged ZSL to conduct photographic survey work. Initially in the prawn fishery using a drop camera [77,78], this was subsequently extended to the halibut fishery, employing a benthic video sled [79]. ZSL was directly funded by SFG, with additional funding for an IUCN BEST 2.0 project in which SFG acted as partners and co-funders. The survey work is undertaken in collaboration with GINR during annual stock surveys cruises. To support the certification of the DSWGHE, Doggerbank Seefischerei engaged the Thünen Institute to analyse bycatch data from German vessels in the fishery on an ongoing basis [22]. SFG also funded PhD research into vulnerable marine ecosystems (VMEs) in Greenland [80].

7. Incentives

Drawing on the MPAG framework's taxonomy of 36 incentives, those incentives employed in the governance of the halibut fishery were identified (Table 4 and Supplementary Information Table 1). A total of 25 incentives were identified, of which seven are important priorities for strengthening, with no incentives identified as important priorities for introduction.

8. Effectiveness

The MPAG framework proposes a scale of effectiveness from 0 (ineffective) to 5 (wholly effective), with qualitative descriptors [23], indicating the extent to which the governance framework addresses the potential impacts, conflicts and drivers identified. Here, a score of 4 'most impacts addressed but some not completely' is assigned.

Many deep-sea fisheries have exhibited a 'boom and bust' cycle, examples of long-standing sustainably exploited target stocks being rare [2,5]. The offshore halibut fishery is perhaps a notable exception, with a comparatively long history of exploitation (>40 years). Stock assessments since 1994 show relative stability, accordingly the advised TAC has been incrementally increased [52,84].

The state-led system of governance is complemented by input from scientific, market-based certification and industry actors. This includes the Fisheries Council, an effective participatory mechanism for consultation, particularly important in a context where fisheries are integral to

Table 4

a-e: Tables a-e summarises incentives employed in the halibut fishery, west Greenland. Incentives are from one of five categories of incentive: a) economic, b) communication, c) knowledge, d) legal and e) participation. Those incentives in need of strengthening are identified (Y = used; Y* = Used, in need of strengthening). These are selected from the 36 incentives (I-1 to I-36) in five categories identified by Jones [23]. The authors' assessments that an incentive is employed and that an incentive requires strengthening, are based on document analysis and interview findings. A more detailed discussion of each incentive is also provided (Supplementary Material, Table 1).

Incentive (I)	Used	How/why?
a) Economic incentives		
I-3. Reducing the leakage of benefits	Y*	Greenlandic vessels must land 25% of catch in Greenland and officers on Greenlandic vessels must have residency status (lived and paid tax in Greenland for >2 years). There are calls for a revised Fisheries Act to reduce the leakage of benefits.
I-4. Promoting profitable and sustainable fisheries and tourism	Y*	The Fisheries Act, Executive Orders and management plan aim to ensure exploitation is sustainable. Overcapacity drives overexploitation in the inshore fishery.
I-5. Promoting green marketing	Y	The Greenlandic and German components of the offshore halibut fishery have obtained MSC certification.
I-8. Investing fishery income/ funding in facilities for local communities	Y	The fishery is a significant contributor to the public purse through tax, duties and licences [19], thus supporting state expenditure.
I-9. Provision of state funding	Y	GINR is funded by the state and conducts stock assessment surveys. A new state-funded research vessel is currently under construction. SFG benefits from tax exemption.
I-10. Provision of NGO, private sector and user fee funding	Y	SFG have funded of a programme of benthic research led by ZSL. This has also been supported by the IUCN BEST 2.0 Grant programme. Licensing of vessels generates revenue for the state.
b) Communication incentives		
I-11. Raising awareness	Y	MSC eco-label promotes consumer awareness of sustainability issues. Research has been shared by ZSL with audiences in Greenland and beyond, though various platforms, including an online game [81].
I-12. Promoting recognition of benefits	Y*	Initially sceptical attitudes among industry and government actors have changed, recognising the role of MSC certification in accessing markets. Limited awareness of eco-labelling and its benefits persists among inshore fishers.
I-13. Promoting recognition of regulations and restrictions	Y	GFLK are responsible for communicating the regulations. The observer programme provides a point of contact on some vessels.
c) Knowledge incentives		
I-14. Promoting collective learning	Y*	Stock surveys are conducted by Greenland (GINR) and Canada (DFO), NAFO Council conducts the analysis and provides TAC advice. Partnerships (SFG-ZSL and Doggerbank Seefisherei-Thünen Insitute) promote collective learning by industry and scientific actors. Both certification assessments place emphasis on the collection and sharing of benthic bycatch data [22,82]. However, effective collective learning must be based on data collectors having adequate knowledge, skills and training, which are currently lacking.
I-15. Agreeing approaches for addressing uncertainty	Y	The management plan stipulates that TAC should follow advice but can only

Table 4 (continued)

Incentive (I)	Used	How/why?
I-16. Independent advice and arbitration	Y*	deviate from the prior year TAC by a maximum of 15% (up or down). This addresses uncertainty by providing a predetermined strategy. Independent scientific advice is provided by NAFO, GINR, DFO, Thünen Institute and ZSL. CABs act as an arbiter, determining whether a fishery meets the MSC Standard. CABs are subject to oversight by ASI. The relationship between CABs and fishery clients observed in this study could be better characterised as a consultant-client relationship, rather than an independent assessor-subject relationship. Some interviewees felt strongly that the independence of CABs needs to be strengthened.
d) Legal incentives		
I-17. Hierarchical obligations	Y	The United Nations General Assembly called upon States to take action to protect vulnerable marine ecosystems (VMEs) in high seas [83]. This definition has been incorporated into the MSC Standard [76]. The MSC Standard is aligned with UN FAO guidance. Non-Greenlandic vessels are subject to fisheries regulations of their home states in addition to relevant Greenlandic regulation.
I-18. Capacity for enforcement	Y*	Enforcement is the responsibility of Joint Arctic Command (a naval component of the Danish armed forces) in cooperation with the Greenland Police. An observer programme is operated by GFLK. Additionally, German vessels have observers from the Thünen Institute in accordance with EU requirements. However, observer coverage is poor. The Fisheries Act details sanctions and fines for infringements.
I-19. Penalties for deterrence	Y	Quotas and licenses are strictly controlled, foreign flag vessels are only permitted through bilateral agreements. There is no evidence of illegal, unregulated or unreported fishing in the offshore fishery.
I-20. Protection from incoming users	Y	MSC certification includes explicit conditions with specified timeframes. These are monitored through annual surveillance audits. This appears to be an effective incentive.
I-21. Attaching conditions to use, property rights, decentralisation, etc.	Y	There are bilateral fisheries agreements with the European Union, Norway, the Faroe Islands and Russia. There is a need to strengthen the non-binding basis on which the TAC is split between Greenland and Canada.
I-22. Cross-jurisdictional coordination	Y*	The Fisheries Act (1996), subsequent amendments and Executive Orders provide a clear and consistent legal basis [61].
I-23. Clear and consistent legal definitions	Y	The Fisheries Council established by the Fisheries Act [61] is an adjudication platform, allowing conflict to be addressed and regulated. The Council considers matters relating to fisheries such as management plans, new Executive Orders and quota setting.
I-25. Legal adjudication platforms	Y	Stock assessment reports are made publicly available by NAFO. The MSC assessment process provides some opportunity for stakeholders to engage. The MSC Standard and assessment documentation are publicly available.
I-26. Transparency, accountability and fairness	Y	
e) Participation incentives		

(continued on next page)

Table 4 (continued)

Incentive (I)	Used	How/why?
I-28. Establishing collaborative platforms	Y	The Fisheries Council is a collaborative platform, described as an 'important institution' and part of a 'special political model where you make sure to have the actors are represented in the decision making' (SC4). SFG is a collaborative industry platform. The NAFO Scientific Council consists of experts from multiple states working together to conduct stock assessments.
I-33. Building trust and the capacity for cooperation	Y	Although Royal Greenland and Polar Seafood are direct competitors, SFG has worked effectively as a cooperative platform. Collaboration through SFG has also 'contributed to an improved and more productive relationship' between KNAFK and Royal Greenland.
I-34. Building linkages between relevant authorities and user representatives	Y	The Fisheries Council provides a linkage between stakeholders and the MFHA. Interviewees described the Fisheries Council positively as an effective participatory approach to stakeholder consultation.
I-36. Potential to influence higher institutional levels	Y	The Fisheries Council provides a formal mechanism to influence higher institutional levels, e.g. the MFHA (Fig. 2). The economic dependence of Greenland on fisheries means that both the offshore industry and inshore fishers are able to influence higher institutional levels. This influence is not necessarily always a positive outcome from a sustainability perspective.

the economy and society. The MSC has acted as an external agency, setting a sustainability agenda and directing the industry's considerable influence. Tangible outcomes include the introduction of a management plan and a programme of research to address the limited knowledge of benthic habitats and trawling impacts. This has undoubtedly improved the effectiveness of governance, 'once we have management plans in place ... it was easier to persuade the politicians [to follow scientific advice] ... you have to apply the management plan otherwise you lose the MSC [certification]' (ST1).

In terms of the sustainability of the benthic ecosystem impacts, it is hard to assess the effectiveness of the governance framework. This limitation was recognised by CAB1, 'the difficulty with the habitats outcome part is it is not as strongly evidence-based as you would like, there is a lot of expert judgement going on'. Ongoing benthic research will provide an opportunity to quantitatively determine the impacts of trawling and further assess the effectiveness of governance with regards to the wider ecosystem.

Critics of the MSC have often highlighted the fact that certification does not necessarily result in changes on the water [e.g. 85]. The MSC's rebuttal is that the certification seeks to promote a much wider programme of change on and off the water [86]. In this fishery the key changes described have been off the water. This was acknowledged by FI2 'nothing has changed in the Greenland halibut fishery [on the water] as a result of the MSC certification. They fish according to the same rules, they use the same gear and they fish in the same area'. Certification has not limited the use of heavy demersal trawling gear over a large area, which likely has significant impacts on deep-sea benthic habitats, as has been demonstrated elsewhere [1,6,87,88]. The footprint, whilst reportedly stable, is not currently constrained.

9. Cross cutting issues

9.1. The role of the Ministry of Fisheries, Hunting and Agriculture

Governing the largest industry in an undiversified economy is inherently challenging, demonstrated by the long-running but unsuccessful efforts to revise the existing Fisheries Act. Challenges are compounded by a high ministerial turnover, 'we have had eight Ministers of Fisheries within the last four, five years' (ST2). Some interviewees were highly critical of the MFHA's capacity, in terms of the number of people and their skills. SC3 described how there is 'very weak management in Greenland ... the department [MFHA, Fisheries Department] who should be managers doesn't have the knowledge to manage'. They continued, 'there are not the skills needed for making sound management and there's no will to get the skills' (SC3).

Civil servants were supportive of certification and 'spent a lot of resources trying to convince our politicians that MSC is a good idea' (ST1). The MSC certification process generated a 'lot of work from our part [MFHA] but also for the companies [SFG] and it entails cooperation and working groups, numerous meetings, numerous hearings - we spend a lot of resources ... [and] a lot of time in the administration attempting to facilitate' (ST1). SFG and CABs requested 'an incredible amount of data', creating a significant amount of work for GFLK, which at times was 'a show-stopper' (ST2).

The implementation of management plans, attributed to engagement with the MSC certification, has had positive impacts for MFHA. Without management plans, stocks are 'under pressure all the time', as fishers and/or the industry lobby to increase quotas or access new areas, 'the pressure is taken off by the MSC' (NGO2). Following the implementation of management plans, 'the discussion about setting the quota ... is a simple administrative process ... we [management] just open the book [management plan] and we can see what we have to do' (ST2). ST1 described how 'once we have management plans in place ... it was easier to persuade the politicians [to follow scientific advice] ... you have to apply the management plan otherwise you lose the MSC'.

9.2. Is the industry driving governance?

Previous studies have recognised the significant lobbying power of the Greenlandic fishing industry [18,43]. Pursuit of MSC certification provided an opportunity to see how the industry exercises this influence. There was little doubt among interviewees representing the breadth of actors that the administrative changes required were driven by the industry.

'Basically the industry came to the fishery Ministry and said you need to make a management plan for this fishery if we are going to have it MSC certified'. During this process 'the civil servants saw themselves as facilitators of [the development of] these management plans'. Specifically, the civil servants felt their responsibility was only to 'arrange a meeting between biologists [GINR] on the one side and the industry on the other, and then they should agree' (SC4).

'[SFG] are pretty much running the MSC process and the administration is just running after the industry. In practice the industry is doing all the work and the administration is just trying to keep up. It is never coming from the politicians, it is coming from the industry' (NGO2).

'SFG had to write three of the existing management plans because the Ministry of Fisheries didn't have any employees who knew how to do it and it didn't have the time to' (FI2).

Interviewees' descriptions of the extent to which SFG were involved in the actual preparation of the management plan varied. SFG clearly had a hands-on role, which, depending on the account, ranged from drafting the document to being consultees. Whilst there was agreement that outcomes such as the introduction of a management plan were

positive, some questioned the legitimacy of the process.

'People at the GINR wondered, is it enough for the managers just to be facilitators or should they take a more leading role?' (SC4).

'That this is not how things should be, it should be the manager who writes the management plans ... [rather than] adopt a management plan that it didn't write itself' (FI2).

Evidently, the industry is able to exert considerable control in the governance of the fishery, and whilst some have concerns about this, others *'don't see it as a problem'* (CAB2). Those of the latter opinion think it is an important for Greenland's key industry to promote its interests. The MSC has incentivised the industry to align management and governance with the Standard, which is in accordance with the MSC Theory of Change. *'It's not the MSC that makes changes happen, it's our partners and the MSC acts as a catalyst or facilitator'* (MSC4). Whilst the MSC Theory of Change describes a cyclical feedback loop, the empirical evidence here suggests a more linear model. The MSC's influence on the market has created demand for certified seafood, as described by Ponte [67]. Responding to this demand, the industry, principally Polar Seafood and Royal Greenland, have steered the state actors, dictating developments in the management and governance of the fishery (Fig. 3). The critical question is *'does this result in a more sustainable fishery?'* The answer depends on the adequacy of the MSC Standard and assessment process.

9.3. MSC certification: defining and assessing sustainability

The Standard codifies the MSC's definition of sustainable, which is intended to be as *'reputable and scientifically based as possible'* (MSC3). Although there are quantitative elements, it is fundamentally qualitative and requires the exercise of judgement by CABs, a process informed by MSC guidance.

Interviewees, including from the MSC, noted the disparity between consumer expectations and the technicalities of the Standard: *'the science of sustainability is different from the public perception of sustainability'* (MSC1). This arises because consumers are rarely familiar with the realities of commercial fishing, for example the high-impact, heavy gear employed in deep-sea trawling. There is an important distinction to be made between impactful and sustainable. The Standard allows for the certification of fisheries that can have significant impacts, including at large spatial scales, providing they meet the Standard's definition of sustainable. Meanwhile, consumers, *'do not necessarily understand the difference between what is sustainable and what is impactful'* (MSC3). Some

interviewees accuse the MSC of being *'disingenuous and misleading to consumers'* in allowing this disparity to persist (SC5). This issue is best expressed by Roberts [16], who questions whether elements of the Standard would *'pass the person on the street test, would the average person think a policy is right or wrong?'*

There are existing technical criticisms of the MSC from NGOs and academics that are pertinent to this fishery and were echoed by some interviewees. These are the independence of CABs, the inconsistency of harmonisation and the assessment of benthic habitat impacts. SC5 warned that the Standard's credibility is seriously comprised, *'they have got to change and if they don't change they will be yesterday's organisation ... they either reform or die'*. NGO1's opinion was that the Standard is *'so weak'* and *'vague'* it renders assessments open to interpretation and *'leaves room for CABs to make money'*. This perspective is supported by the issues highlighted around the independence of CABs, the failure of harmonisation and the weaknesses in the assessment of the benthic habitat impacts, which are discussed below. Notably, to date, significant criticisms have not emerged from consumers or retailers. These stakeholders are core to the MSC's financial model and Theory of Change, *'we would see significant trouble ... if the retailers stopped trusting the MSC'* (MSC4).

Interviewees representing CABs and the MSC dismissed criticisms around independence citing the safeguards in place, such as oversight by ASI. The ASI is responsible for ensuring CABs act in compliance with the MSC Certification Requirements, non-compliance resulting in sanctions, such as suspension of the CAB, which are detailed on the ASI website. Conversely, others questioned whether CABs *'as judge and jury have too much control over the outcome, this leads to risks that they will favour the client ... because they are being paid by them'* (SC5). The relationship between CABs and fishery clients observed in this study would arguably be better characterised as a consultant-client relationship, rather than an independent assessor-subject relationship.

There are simple measures that the MSC could take to address these concerns, and strengthen the incentives described here (Table 4e, I-30). CABs are incentivised to certify fisheries as this potentially secures future business in the form of annual audits and re-assessments. The WGOGHF initial assessment, two subsequent surveillance audits and scope extension were all conducted by the same CAB, DNV GL [21,30,89]. A simple fix would be to require fishery clients to contract different CABs for re-assessments or surveillance audits. This would reduce the risk of CAB-client relationships developing in such a way that incentivised CABs to make favourable assessment and have the added benefit of introducing a 'fresh pair of eyes'. Another benefit would be the proliferation of CABs and assessors, in what is currently recognised as a small

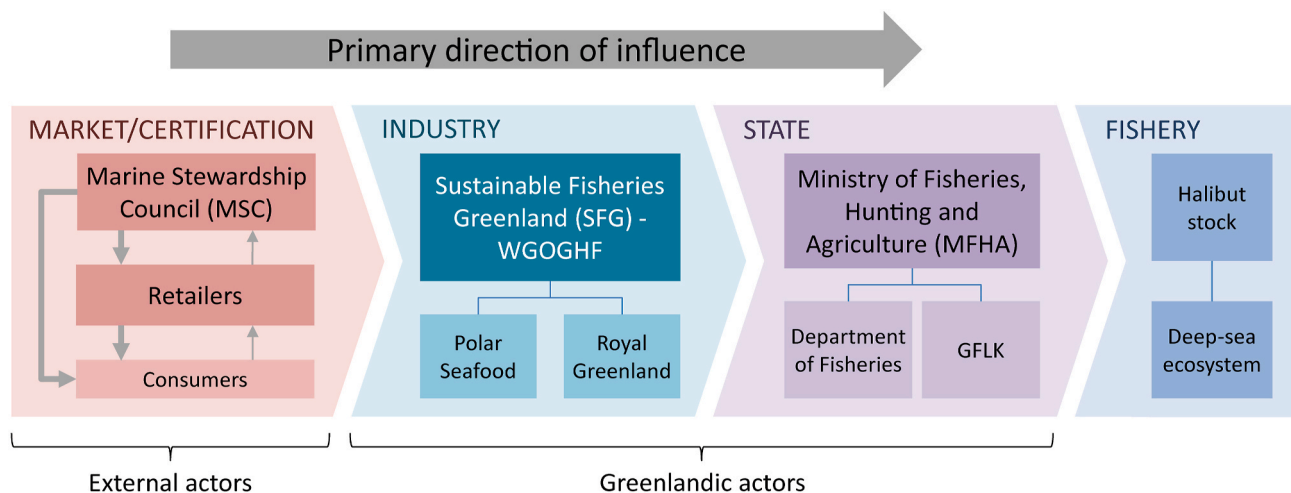


Fig. 3. Representation of the influence of key Greenlandic and external actors in steering the governance of the offshore Greenland halibut fishery, west Greenland. Grey arrows indicate the direction of influence/steer, scaled to suggest relative strength.

pool [90]. The process by which stakeholder, MSC technical oversight and peer review comments are handled could be improved. By design, the process of producing the assessment report is similar to the publishing of academic papers. A critical difference is that the CAB acts as both the author and editor: they are responsible for determining if their response to comments is sufficient and making the decision to publish. There are multiple examples in the certification of the DSWGHE and WGOGHF where the CAB's response is not to make any material changes to the score, i.e. changes that would result in a further condition or failure [21,22]. There is an obvious risk of abuse in a system where the roles of author and editor are played by a single entity employed by the fishery being assessed.

Harmonisation is an inbuilt test of the certification process, determining whether the assessment process is consistent. Vessels in the DSWGHE operate within a subset of the area exploited by the previously certified WGOGHF, employing the same gear and subject to the same Greenlandic regulations. Thus some components of the assessment required harmonisation, including P2 [22]. Two stakeholders, SFG and ZSL, made written submissions questioning the consistency of the assessments and harmonisation.

SFG details the rationale for believing that the conditions for the DSWGHE are not harmonised with those for the WGOGHF. The CAB's (Control Union) response is that 'there is no material difference in the conditions' for the WGOGHF and DSWGHE [22]. This is demonstrably not the case given there was one less P2 condition imposed on the DSWGHE fishery (Table 3). This difference is not trivial as conditions are the mechanism by which the certification drives fishery improvements and are core to the MSC's Theory of Change. ZSL's submission is considered in the following section (9.4 Benthic Impacts).

9.4. Benthic impacts

The consensus among interviewees was that trawling impacts are considerable within the fishery. SC1 stated, 'when you have a [deep-sea] trawl fishery there is only very little left of the original fauna'. NGO2 described how, '[the industry has] trawled the same areas for the last ten, fifteen, twenty years ... there is nothing left there'. FI3 explained that the gear used to target halibut is very heavy, 'it is rigged in a way that it takes the top off the seafloor'.

Given the widely accepted vulnerability of deep-sea benthic habitats and slow speed of recovery, spatial management is often cited as the most appropriate option [91]. This is implicitly recognised within the MSC Standard, which requires that fisheries do not cause 'the reduction in habitat structure, biological diversity, abundance and function such that the habitat would be unable to recover to at least 80% of its unimpacted structure, biological diversity and function within 5-20 years, if fishing were to cease entirely' [76]. The implication is that habitat within the footprint of fishery can be wholly and irreversibly altered provided that, outside of the fishery, 80% of the habitat remains unimpacted. This is effectively a quantitatively defined ratio for spatial management. It is on this basis that the WGOGHF was found to be sustainable with respect to benthic impacts (P2.4.1) [21].

The WGOGHF assessment reports that the total area trawled in a three year period by the Greenlandic halibut fleet was 14,963 km² and that this footprint is stationary [21]. The impacted area is compared with 270,000 km², the total area >500 m in west Greenland, from which it is concluded that 94.5% of the habitat remains unimpacted. Assuming all areas within the western half of Greenland's EEZ >500 m represent equivalent habitat represents a gross simplification. At the very least, this should be constrained to the depth range (800–1,400 m) within which trawling occurs, as conditions and thereby the habitats hundreds and thousands of meters deeper will be very different. The fishery operates in two discrete areas of the comparatively shallow Davis Strait. The Davis Strait acts as a bathymetric bottleneck between the deeper Labrador Sea and Baffin Bay basins (Fig. 1), uniquely shaping the hydrographic conditions. A more nuanced approach would consider

abiotic factors including temperature, salinity, current and slope characteristics within the fishery and to what extent they are replicated elsewhere. MSC2 agreed that, '[the CAB] haven't defined the [spatial extent of the] habitats effectively', and explained that 'as evidenced by the technical oversight that we [the MSC] raised ... we weren't particularly satisfied with the rationale presented', but noted that '[the MSC] are a stakeholder in the process, they [the CAB] are not mandated to change their information, we're not replacing their expert knowledge'. Ultimately, the fishery was certified on this basis of this simplistic, somewhat cursory analysis of benthic impacts.

Subsequently and conversely, the DSWGHE assessment found the recovery of habitats impacted within the footprint is likely to be sufficiently fast to ensure recovery of at least 80% of structure and function within 20 years [22]. This was subject to a detailed stakeholder submission by ZSL, whose principle concern was that the CAB's assessment was inappropriately based on a global analysis of trawl impacts by Hiddink et al. [92]. The meta-analysis of Hiddink et al. [92] drew on shallow shelf fisheries predominantly at depths <50 m, with only one 'deep' fishery at just 400 m.

The harmonisation, or lack thereof, demonstrates serious failings in the consistency and robustness of the MSC assessment process. Clearly the rationale employed in each assessment is questionable in terms of the scientific rigour, though some may dismiss this as differences in expert opinion. However, critically the fundamental basis on which two overlapping fisheries employing the same gear were found to be sustainable in terms of ecosystem impacts (P2, PI 2.4.1), was wholly different and contradictory. This is not trivial, in that two CABs applied the same Standard and yet employed directly contradictory arguments to find that the habitat impacts were sustainable.

9.4.1. Vulnerable marine ecosystems (VMEs)

The United Nations General Assembly (UNGA) Resolution 61/105 called upon States to take action to protect vulnerable marine ecosystems (VMEs) [83], which are deep-sea habitats of biodiversity value that are vulnerable to physical disturbance. Identification of VMEs has frequently been based on the occurrence of significant concentrations of VME indicator species, such as cold-water coral or sponges, which is a matter of expert judgement in the absence of explicit thresholds [93].

VMEs are now explicitly incorporated in the MSC Standard [76]. States and RMFOs have not yet adopted consistent approaches for identifying and protecting VMEs, and knowledge gaps remain [94,95], including in the northwest Atlantic. MSC2 notes that for MSC assessments, 'a perennial issue has been the identification and understanding of management frameworks around vulnerable marine ecosystems (VMEs)'.

The fishery's management measures include move-on rules to protect VMEs. Specifically, vessels must cease fishing, move a minimum of 2 nm and inform GFLK in the event that 300 kg of live sponges or 60 kg of live corals are taken in one trawl [48]. The inadequacy of move-on rules in general has been discussed elsewhere [93]. In this fishery, the large mesh (140 mm cod-end) employed means many VME indicator species can be impacted without forming a significant component of the landed bycatch. There are no reports of move-on rules having been triggered, confirmed by GFLK and stated in both MSC assessments [22, 44]. This may indicate that VMEs are absent from this area. Conversely, VMEs may be present and subject to damage without triggering the move-on rules. This is compounded by the fact that fishers lack the required knowledge and skills to identify benthic bycatch (Table 4c, I-14). A better management approach would employ spatial exclusions informed by an improved understanding of VME distribution.

Engagement with the MSC has resulted in ongoing research, supported by the industry, into the distribution of VMEs and impacts of trawling. To date this research has resulted in the identification of a candidate soft coral garden VME, immediately adjacent to the southern portion of the halibut fishery in shallower water (300–600 m) [79]. The response of the actors to this newly proposed VME will serve as a test of the governance framework and its capacity for adaptive management.

9.5. Role of NGOs

Despite having an economy dependent on natural resource exploitation, environmental NGOs (eNGOs) in Greenland are conspicuous by their absence. WWF is the only international eNGO with a permanent presence, maintaining a one-person office in Nuuk. This is partly because of a long-standing antipathy towards eNGOs arising from past campaigns against marine mammal hunting.

A key component of the MSC model is stakeholder engagement, including from eNGOs. *'It benefits fishery assessments when there is engagement from NGOs ... in areas where there is less presence [of NGOs], you are going to have less scrutiny, it's obvious'* (MSC2). There is very little input from NGOs to these assessments compared with other MSC certifications of trawl fisheries in the North Atlantic. MSC3 conceded that the halibut fishery assessment would have *'undoubtedly'* received more scrutiny in other contexts. The certification assessments and governance framework would benefit from more critical perspectives.

10. Conclusion

The importance of fishing to Greenland means effective governance of marine resources is critical, making it an ideal context to consider the effectiveness of market-based mechanisms, such as MSC certification, to promote sustainable fishery management. Indeed, there can be few, if any, countries with a higher proportion of their GDP MSC certified.

The MPAG framework served as an appropriate tool to critically analyse the governance of this fishery and the role of the MSC certification. The framework could readily be applied to other fisheries. The study found an effective state-led system of governance supported by scientific, certification and industry actors. Previous MPAG studies have shown that effective governance requires a diversity of actors and related incentives [96], as is the case here, with a wide range of actors from within and beyond Greenland. Collectively they operate a diversity of interacting and mutually supportive incentives from all five categories, including the collaborative role of the Fisheries Council (I-28), a participatory incentive that enjoys widespread support. This Fisheries Council model could be replicated elsewhere to ensure adequate representation of stakeholders, providing them with direct access to policy makers and managers. This can contribute to more equitable and transparent governance of marine resources.

The MSC certification provides a strong market steer for the industry's considerable influence. Engagement with the MSC led to a new paradigm, from which there emerged *'an interesting dynamic between the companies and the Government because the companies come and ask to be regulated, which is otherwise very rare'* (ST1). Outcomes include the introduction of a halibut management plan and a program of benthic research delivered through new partnerships between industry and scientific actors. Whilst certification has undoubtedly strengthened the governance of the fishery with tangible changes, significant issues remain. It is uncertain how challenges in the inshore fishery will impact the offshore fishery and whether the MSC certification can achieve similar results in this contested small-scale fishery.

The MSC considers this and other certified Greenlandic fisheries as prime examples of the Theory of Change in action. Interviewees described how the *'the MSC theory is in practice in Greenland'* (MSC1), where *'fishery improvements, in our eyes, have been levered in through certification'* (MSC2). Accordingly, the halibut fishery has been repeatedly highlighted by the MSC in annual reports and other external communications [9]. It may surprise some to see a demersal trawl fishery, employing heavy gear in poorly known deep seas, held up as a flagship example of sustainability. This demonstrates the subjective nature of the term, to some extent sustainability is in the eye of the beholder. For these reasons it is important that certifications are transparent, robust and consistent if they are to be credible.

However, the study provides specific examples of existing criticisms of the MSC certification. The assessment of habitat impacts is weak and

over-reliant on the expert and definitive judgement of CABs, whose independence has reasonably been questioned. The issue is compounded by the limited presence of critical voices. The most serious concern is the lack of harmonisation between the two assessments of overlapping fisheries. Greenlandic and German vessels employing the same gear in the same area were found to be sustainable with respect to benthic impacts, by CABs which employed fundamentally different and conflicting logic. This represents a serious failing of the assessment process, compromising one of the MSC three principles of sustainability. The MSC certification and indeed any eco-label, must ensure that the process is robust, consistent and independent, which was not always the case in this study. This could be addressed by the simple but fundamental measures suggested here. For example, requiring the original CAB to be changed in subsequent assessments and removing the dual role of author and editor that CABs enjoy in the reporting process. The future of the MSC certification and the assurance it provides arguably relies on proactively addressing these growing and significant concerns.

Growing knowledge of benthic habitats is providing new insights into the nature and distribution of deep-sea habitats, including VMEs, and the impacts of trawling. This will provide an opportunity to objectively and quantitatively review the sustainability of this fishery in terms of the wider ecosystem. This should be used to re-assess the effectiveness of governance and the validity of the MSC certifications, with applications to the future management of this fishery and others.

Declaration of competing interest

The habitat surveys are part of an ongoing collaboration between Zoological Society of London (ZSL) and GINR, contributing to the Initiating North Atlantic Benthos Monitoring (INAMon) project and an IUCN BEST 2.0 project (#1586). The IUCN BEST 2.0 project is led by the ZSL, with Sustainable Fisheries Greenland (SFG), as a partner and co-funder.

CRedit authorship contribution statement

Stephen Long: Conceptualization, Methodology, Investigation, Data curation, Writing - original draft, Visualization. **Peter J.S. Jones:** Conceptualization, Methodology, Writing - review & editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.marpol.2020.104095>.

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