Marine Resources, Climate Change and International Management Regimes

edited by
Olav Schram Stokke
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Acronyms and Abbreviations

ABMT	area-based management tool
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ACC	Antarctic Circumpolar Current
ACDR	Announcement Comment Draft Report (MSC)
AGRIFISH	Agriculture and Fisheries Council (EU)
AMO	Atlantic Multidecadal Oscillation
ARK	Association of Responsible Krill Harvesting Companies
ASI	Assurance Services International (MSC)
ASOC	Antarctic and Southern Ocean Coalition
ATCM	Antarctic Treaty Consultative Meeting
ATS	Antarctic Treaty System
BAS	British Antarctic Survey
BBNJ	Marine Biodiversity Beyond National Jurisdiction
BEAR	Barents Euro-Arctic Region
CAB	Conformity Assessment Body (MSC)
CAMLR Convention	Convention on the Conservation of Antarctic Marine Living Resources
CAOF Agreement	Central Arctic Ocean Fisheries Agreement
CAP	Client Action Plan (MSC)
CBD	Convention on Biological Diversity
CBS Convention	Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CDW	Circumpolar Deep Water
CEP	Committee for Environmental Protection (ATS)
CFP	Common Fisheries Policy (EU)

CFSP	Common Foreign and Security Policy
Chl-a	Chlorophyll-a
CJEU	Court of Justice of the European Union
CLCS	Commission on the Limits of the Continental Shelf
CM	Conservation Measure (CCAMLR)
CMIP	Coupled Model Intercomparison Project
CNCP	Cooperating Non-Contracting Party
COP	Conference of the Parties
CPRDR	Client and Peer Review Draft Report (MSC)
CRAMRA	Convention on the Regulation of Antarctic Mineral Resource Activities
DG MARE	Directorate-General for Maritime Affairs and Fisheries (EU)
DNV	Det Norske Veritas (now DNV GL)
DNV GL	Det Norske Veritas and Germanischer Lloyd
EAF	Ecosystem Approach to Fisheries
EAMPA	East Antarctic Marine Protected Area
EEAS	European External Action Service (EU)
EEZ	Exclusive Economic Zone
EP	European Parliament (EU)
EPB	European Polar Board
ETP	endangered, threatened or protected (species)
EU	European Union
EUR	euro (EU)
FAO	Food and Agriculture Organization (UN)
FCP	Fisheries Certification Process (MSC)
FIUN	Fishing Industry Union of the North (Russia)
FP	Framework Programme (EU)
FPZ	Fisheries Protection Zone
GATT	General Agreement of Tariffs and Trade
GFCM	General Fisheries Commission for the Mediterranean
GSSI	Global Sustainable Seafood Initiative

HR	High Representative of the Union for Foreign Affairs and Security Policy (EU)
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IMR	Institute of Marine Research (Norway)
IOTC	Indian Ocean Tuna Commission
IPCC	Intergovernmental Panel on Climate Change
IPHC	International Pacific Halibut Commission
IUCN	International Union for Conservation of Nature
IUU fishing	Illegal, Unreported and Unregulated fishing
JNRFC	Joint Norwegian–Russian Fisheries Commission
LÍÚ	Federation of Icelandic Fishing Vessel Owners
MARPOL	International Convention for the Prevention of Pollution from Ships (IMO)
MCS	Monitoring, Control and Surveillance
MEP	Member of the European Parliament (EU)
MINSA	Mackerel Industry Northern Sustainability Alliance
MOC	Atlantic Multidecadal Oscillation
MOP	Meeting of the Parties
MPAs	Marine Protected Areas
MSC	Marine Stewardship Council
MSCI	Marine Stewardship Council International (MSC)
MSY	Maximum Sustainable Yield
MT	Million tonnes
NAFO	Northwest Atlantic Fisheries Organization
NASCO	North Atlantic Salmon Conservation Organization
NATO	North Atlantic Treaty Organization
NEAFC	North-East Atlantic Fisheries Commission.
NFD	Norwegian Fisheries Directorate

NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (USA)
NorESM	Norwegian Earth System Model
NPAFC	North Pacific Anadromous Fish Commission
NPFC	North Pacific Fisheries Commission
NRK	Norsk Rikskringkastning (Norwegian Broadcasting Corporation)
NW	North-West
OJ	Official Journal (EU)
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
P1, P2, etc.	Principle 1, Principle 2, etc. (MSC)
PAR	photsynthetically active radiation
PCA	Permanent Court of Arbitration
PCDR	Public Comment Draft Report (MSC)
PD	Annex PD (MSC objection procedure)
PECH	European Parliament Committee on Fisheries (EU)
PF	Polar Front
PI	Performance Indicator (MSC)
PINRO	Polar Research Institute of Marine Fisheries and Oceanography (Russia)
PSM Agreement	Port State Measures Agreement (FAO)
RCP	Representative Concentration Pathway (IPCC)
RFB	Regional Fishery Body (FAO)
RFMA	Regional Fisheries Management Arrangement
RFMO	Regional Fisheries Management Organization
RFMO/As	Regional Fisheries Management Organizations and Arrangements
RIA Novosti	Russian News and Information Agency
ROMS	Regional Ocean Modeling System
SACCF	Southern Antarctic Circumpolar Current Front
SAF	Sub-Antarctic Front

SC-CAMLR	Scientific Committee for the Conservation of Antarctic Marine Living Resources
SEAFO	South East Atlantic Fisheries Organisation
SG	Scoring Guidepost (MSC)
SI	Scoring Issue (MSC)
SIC	sea-ice concentration
SIOFA	Southern Indian Ocean Fisheries Agreement
SOLAS	International Convention for the Safety of Life at Sea (IMO)
spp.	species pluraris (multiple species)
SPRFMO Convention	South Pacific Regional Fisheries Management Organisation
SSB	spawning-stock biomass
SSS	sea surface salinity
SST	Sea Surface Temperature
SW	South-West
T	temperature
TAC	total allowable catch
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
UNCLOS	United Nations Convention on the Law of the Sea
UNFSA	UN Fish Stock Agreement
UNGA	UN General Assembly
UoA	Unit of Assessment (MSC)
UoC	Unit of Certification (MSC)
UNTS	United Nations Treaty Series
UVB	Ultraviolet B
VNIRO	Russian Federal Research Institute of Fisheries and Oceanography
WECAFC	Western Central Atlantic Fishery Commission
WSMPA	Weddell Sea Marine Protected Area
WTO	World Trade Organization
WW1	First World War
WWF	World Wide Fund for Nature

Part One

Introduction

1

Introduction: Climate Change and Resilient Fisheries Management

Olav Schram Stokke, Andreas Østhagen, Andreas Raspotnik
and Jan Erik Stiansen

The world's oceans are already feeling the impacts of global warming. How may this affect the international management of marine living resources? In this book we examine the challenges that warming oceans pose to institutions for managing fish stocks that are shared by several states or straddle the high seas beyond national jurisdiction. Special attention is paid to institutional resilience – the capacity of management regimes to adapt to such challenges.

In recent decades, changes in climate have affected natural and human systems on all continents and across the oceans. Scientific projections of climate changes expected by the mid-twenty-first century and beyond show that global marine-species redistribution and marine-biodiversity reduction in sensitive regions will challenge the sustained provision of fisheries productivity and other ecosystem services (IPCC 2015). Spatial shifts of marine species due to projected warming will bring invasions to high-latitude seas, and greater local-extinction rates in the tropics and in semi-enclosed seas. Species richness and fisheries catch-potential are projected to increase at mid- and high latitudes and decrease at tropical latitudes.

Much of the evidence of recent climate change has been obtained through remote sensing and outputs from coupled atmosphere-ocean models. However, to detect the effects of these changes on marine living resources in each region it is necessary to link global trends with observations at the regional level. Combining oceanographic and biodiversity data offers a major source of regional data for uncovering climate-change effects on living marine resources in high latitudes over the past fifty years, as described in Chapters 6 and 11.

Climate change affects marine living resources by inducing greater variability in ocean conditions such as temperature, sea-ice extent, salinity and stratification. Such variability may affect the metabolic and reproductive processes of marine organisms directly; or indirectly, by altering their biological and abiotic environment – including spatial overlaps with predators and prey and the type and structure of their habitat. Among the possible consequences of such changes are shifts in the abundance, geographical distribution and migratory patterns of commercially and ecologically important fish stocks.

Narrowing in on selected cases of international marine living resources management, the contributions to this book bring out how these impacts of climate change impinge on the core tasks of resource management – scientific advice, regulation and compliance control – and how institutional features interact with political factors in efforts to adapt management regimes in order to retain or improve their performance. The cases of resource management studied here (cod, mackerel and crustaceans) are among the largest harvested stocks in the world. As this introductory chapter brings out, findings from these cases are relevant also for many other unilateral, bilateral and multilateral efforts worldwide to cope with resource-management challenges that are becoming amplified by the impacts of climate change.

Climate change and the abundance and distribution of marine stocks

Annual-to-decadal variations in ocean temperature tend to have greater amplitude than multi-decadal variations, and the variability at these two timescales differs in the impacts on marine ecosystems.[1] In general, ecological changes due to physical forcing move from local effects on individuals on shorter timescales (hours/days/months), to regional effects on population dynamics on medium timescales (seasonal/annual/decadal), to broader basin-scale effects on ecosystem dynamics on longer timescales (decadal/multidecadal). For example, annual-to-decadal temperature variations might affect production on lower trophic levels as well as fish recruitment and year-class strength, whereas multi-decadal variations may induce habitat expansion of populations as well as altering production, especially on higher trophic levels. These different timescales must be taken into consideration when discussing how climate change affects marine ecosystems.

The cold-temperate regions of the oceans, from about 40°N latitude to the Arctic Front and southward from the Antarctic Polar Front, support large and productive fisheries. Not all species have responded in the same way to ocean warming (Hollowed and Sundby 2014). Response patterns appear to be linked to a complex suite of climatic and oceanic processes that may portend future responses to warming ocean conditions. For example, the year-class strength of Northeast Arctic cod, the world's largest cod stock, is governed by a complex suite of processes during the first year of life. Temperature serves as a proxy for several of these processes.

Climate variability and change are known to have many and diverse biological effects – directly on an organism, such as through inducing physiological changes, or indirectly, for example through their effect on predators and prey. Inter-annual temperature variations influence recruitment from year to year, but longer-term variations also influence stock structure and distribution. During warming phases, the spawning-stock biomass may gradually build up, whereas in cooling phases, spawning-stock biomass may decrease. It is becoming increasingly important to identify the mechanisms by which climate change can affect fish population dynamics; to improve our understanding of how climate change will impact shifts in the distributions of fish species; and to develop models to predict the effects of climate change on future distributions of fish and fisheries (Hollowed et al. 2013).

By developing and linking models of physical, biological and human responses to climate change, we can predict impacts on fish yields and dependent societies. The adoption of highly resolved shelf-sea physical-biological models rather than global climate models gives greater confidence in predicting the consequences at national scales, although there are significant trade-offs (Barange et al. 2014).

In a global perspective, climate change will generally increase the water temperature at every location. The temperature gradient polewards from the Equator will remain, but the species-temperature habitat will move polewards, leading to pressure on Arctic and Antarctic species. As biodiversity is highest at low latitudes and decreases nearer the poles, it is likely to increase locally in areas of polar water retreat. However, the lower biodiversity found in the open oceans has also allowed a few specialist species to proliferate, as is the case in the Nordic and Barents Sea ecosystems as well as in the Southern Ocean. These abundant species will tend to shift polewards, albeit limited by factors such as food availability, competition and good spawning grounds. Kjesbu et al. (2021) investigated thirty-nine commercial species in the Northeast Atlantic: they found that in the next fifty years the boreal species of the Norwegian Sea are highly likely to benefit from climate change, whereas the Arctic-water species in the Barents Sea will decline. Bryndum-Buchholz et al. (2020) report similar results for the Northwest Atlantic, noting that projected declines in harvestable biomass have been especially marked in historically important fishing grounds such as the Grand Banks of Newfoundland and the Scotian Shelf. As elaborated by McBride in Chapter 11, modelling studies of krill in the Southern Ocean under different warming scenarios generally predict a reduction and a poleward shift (e.g. Cuzin-Roudy et al. 2014; Piñones and Fedorov 2016). Arctic ecosystems, and probably also the Antarctic ones, will be losers in the long run, with shrinking areas of productivity.

Management tasks, stock-shifts and institutional resilience

Changes in the abundance and spatial distribution of marine stocks will pose additional challenges to the institutions that have been set up to manage transboundary stocks (see Pinsky and Mantua 2014; Cheung et al. 2017; Cheung 2018; Pinsky et al. 2018; Sumaila et al. 2020). Managing marine living resources involves making and implementing authoritative decisions on use and conservation: 'use' here refers to resource exploitation and allocation of benefits, whereas 'conservation' is about ensuring future availability. The problem of balancing those objectives can be subdivided into three management tasks: cognitional, regulatory and behavioural (Stokke 2015).

The *cognitional* management task involves providing scientific advice based on a shared, well-founded understanding of how various levels of harvesting pressure will affect the state of the fish stocks, as well as their long-term ability to provide employment, fishery yield, food security and food-web stability. The *regulatory* task entails moving from such a shared understanding of means–end relationships into joint commitments among states to a set of common or compatible rules. The behavioural or *compliance* task is to ensure that those rules actually shape the performance of target groups. In conjunction with other factors that affect the spatial distribution of marine stocks – notably, bottom topography, stock size and food availability – climate change can impinge on each of these management tasks and therefore on the performance and effectiveness of various institutions established to support them.

For instance, a stock that expands its area of distribution may become available to fishers from additional states, complicating the cognitional task by requiring not only wider spatial coverage in the scientific survey activities often underlying the advice but also broader involvement in data analysis and generation of policy advice (Cheung 2018: 800). Studies of scientific assessments (Cash et al. 2003; Mitchell et al. 2006) indicate that, without such involvement, scientific advice is less likely to be perceived as credible and legitimate by those who are involved in the fishery and its regulation – which may in turn impinge on the collective ability of the states involved to reach agreement on the conservation measures advised by scientists.

Also the *regulatory* side of management can be directly affected by a spatial stock shift. For instance, it may put pressure on agreed quota-allocation arrangements among user-states (Pinsky et al. 2018: 1189), especially if the shift involves a significant and long-term change in the stock's 'zonal attachment': its occurrence in the various exclusive economic zones (EEZs) that states have established along their coasts and in waters beyond national jurisdiction.

With respect to *compliance* activities, a stock that moves into high-seas areas will narrow the jurisdictional basis for at-sea inspection and other modes of verification necessary for review of compliance and response to rule violation. That is because, under international law, the flag state enjoys a near-monopoly on rule enforcement beyond the maritime zones of coastal states (Stokke 2019).

In such cases, climate change will amplify generic challenges to the cognitional, regulatory and compliance tasks of fisheries management, thereby giving rise to questions about institutional resilience. In ecosystems analysis, resilience denotes 'the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist' (Holling 1973: 17). In the study of governance systems, 'institutional resilience' concerns the ability to deal with new challenges by adapting institutions, or relationships among them, to an extent sufficient for maintaining or improving institutional performance (see Young 2010: 379; Herrfahrdt-Pähle and Pahl-Wostl 2012: 2).[2] Possible adaptations include creating new management regimes in areas where no such bodies have existed; within-regime changes such as broader membership or geographic scope, or modified quota-allocation keys; and efforts to improve the interplay among institutions relevant to management, including their spatial or functional division of labour.

The chapters in this book disentangle these relationships between climate change and international management of shared and straddling fish stocks, drawing on findings from in-depth case studies to shed light on general requirements for institutional resilience.

Research questions and case diversity

The overarching questions examined in this book concern institutional performance in the face of rapidly changing circumstances; and answering them has involved close collaboration between natural and social scientists:

1. How do global warming and other environmental changes generate shifts in the abundance, distribution and migratory patterns of commercially and ecologically important marine stocks?
2. To what extent and how do stock-shifts pose challenges to the national, international and transnational management regimes established for the management of commercially and ecologically important fisheries?
3. To what extent and how have the actors operating these regimes adapted them to the changing circumstances and succeeded in maintaining or improving levels of performance – i.e. achieved institutional resilience?

We examine those three questions empirically by narrowing in on selected marine stocks in the Barents Sea, the Nordic Seas and the Southern Ocean – of cod, snow crab, mackerel and krill. Jointly, the processes of managing these stocks provide analytically helpful diversity with respect to three factors likely to weigh heavily on the capacity of resource management regimes to cope with the challenges posed by climate-related stock-shifts: the *extent* of the spatial shift, especially in terms of changes in zonal attachment; the *number of actors* who are engaged in the fishery and who must agree to any change in the management system in response to a stock shift; and the procedural *strength* of the management institution in place: its ability to adopt binding decisions also on substantive matters that are controversial among members.

Here we elaborate on this case diversity and on how it affects the implications to be drawn from this study to efforts in other parts of the world aimed at adapting fisheries management regimes to the impacts of climate change.

Extent of the spatial shift

The extent of change in the spatial distribution of a marine stock matters, because a minor change in zonal attachment from one year to another is unlikely to complicate the provision of scientific advice or to generate politically demanding requests for renegotiation of existing allocation arrangements. Among the cases studied here, the spatial distribution of Northeast Atlantic mackerel has shifted widely in the period under study; that for Northeast Arctic cod has shifted only slightly; whereas scientific uncertainty and dissensus remain concerning the strength of the evidence of a poleward shift of Antarctic krill associated with a warming Southern Ocean.

The ‘Nordic Seas’ is a collective term denoting the Norwegian Sea, the Greenland Sea and the Iceland Sea, three ocean areas separated from the remaining North Atlantic by the Greenland–Scotland Ridge (ICES 2018). These waters are home to the world’s largest stocks of mackerel and herring, as well as holding many other species such as blue whiting, saithe, redfish, salmon and tuna. The chapters in this book pay particular attention to the regional mackerel stock (*Scomber scombrus*), which has posed especially difficult management challenges in recent years. From around 2007, the increased abundance and considerable geographic expansion of this stock, involving greater availability in Faroese, Icelandic, Greenlandic and high-seas waters (Astthorsson et al. 2012; Utne et al. 2012; Nøttestad et al. 2016), have given risen to international negotiations, deadlocks and sanctions of various kinds between new entrants and those with a long track record of harvesting this stock – the EU and Norway (see Ch. 7). Further confounding this management challenge was the UK decision in 2016 to leave the EU, implying that it would again become an independent actor in international fisheries regulation – and linking efforts to cope with the mackerel dispute to the protracted and complex negotiations over the fisheries part of Brexit.

A more modest, yet significant, spatial shift has been recorded for the main commercial stock in the Barents Sea, Northeast Arctic cod (*Gadus morhua*). This stock occurs mostly in the EEZs of the two coastal states, Norway and Russia, but in some years it is also available in economically lucrative amounts in the high-seas 'Loophole' area of the Barents Sea (see Ch. 9). Since around 2010, a combination of relatively high ocean temperatures and a large stock size has induced a north- and eastward expansion, with somewhat higher zonal attachment in the Russian EEZ than previously (see Chs. 6 and 8).

In the Barents Sea we also examine a regional stock of snow crab (*Chionoecetes opilio*), believed to have entered the region either through migration from the Beaufort Sea through Russian waters or in shipborne ballast water (McBride et al. 2016: 80). Snow crab is a sedentary species that was first observed in the Barents Sea in the mid-1990s, around Novaya Zemlya; it has since expanded westwards and is now found also in western parts of the Barents Sea, including the waters around Norway's Svalbard archipelago. This has led to an international management dispute between Norway and the EU: the EU holds that certain provisions in the 1920 international treaty that granted Norway sovereignty over Svalbard imply that nationals of other signatories have equal access to natural resources in these waters as do Norwegians (see Chs. 8–10 and 14).

The extent of the spatial shift in distribution is uncertain for the final case of international resource management studied here, revolving around the world's largest crustacean fishery, that for Antarctic krill (*Euphausia superba*) – the hub of the Antarctic marine ecosystem with a circumpolar biomass of several hundred million tonnes (Atkinson et al. 2017). Whereas modelling studies concur that a contraction and a poleward shift of this stock is an expected result of global warming, a hefty scholarly debate has arisen over studies reporting that such changes are already underway (Cox et al. 2019; Hill et al. 2019; see Ch. 11).

Number of actors

The number of states or other entities with access to the fishery matters, because the fewer the actors who must agree on regulatory constraints, the lower the danger that one or more will exploit the free-rider option of avoiding commitments or compliance, or both (Olson 1971; see also Chs. 2–3).

Snow crab is managed unilaterally by Norway and Russia on their respective continental shelves, although the EU challenge complicates the matter with respect to the continental shelf around Svalbard. Cod is a shared stock occurring primarily in waters under Norwegian or Russian jurisdiction and is subject to bilateral management by those coastal states. Like herring, Northeast Atlantic mackerel is now taken by seven states or other entities with exclusive fisheries jurisdiction in the Northeast Atlantic: the EU, the Faroe Islands, Greenland, Iceland, Norway, Russia and, following Brexit, the UK. The number of states involved in the fisheries for Antarctic krill in the Southern Ocean is comparable to the case of mackerel, but management of this stock is placed within the much broader Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), with its twenty-six members, including the EU.

As with the extent of the spatial shift, therefore, our cases display considerable variance also on the actor dimension.

Procedural strength

The procedural strength of an institution denotes its capacity to adopt prescriptive outputs that are deep – i.e. that request more than the prescriptive target (here, states engaging in resource management) would otherwise do – despite resistance from one or a minority of those targeted (Underdal 2004). Although in practice the procedural rule of consensus predominates in all the management regimes examined here, as it does in most environmental management regimes, there is considerable diversity regarding institutional means that facilitate consensus.

On a continuum of procedural strength, the Joint Norwegian–Russian Fisheries Commission (JNRFC) is located on the 'strong' side. This bilateral management body, established in 1976, forms the core of a well-established management institution that annually sets legally binding national catch quotas and a range of technical regulations applicable throughout the area of distribution of the shared stocks: cod, haddock, capelin, Greenland halibut and, since 2017, redfish (see Ch. 8). Scientific advice is provided by the International Council for the Exploration of the Sea (ICES), with its solid reputation for impartiality (Gullestad 1998) and advanced peer-review procedures for insulating the advisory process from political pressure (Lassen, Kelly and Sissenwine 2014). Underlying the ICES advice, moreover, are longstanding and cooperative surveys and data analyses conducted by scientists from both coastal states. Regulations adopted under the JNRFC bind also other user-states in the region by means of a string of reciprocal and other access and quota agreements negotiated annually with the EU, Iceland, the Faroe Islands, Greenland and following Brexit, also the UK.

On the opposite side of the procedural-strength continuum we find the fragmented institutional complex responsible for managing pelagic fisheries in the Nordic Seas. As with the JNRFC, scientific advice from ICES forms the basis for annual negotiations among the user-states, but the *regulatory* task is far more decentralized. In the JNRFC, annual negotiations start out from agreed interpretations of basic conservation principles, like the precautionary approach, and clearly defined harvest-control and allocation rules – whereas management of the pelagic complex proceeds on a stock-by-stock basis, involving two multilateral venues and numerous bilateral ones. The regulatory core is an annual multilateral fisheries consultation process among those with acknowledged coastal-state rights, groupings that may vary from one stock to another. Such consultations sometimes produce an inclusive agreement on the TAC and its allocation, but more often the result is an agreement limited to a subset of those capable of harvesting the stock within their own EEZ.

The outcomes of those stock-specific multilateral consultations on pelagic stocks in the Nordic Seas form the basis for subsequent bilateral negotiations among the relevant coastal states concerning quota exchange and mutual access to each other's zones. Here, the additional complications deriving from Brexit are evident in the fact that, although the UK has negotiated a string of framework instruments with other user-states and entities to enable annual consultations on fisheries, by the end of 2021 only that with the EU had generated a tangible accord on quota sharing and mutual access to each other's zones. The outcomes of the multilateral consultations also set the parameters for decisions within the North-East Atlantic Fisheries Commission (NEAFC), whose competence relates mainly to the high seas, including a segment of the high-seas portion of the Central Arctic Ocean.

Somewhere in-between the cohesive strength of the JNRFC and the fragmented weakness of the institutional complex for managing pelagic species in the Nordic Seas we find CCAMLR. For reasons associated with the disputed sovereignty claims to the Antarctic continent, this institution is not authorized to allocate the agreed total allowable catch among its members by means of catch or effort quotas – but CCAMLR's contribution to the practical suspension of the sovereignty claims and its placement in the larger cooperative framework of the Antarctic Treaty System has nurtured the development of a general consensus-seeking approach (Stokke 1996; see also Ch. 12). That approach, in which problematic issues are typically aired already in the preparatory stages, allowing adaptation of proposals before they reach the decision stage, enabled CCAMLR to take an early lead among regional fisheries management organizations with respect to precautionary management and measures for combating illegal, unreported and unregulated (IUU) fishing (Szigeti and Lugten 2015: 8–9). Since every member is a de facto veto-holder, regulatory advance under CCAMLR is vulnerable to substantive political disagreement, which has been on the rise during the past decade – especially concerning the designation and implementation of marine protected areas (MPAs) in the Southern Ocean (see Chs. 12–13). An unusual feature of CCAMLR, and one that may contribute to disagreement over how to balance between use and protection, is that only a subset of its members engage in fisheries in the Southern Ocean.

In short, the cases examined in this book display considerable diversity with respect to three conditions likely to influence institutional resilience to the challenges that climate change may pose to sustainable resource management: the extent of a stock shift, the number of states and entities involved in the harvesting and the procedural strength of the management institution.

Case diversity and broader relevance

Northeast Arctic cod, Barents Sea snow crab, Northeast Atlantic mackerel and Antarctic krill are all commercially and ecologically important transboundary stocks that have experienced substantial variations in abundance and geographic distribution over the past decade. The management cases studied in this book are highly interesting in themselves for anyone interested in whether and how climate- or otherwise-induced spatial stock-shifts can impinge on the performance of international management systems.

The relevance of our case studies is further broadened by the diversity concerning the extent of the spatial stock shift experienced, the number of participants engaged in the fisheries and the procedural strength of the management regimes involved. That is because the cross-case variation in conditions believed to influence institutional resilience means that the processes and outcomes studied in this book may shed light on more generic propositions on circumstances that promote or impede institutional adaptation to external perturbations – within as well as beyond the empirical context of climate change and fisheries management.

Such case diversity also improves the potential for generalizing our findings to other regional fisheries-management efforts aimed at dealing with distributive impacts of climate change. Although caution should always be exercised in drawing broader implications from a small number of cases, as the dynamics observed may derive from case-specific combinations of conditions not found elsewhere (Ragin 1994; Levy 2008), the basis for generalization is nevertheless improved if major categories of the phenomena under study are represented among the cases.

Thus, the broader category of resource management institutions represented by the Barents Sea snow-crab case comprises regulatory measures set up unilaterally by a coastal state and challenged by one or more other states or entities over issues of jurisdiction. Such jurisdictional disputes with fisheries implications abound worldwide, including in the South China Sea (e.g. Zhang 2018) and the dispute involving Japan and Russia concerning islands north of Hokkaido that were occupied by the Soviet Union towards the end of the Second World War.[3]

Among the bilateral fisheries management institutions, in this book represented by the JNRFC, we also find other longstanding bodies set up by two coastal states for managing transboundary stocks, such as the International Pacific Halibut Commission established by Canada and the USA nearly a century ago (see Sumaila et al. 2020). Also in this category are institutionally thinner frameworks for annual negotiations over quota sharing and reciprocal access, like those established in almost all dyads of states littoral to the Northeast Atlantic – and many other places worldwide.

Similar comments apply to multilateral regional fisheries management organizations or arrangements (RFMO/As) (see Ch. 2).[4] Both variants have a distinctive decision-making body, but arrangements (RFMAs) lack the defining features of an international organization – legal personality, a (usually small) staff and physical location. Represented in this book is the subcategory with regulatory competence mainly limited to the high-seas waters (NEAFC, one part of the complex for managing mackerel) as well as that with institutions also authorized to make binding decisions concerning EEZs (CCAMLR).

In the former subcategory we also find, for instance, the Northwest Atlantic Fisheries Organization (see Joyner 2001) and the arrangement based on the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (see Balton 2001). As in the mackerel case, those two institutions have a medium-sized membership of wealthy states and entities – whereas another RFMO/A with a high-seas mandate only, the South East Atlantic Fisheries Organization, also involves coastal states belonging to the Global South (see Henriksen et al. 2006).

In the second subcategory – fisheries regimes with regulatory competence in high seas as well as waters under national jurisdiction – we find several tuna RFMOs, typically with relatively large numbers of members, as is also the case of CCAMLR.

In summary, the cases of institutional resilience to changing spatial distribution of marine stocks studied in this book are highly interesting in their own right – because the stocks are so important and their spatial shifts so significant – but they also have far broader relevance. With their diversity in terms of conditions likely to influence resilience and the fact that they represent major categories of fisheries management institutions, the cases examined here can shed light on a wide range of other efforts to adapt management institutions to the impacts of climate change. However, the caution always warranted when generalizing findings from one empirical context to another includes taking into consideration the similarities and differences among the international fisheries institutions noted in this section.

Structure of the book

After the introductory Part I, the chapters in Part II elaborate on legal and political aspects of international fisheries management institutions and examine the roles of two important non-state actors involved in all the management cases studied here – the partly supranational EU, a member of both NEAFC and CCAMLR, and the leading private governance organization in world fisheries, the Marine Stewardship Council.

Parts III and IV deal with the two regions in focus here: the eastern Atlantic segment of the Northern Seas (the Barents and Nordic Seas) and the Southern Ocean. Each part begins by presenting the state of knowledge regarding observed and modelled impacts of climate change on the abundance and spatial distribution of major stocks, followed by analyses of how the actors and institutions examined in Part II interact and adapt to those impacts in order to retain or improve performance. The concluding chapter in Part V summarizes the answers derivable from Parts II to IV to the three overarching research questions formulated above, including a comparative analysis of the cases studied.

Part II: Institutions and actors

Chapter 2 by Erik Molenaar examines legal aspects of cooperation through RFMO/As. The focus is on the meaning and scope of the duty that states have under international law to cooperate through such regional regimes which, as Molenaar notes, have become the pre-eminent institutions in international fisheries law. He links that duty to various practical challenges to effective fisheries management that are exacerbated by climate change – such as new entrants in the fishery, or free riders that either refuse to accept regulations or fail to comply with them – as well as rules and practices concerning participation in management regimes and allocation of fishing opportunities. Also examined is how the Fish Stocks Agreement's approach to strengthening the duty to cooperate has served as inspiration in the ongoing negotiation of a legally binding instrument on marine biodiversity of areas beyond national jurisdiction (BBNJ).

Chapter 3 by Oran Young and Olav Schram Stokke starts out from the observation that responding to challenges arising from climate- or otherwise-derived stock-shifts is a variant of the more generic problem of finding ways to avoid institutional failure. Avoiding such failure when creating, adapting or operating institutions, they argue, often entails navigating between two opposite perils that threaten to derail management efforts – *reductionism* and *overload*. Institutional reductionism is evident when those responsible for creating and implementing environmental regimes have failed to take account of substantively important parts of the activity system, or fail to adapt the institution when the activity system has changed – for instance, due to stock-shifts that bring new entrants in a fishery, or increased user conflicts across sectors of industry. Institutional overload denotes the opposite pitfall: it occurs when those responsible for designing or adapting regimes strive to incorporate all relevant factors in an effort to respond to the complexities of real-world situations. This may result in unwieldy or excessively ambitious arrangements, frequently yielding gridlock rather than problem-solving. Central to the discussion by Young and Stokke is the presentation of a set of risk factors likely to propel governance systems toward reductionism or overload, and a set of response strategies that can help those negotiating or operating management regimes to avoid both perils.

Chapter 4 by Andreas Raspotnik and Andreas Østhagen concerns the EU and its actorness in international fisheries governance – that is, its externally recognized capacity to act coherently and influentially (Bretherton and Vogler 2008). Because its member-states have granted the EU the competence to represent them in international fisheries regulation, the EU has obtained membership in many international fisheries regimes. Raspotnik and Østhagen note certain tensions discernible between the internal and the external dimensions of the EU Common Fisheries Policy. Notably, the internal emphasis on the sustainability and precautionary principles contrasts with the emphasis assigned to fishing-industry interests in external negotiations, such as those on EEZ access in the Global South and quota allocation in the Northern Seas. The authors relate those tensions to the contrast between the complexity and convolution that marks EU decision-making on fisheries issues, and external perceptions of the EU as a relatively cohesive actor.

In Chapter 5, Geir Hønneland assesses the role of another non-state, yet increasingly influential, actor in international fisheries management – the Marine Stewardship Council (MSC), which currently certifies more than 10 per cent of the world's marine capture fisheries, including those for major stocks in all the seas examined in this book. Hønneland explains the procedural and substantive requirements for MSC certification and uses several Northeast Atlantic mackerel cases to evaluate the effects of this private governance arrangement on the mackerel fisheries as well as its international regulation.

Part III: Northern Seas

The term 'Northern Seas' refers to the northern North Atlantic, the Nordic Seas, the Barents Sea and the Central Arctic Ocean (Dickson et al. 2008; Eldevik et al. 2014: 225). As noted, the cases in this part of the book concern the management of demersal, benthic as well as pelagic species in the Barents Sea and the Nordic Seas.

Chapter 6 by Jan Erik Stiansen, Geir Odd Johansen, Anne Britt Sandø and Harald Loeng provides an update on the state of knowledge regarding how climate change affects physical and biotic conditions as well as the harvesting patterns for major marine stocks in the Nordic and Barents Seas, including mackerel, herring, cod and snow crab. These authors bring out the close link between the Norwegian and Barents Seas, in terms of physical oceanography and their ecosystems. Both regions exhibit high inter-annual as well as multi-decadal hydrographic variability; multi-decadal variations in temperature both amplify and counteract the slower increase in temperature due to climate change in the Barents Sea as well as in the Norwegian Sea. In general, northwards shifts in temperature habitats are opening new potential feeding areas for fish stocks farther north and east; but the effects on spatial distribution will differ with factors such as bottom topography, stock size and food availability.

Chapter 7 by Andreas Østhagen, Jessica Spijkers and Olav Anders Totland focuses on the mackerel dispute between the EU and Norway on the one hand and the three new entrants to this fishery – Iceland, the Faroe Islands and Greenland – on the other. Seeking to draw lessons for other transboundary quota disputes, the authors examine whether the failure to reach an inclusive allocation agreement is best explained by scientific uncertainty, weak international institutions or excessively rigid positions due to heavy fishing-industry influence on the negotiators.

In Chapter 8, Anne-Kristin Jørgensen enquires into why the spatial shift of the Northeast Arctic cod stock, entailing higher availability in parts of the Barents Sea that fall within the coastal-state maritime zones of the Russian Federation, has *not* given rise to allocation disputes similar to those over the pelagic stocks in the Norwegian Sea. Although the JNRFC has not been completely spared from challenges to existing allocation rules, those challenges have concerned stocks of lesser commercial value than cod, and have been handled cooperatively within the regime. Certain characteristics of that institution – notably the increasing involvement of scientific and technical expertise in the preparation of allocation decisions and its longstanding history of facilitating compromises on difficult issues – are among the drivers of resilience pinpointed by Jørgensen.

Whereas Chapters 7 and 8 focus on the regulatory side of management, and quota allocation in particular, Chapter 9 by Olav Schram Stokke concerns challenges to the compliance systems of international institutions. Like Jørgensen, Stokke examines management of cod in the Barents Sea; he too identifies institutional differentiation within the JNRFC, notably the creation of an expert body on compliance and control, as an important mechanism for adapting the regime to a climate-related compliance deficit. An even more important adaptation, according to Stokke, is the gradual expansion of the institutional complex drawn upon to ensure compliance with international quota agreements, bringing in also a string of bilateral coastal-state agreements, the NEAFC and international trade rules.

In closing the Northern Seas part of the book, Andreas Østhagen and Andreas Raspotnik (Ch. 10) focus on the dispute between Norway and the EU over snow crab, a relatively new species in the Barents Sea. That dispute gives rise to issues extending beyond the management of living resources – partly because harvesting has occurred in waters near Svalbard, where the parties hold differing positions regarding the legal basis for their right to quotas, linked to disagreement on the spatial scope of the 1920 Svalbard Treaty.[5] Moreover, harvesting of this sedentary species is governed by the continental shelf regime, so any solution to the dispute might have implications for the regulation of oil and gas activities as well. As Østhagen and Raspotnik point out, the various participants in EU decision-making differ in the relative emphasis they place on fisheries and broader foreign-policy concerns.

Part IV: Southern Ocean

Part IV shifts the focus to the Southern Ocean. In Chapter 11, Margaret Mary McBride presents the physical and biological characteristics of this large marine ecosystem, including its relatively low species diversity and the central food-web position held by Antarctic krill. Rapid upper-ocean warming has occurred in the Atlantic sector where practically all krill harvesting occurs, so this chapter pays special attention to the implications of that development for krill abundance and the spatial distribution of this stock, which supports the world's largest crustacean fishery.

Krill fisheries are also central in Chapter 12, where Stokke assesses the capacity of CCAMLR to detect climate-induced or other changes in the distribution and abundance of this stock and its predators, and to adjust regulations accordingly. In focus are the prospects for overcoming political and other impediments to an improved risk-assessment procedure that includes regular monitoring of ecosystem components potentially affected by krill fisheries, and a feedback management system that employs the data from such monitoring to adjust the agreed conservation measures.

Chapter 13 returns to the issue of EU actorness. As in the Northern Seas, the EU is a major actor in Antarctic fisheries management. But as Raspotnik and Østhagen show, the EU's economic interest in krill harvesting has been miniscule. They relate this observation, and EU commitments to global targets on marine protection, to a series of initiatives within CCAMLR focused on the creation of new MPAs in the Antarctic. As they showcase, much of the EU's stance on this issue can be attributed to special interests in the EU system relating to actions – more or less symbolic – to accommodate demands for conservation efforts at sea.

Part V: Comparisons and conclusions

Stokke's concluding Chapter 14 summarizes the main answers offered by the individual chapter authors to the three questions specified above: 1) the effects of climate change and other environmental changes on the abundance and distribution of major stocks in two large polar marine ecosystems; 2) the challenges that such shifts imply for the complexes of institutions that co-govern fisheries for major commercial species; and 3) how to explain variation in the resilience of these management regimes – their ability to adapt, if necessary, to such changing circumstances in order to retain or even raise levels of performance. The author compares the regional management regimes examined here in terms of resilience to the additional cognitional, regulatory and compliance challenges posed by climate- or otherwise-induced stock-shifts, seeks to explain variation in institutional resilience by means of the risk factors identified in Chapter 3 and examines the applicability of the book's findings to broader sets of efforts to adapt fisheries management to the impacts of climate change in other parts of the world.

Notes

1 We would like to thank Harald Loeng for valuable inputs to this section.
2 Specific performance indicators derive from the social problem the institution was set up to address (Young 1999; Stokke 2012).
3 For reports on recent fisheries incidents, see 'Fight over Fish Fans a New Stage of Conflict in South China Sea', *Bloomberg*, 1 September 2020, https://www.bloomberg.com/graphics/2020-dangerous-conditions-in-depleted-south-china-sea/; and 'Russia Seizes Japanese Fishing Boat Near Disputed Islands', *Moscow Times*, 15 January 2020, https://www.themoscowtimes.com/2020/01/15/russia-seizes-japanese-fishing-boat-near-disputed-islands-a68917.
4 Note that the category RFMO/As include also bilateral institutions; Chapter 2 by Molenaar gives an overview of the general phenomenon and a list of those with high-seas coverage, including the JNRFC.
5 Treaty concerning the Archipelago of Spitsbergen, 9 February 1920; in force 14 August 1925, here: Svalbard Treaty.

References

Astthorsson, O. S., H. Valdimarsson, A. Gudmundsdottir and G. J. Óskarsson (2012), 'Climate-Related Variations in the Occurrence and Distribution of Mackerel *(Scomber scombrus)* in Icelandic Waters', *ICES Journal of Marine Science*, 69 (7): 1289–97.

Atkinson, A., S. L. Hill, E. A. Pakhomov, V. Siegel, R. Anadon, S. Chiba, K. L. Daly, R. Downie, S. Fielding, P. Fretwell, L. Gerrish, G. W. Hosie, M. J. Jessopp, S. Kawaguchi, B. A. Krafft, V. Loeb, J. Nishikawa, H. J. Peat, C. S. Reiss, R. M. Ross, L. B. Quetin, K. Schmidt, D. K. Steinberg, R. C. Subramaniam, G. A. Tarling and P. Ward (2017), 'KRILLBASE: A Circumpolar Database of Antarctic Krill and Salp Numerical Densities, 1926–2016', *Earth System Science Data*, 9: 193–210.

Balton, D. A. (2001), 'The Bering Sea Doughnut Hole Convention: Regional Solution, Global Implications', in O. S. Stokke (ed.), *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*, 143–77, Oxford: Oxford University Press.

Barange, M., G. Merino, J. L. Blanchard, J. Scholtens, J. Harle, E. H. Allison, J. I. Allen, J. Holt and S. Jennings (2014), 'Impacts of Climate Change on Marine Ecosystem Production in Societies Dependent on Fisheries', *Nature Climate Change*, 4: 211–16. doi: 10.1038/nclimate2119.

Bennett, J. R., J. D. Shaw, A. Terauds, J. P. Smol, R. Aerts, D. M. Bergstrom, J. M. Blais, W. W. L. Cheung, S. L. Chown, M. A. Lea, U. N. Nielsen, D. Pauly, K. J. Reimer, M. J. Riddle, I. Snape, J. S. Stark, V. J. Tulloch and H. P. Possingham (2015), 'Polar Lessons Learned: Long-Term Management Based on Shared Threats in Arctic and Antarctic Environments', *Frontiers in Ecology and the Environment*, 13: 316–24.

Bretherton, C. and J. Vogler (2008), 'The European Union as a Sustainable Development Actor: The Case of External Fisheries Policy', *Journal of European Integration: Policy Coherence and EU Development Policy*, 30: 401–17. doi: 10.1080/07036330802142012.

Bryndum-Buchholz, A., D. G. Boyce, D. P. Tittensor, V. Christensen, D. Bianchi, and H. K. Lotze (2020), 'Climate-Change Impacts and Fisheries Management Challenges in the North Atlantic Ocean', *Marine Ecology Progress Series*, 648: 1–17.

Cash, D. W., W. C. Clark, F. Alcock, N. M. Dickson, N. Eckley, D. H. Guston, J. Jäger and R. B. Mitchell (2003), 'Knowledge Systems for Sustainable Development', *Proceedings of the National Academy of Sciences of the United States of America*, 100 (14): 8086–91. doi: 10.1073/pnas.1231332100.

Cheung, W. W. L. (2018), 'The Future of Fishes and Fisheries in the Changing Oceans', *Journal of Fisheries Biology*, 92: 790–803.

Cheung, W. W. L., M. C. Jones, V. W. Y. Lam, D. D. Miller, Y. Ota, L. Teh, and U. R. Sumaila (2017), 'Transform High Seas Management to Build Climate Resilience in Marine Seafood Supply', *Fish and Fisheries*, 18: 254–63.

Cox, M. J., S. Candy, W. K. de la Mare, S. Nicol, S. Kawaguchi and N. Gales (2019), 'Clarifying Trends in the Density of Antarctic krill *Euphausia superba* Dana, 1850, in the South Atlantic: A Response to Hill et al.', *Journal of Crustacean Biology*, 39 (3): 323–27. doi: 10.1093/jcbiol/ruz010.

Cuzin-Roudy, J., J.-O. Irisson, F. Penot, S. Kawaguchi and C. Vallet (2014), 'Southern Ocean Euphausiids', in C. De Broyer, P. Koubbi, H. J. Griffiths, B. Raymond, B. C. d'Udekem d'Acoz, A. P.Van de Putte, B. Danis, B. David, S. Grant, J. Gutt, C. Held, G. Hosie, F. Huettmann, A. Post and Y. Ropert-Coudert (eds), *Biogeographic Atlas of the Southern* Ocean, 309–20, Cambridge: Scientific Committee on Antarctic Research.

Dickson, R. R., J. Meincke and P. Rhines (2008), *Arctic–Subarctic Ocean Fluxes: Defining the Role of the Northern Seas in Climate*, Dordrecht: Springer Netherlands.

Eldevik, T., B. Risebrobakken, A. E. Bjune, C.Andersson, H. J. B. Birks, T. M. Dokken, H. Drange, M. S. Glessmer, C. Li, J. E. Ø. Nilsen, O. H. Otterå, K. Richter and Ø. Skagseth (2014), 'A Brief History of Climate – The Northern Seas from the Last Glacial Maximum to Global Warming', *Quaternary Science Reviews*, 106: 225–46. doi: 10.1016/j.quascirev.2014.06.028.

Gullestad, P. (1998), 'The Scope for Research in Practical Fishery Management', *Fisheries Research*, 37: 251–8.

Henriksen, T., G. Hønneland and A. Sydnes (2006), *Law and Politics in Ocean Governance: The UN Fish Stocks Agreement and Regional Fisheries Management Regimes*, Leiden: Brill Nijhoff.

Herrfahrdt-Pähle, E. and C. Pahl-Wostl (2012), 'Continuity and Change in Social-ecological Systems: The Role of Institutional Resilience', *Ecology and Society*, 17. doi: 10.5751/ES-04565-170208.

Hill, S. L., A. Atkinson, E. A. Pakhomov and V. Siegel (2019), 'Evidence for a Decline in the Population Density of Antarctic Krill *Euphausia superba* Dana, 1850 Still Stands: A Comment on Cox et al.', *Journal of Crustacean Biology*, 39: 316–22. doi: 10.1093/jcbiol/ruz004.

Holling, C. S. (1973), 'Resilience and Stability of Ecological Systems', *Annual Review of Ecology and Systematics*, 4: 1–23.

Hollowed, A. B. and S. Sundby (2014), 'Change is Coming to the Northern Oceans', *Science*, 344: 1084. doi: 10.1126/science.1251166.
Hollowed, A. B., B. Planque and H. Loeng (2013), 'Potential Movement of Fish and Shellfish Stocks from the Sub-Arctic to the Arctic Ocean', *Fisheries Oceanography*, 22 (5): 355–70.
ICES (2018), 'Norwegian Sea Ecoregion: Ecosystem Overview', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/2018/NorwegianSea_EcosystemOverview.pdf.
IPCC (2015), *Climate Change 2014: Synthesis Report*, Geneva: Intergovernmental Panel on Climate Change (IPCC)
Johannesen, E., L. L. Jørgensen, M. Fossheim, R. Primicerio, M. Greenacre, P. A. Ljubin, A. V. Dolgov, R. B. Ingvaldsen, N. A. Anisimova and I. E. Manushin (2017), 'Large-scale Patterns in Community Structure of Benthos and Fsh in the Barents Sea', *Polar Biology*, 40: 237–46. doi: 10.1007/s00300-016-1946-6.
Joyner, C. C. (2001), 'On the Borderline? Canadian Activism in the Grand Banks', in O. S. Stokke (ed.), *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*, 207–33, Oxford: Oxford University Press.
Kjesbu, O. S., S. Sundby, A. B. Sandø, M. Alix, S. S. Hjøllo, M. Tiedemann, M. Skern-Mauritzen, C. Junge, M. Fossheim, C. T. Broms, G. Søvik, F. Zimmermann, K. Nedreaas, E. Eriksen, H. Höffle, A. M. Hjelset, C. Kvamme, Y. Reecht, H. Knutsen, A. Aglen, O. T. Albert, E. Berg, B. Bogstad, C. Durif, K. T. Halvorsen, Å. Høines, C. Hvingel, E. Johannesen, E. Johnsen, E. Moland, M. S. Myksvoll, L. Nøttestad, E. Olsen, G. Skaret, J. E. Skjæraasen, A. Slotte, A. Staby, E. K. Stenevik, J. E. Stiansen, M. Stiasny, J. H. Sundet, F. Vikebø and G. Huse (2021), 'Highly Mixed Impacts of Near-Future Climate Change on Stock Productivity Proxies in the North East Atlantic', *Fish and Fisheries*. doi: 10.1111/faf.12635.
Lassen, H., C. Kelly and M. Sissenwine (2014), 'ICES Advisory Framework 1977–2012: From Fmax to Precautionary Approach and Beyond', *ICES Journal of Marine Science*, 71 (2): 166–72.
Levy, J. S. (2008), 'Case Studies: Types, Designs, and Logics of Inference', *Conflict Management and Peace Science*, 25: 1–18.
McBride, M. M., J. R. Hansen, O. Korneev, O. Titov, J. E. Stiansen, J. Tchernova, A. Filin and A. Ovsyannikov (2016), *Joint Norwegian-Russian Environmental Status 2013 Report on the Barents Sea Ecosystem*. Bergen: Marine Research Institute.
Mitchell, R. B., W. C. Clark, D. W. Cash and N. M. Dickson (2006), *Global Environmental Assessments: Information and Influence*, Cambridge, MA: MIT Press.
Molenaar, E. J. (2019), 'Participation in Regional Fisheries Management Organization', in J. R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 103–29, London: Hart.
Nøttestad, L., K. R. Utne, G. J. Óskarsson, S. Þ. Jónsson, J. A. Jacobsen, Ø. Tangen, V. Anthonypillai, S. Aanes, J. H. Vølstad, M. Bernasconi, H. Debes, L. Smith, S. Sveinbjörnsson, J. C. Holst, T. Jansen and A. Slotte (2016), 'Quantifying Changes in Abundance, Biomass, and Spatial Distribution of Northeast Atlantic Mackerel (Scomber scombrus) in the Nordic Seas from 2007 to 2014', *ICES Journal of Marine Science*, 73 (2): 359–73.
Olson, M. (1971), *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.
Palacios-Abrantes, J., U. R. Sumaila, and W. W. L. Cheung (2020), 'Challenges to Transboundary Fisheries Management in North America under Climate Change', *Ecology and Society*, 25: 41.

Piñones, A. and A. V. Fedorov (2016), 'Projected Changes of Antarctic Krill Habitat by the End of the 21st Century', *Geophysical Research Letters*, 43: 8580–9.
Pinsky, M. L. and N. J. Mantua (2014), 'Emerging Adaptation Approaches for Climate-Ready Fisheries Management', *Oceanography*, 27: 146–59.
Pinsky, M. L., G. Reygondeau, R. Caddell, J. Palacios-Abrantes, J. Spijkers and W. Cheung (2018), 'Preparing Ocean Governance for Species on the Move', *Science*, 360.
Ragin, C. C. (1994), *Redesigning Social Inquiry: Set Relations in Social Research*, Chicago, IL: University of Chicago Press.
Stokke, O. S. (1996), 'The Effectiveness of CCAMLR', in O. S. Stokke and D. Vidas (eds), *Governing the Antarctic: The Effectiveness and Legitimacy of the Antarctic Treaty System*, 120–51, Cambridge: Cambridge University Press.
Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.
Stokke, O. S. (2015), 'Fisheries and Whaling', in *Encyclopedia of Global Environmental Governance and Politics*, 364–73, Cheltenham: Edward Elgar.
Stokke, O. S. (2019), 'Management Options for High Seas Fisheries: Making Regime Complexes More Effective', in J. R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 51–78, London: Hart.
Sumaila, U. R., J. Palacios-Abrantes and W. W. L. Cheung (2020), 'Climate Change, Shifting Threat Points, and the Management of Transboundary Fish Stocks', *Ecology and Society*, 25: 40.
Szigeti, P. D. and G. Lugten (2015), The Implementation of Performance Review Reports by Regional Fishery Bodies 2004–2014, *FAO Fisheries and Aquaculture Circular*, C1108.
Underdal, A. (2004), 'Methodological Challenges in the Study of Regime Effectiveness', in A. Underdal and O. R. Young (eds), *Regime Consequences: Methodological Challenges and Research Strategies*, 27–48, Dordrecht: Kluwer Academic.
Utne, K. R., G. Huse, G. Ottersen, J. C. Holst, V. Zabavnikov, J. A. Jacobsen, G. J. Óskarsson and L. Nøttestad (2012), 'Horizontal Distribution and Overlap of Planktivorous Fish Stocks in the Norwegian Sea During Summers 1995–2006', *Marine Biology Research*, 8 (5–6): 420–41.
Young, O. R. (1999), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, Cambridge, MA: MIT Press.
Young, O. R. (2010), 'Institutional Dynamics: Resilience, Vulnerability and Adaptation in Environmental and Resource Regimes', *Global Environmental Change*, 20 (3): 378–85. http://dx.doi.org/10.1016/j.gloenvcha.2009.10.001.
Zhang, H. (2018), 'Fisheries Cooperation in the South China Sea: Evaluating the Options', *Marine Policy* 89: 67–76.

Part Two

Institutions and Actors

2

International Cooperation through Regional Fisheries Management Organizations

Erik J. Molenaar

Introduction

Marine fish stocks are renewable resources that move around freely, unhindered by maritime boundaries. Some fish stocks have a geographical range of distribution that lies entirely within the maritime zones of one single coastal state. The conservation and management of such stocks can in principle be undertaken by that state itself, and does not depend on cooperation with other states. However, many fish stocks can be classified as 'transboundary', as their distributional range encompasses the maritime zones of two or more coastal states (shared fish stocks) or the high seas and the maritime zones of one or more coastal states (straddling fish stocks and highly migratory fish stocks).

Success in the conservation and management of transboundary fish stocks and fish stocks whose distributional range is confined to the high seas (discrete high-seas fish stocks) depends to a large extent on cooperation between the coastal states and high-seas fishing states involved. Among the main challenges here is the considerable variability in the status of commercially exploited fish stocks – their abundance and distributional range in particular. The status of fish stocks is determined by a wide range of factors, including fishing pressure, predator–prey relationships, other impacts of fishing (e.g. on non-target species and benthic habitats) and other anthropogenic impacts, such as climate change and ocean acidification. Especially these latter impacts may cause changes in fish stocks to become more frequent, more profound and possibly less predictable – as well as being irreversible at human timescales.

International cooperation on marine fisheries is governed by international fisheries law, which is the domain of international law that relates specifically to the conservation and management and/or development of marine capture fisheries. It consists of substantive norms (e.g. rights, obligations and objectives), substantive fisheries standards (e.g. catch restrictions) as well as institutional rules and arrangements (e.g. mandates and decision-making procedures). International fisheries law is part of public international law and can also be seen as a branch or part of the domain of the international law of the sea.

The law of the sea divides the marine environment into coastal-state maritime zones and areas beyond national jurisdiction (ABNJ: the high seas and the international seabed – 'the Area'). Whereas coastal states have exclusive access to fisheries resources in their own maritime zones pursuant to their sovereignty or sovereign rights therein,[1] all states have the right to fish in ABNJ.[2] Significant changes – whether driven by climate change or other factors – in distribution and abundance between coastal-state maritime zones and ABNJ will lead to changes relating to access and availability, thereby undermining intergovernmental arrangements on overall catches, allocation of fishing opportunities and access. Pressure on these arrangements can also be caused by 'new entrants'– for instance, coastal states into whose maritime zones 'new' fish stocks have moved, or high-seas fishing states that want to participate in a high-seas fishery. Another example is the UK: when it finally withdrew from the EU at the end of 2020, it once again became an independent actor within the domain of international fisheries law and thereby a new entrant as regards many intergovernmental fisheries bodies and arrangements.

Regional fisheries management organizations and arrangements (RFMO/As) have become the pre-eminent institutions for international cooperation in the domain of international fisheries law. The origins of international fisheries law can be traced back to the end of the nineteenth century, when North Sea coastal states adopted multilateral rules on fisheries enforcement at sea, and the USA unsuccessfully asserted coastal-state jurisdiction for the purpose of the conservation of fur seals in high-seas areas adjacent to its territorial sea (Takei 2013: 14–16). The earliest precursor of the bilateral International Pacific Halibut Commission (IPHC) – established in 1924 – could be regarded as the first RFMO *avant la lettre*. The first multilateral fisheries bodies were the precursors of today's Northwest Atlantic Fisheries Organization (NAFO) and the North-East Atlantic Fisheries Commission (NEAFC), both established shortly after the Second World War (Takei 2013: 25).

Even though the first RFMOs *avant la lettre* were already operating by the start of the first United Nations Conference on the Law of the Sea in 1958, the 1958 High Seas Fishing Convention[3] contains only an implicit reference to fisheries bodies in Article 6(2). The provisions of the 1982 UNCLOS[4] on cooperation on transboundary fish stocks and high-seas fishing accorded a far more prominent role to subregional and regional organizations, but left states with a considerable margin of discretion in deciding on the form and level of such cooperation.[5] A further step was taken by the 1995 Fish Stocks Agreement,[6] which gives more explicit and operationalized support for regional fisheries regulation through RFMO/As and is widely regarded as expressing the international community's recognition of RFMO/As as the pre-eminent vehicles for regional fisheries regulation.[7] This was subsequently confirmed in the 2009 PSM Agreement,[8] which also recognizes the prominent role of RFMO/As in combating illegal, unreported and unregulated (IUU) fishing.

Following the conclusion of the negotiations on the Fish Stocks Agreement, the international community devoted significant efforts to ensuring full high-seas coverage with RFMO/As that meet the minimum standards laid down in the Fish Stocks Agreement. This involved modernizing the constitutive instruments of existing fisheries bodies, as well as establishing entirely new RFMO/As, such as the 2018 CAOF Agreement.[9] The International Commission for the Conservation of Atlantic Tunas (ICCAT) finalized negotiations on modernizing its constitutive instrument at the end of 2019,[10] and at the time of writing the Western Central Atlantic Fishery Commission (WECAFC) is engaged in a process of transforming itself into an RFMO or an RFMA.[11] Other gaps in high-seas coverage with RFMO/As remain to be filled as well (Harrison 2019: 81).

This chapter's focus on international cooperation through RFMO/As responds to the second and third main research questions of this book (see Ch. 1). Both questions relate to management regimes, and this chapter provides the necessary information on, and analysis of, these regimes, thereby establishing the foundations underlying the specific case studies presented in this book. For that reason, key features and practices of the main regional regimes covered in these case studies – the CAOF Agreement, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Joint Norwegian–Russian Fisheries Commission (JNRFC) and NEAFC – have been integrated into this chapter.

The chapter starts with an overview on the different types, key distinctions and functions of RFMO/As, and the issue as to whether a body qualifies as an RFMO or an RFMA. The next section, 'The duty to cooperate through RFMO/As', examines the duty of states to cooperate through RFMO/As under international fisheries law by analysing the meaning and scope of this duty as laid down in global fisheries instruments and its implementation and operationalization through RFMO/As, with particular attention to free riders and new entrants. The subsequent section is devoted to the currently ongoing negotiations on a new BBNJ Implementation Agreement under UNCLOS (BBNJ negotiations),[12] which have used the Fish Stocks Agreement's duty to cooperate as a source of inspiration. Some conclusions are offered in the last section.

Types, distinctions and functions of RFMO/As

Introduction

Whether or not a body qualifies as an RFMO or an RFMA determines the applicability of particular rights and obligations under international fisheries law. These rights and obligations are relevant for members[13] as well as non-members of RFMO/As. Especially relevant for non-members are the rights to engage in fishing and fishing-related activities (e.g. provisioning of fuel, water, etc., and transhipment of catch)[14] on the high seas, pursuant to Articles 87(1)(a) and 116 of UNCLOS; and the right of states with a 'real interest' to participate in RFMO/As, pursuant to Article 8(3) of the Fish Stocks Agreement. Relevant rights for members include the mandate of RFMO/As to deal with non-members that undermine the efforts of RFMO/As due to their behaviour as 'free riders'. As explained in the subsection 'Dealing with free riders', these rights of members and non-members go hand in hand with various duties to cooperate.

Determining whether a body qualifies as an RFMO or an RFMA is not always a straightforward task, not least because there are no generally accepted definitions of the concepts of an RFMO or an RFMA. Even though no definitions are included in UNCLOS for either concept, Article 1(1)(d) of the Fish Stocks Agreement nevertheless defines an RFMA as:

> a cooperative mechanism established in accordance with the [LOS] Convention and this Agreement by two or more States for the purpose, *inter alia*, of establishing conservation and management measures in a subregion or region for one or more straddling fish stocks or highly migratory fish stocks.

A noteworthy feature of this definition is that an RFMA may have as few as two participating states (or entities). Moreover, unlike an RFMO, an RFMA is not an intergovernmental organization, nor does it establish one. This means that an RFMA does not necessarily have to be established pursuant to a legally binding instrument. Table 2.1 lists four RFMAs.

The concepts of RFMO and RFMA are not used exclusively in relation to straddling and highly migratory fish stocks, but concern also other categories of fish stocks, such as anadromous, shared and discrete high-seas fish stocks (Molenaar 2016: 441–5). This is further supported by the more recent definition of an RFMO included in Article 1(i) of the PSM Agreement, which only says that it is 'an intergovernmental fisheries organization […] that has the competence to establish conservation and management measures'. Illustrative is moreover the broad concept of a regional fishery body (RFB) used by the Food and Agriculture Organization of the United Nations (FAO) to denote a mechanism through which states and entities cooperate for the conservation and management of marine living resources and/or the development of marine capture fisheries.[15] The broad scope of the concept of an RFB is reflected in the fact that it covers not only also bodies regulating inland fisheries and aquaculture but also the International Whaling Commission and the North Atlantic Marine Mammal Commission – but not other regional instruments and bodies relating to marine mammals (Billé et al. 2016: 29) – and even ACAP,[16] which is a treaty aimed at the conservation of albatross and petrel species against the threats posed by fisheries bycatch in particular.

RFMO/As are a subset of RFBs that can be distinguished from other RFBs because (1) they relate to marine fisheries, rather than inland fisheries; and (2) have a mandate to impose legally binding conservation and management measures on their members, rather than merely exercising an 'advisory' mandate – whether primarily science-oriented, as with the International Council for the Exploration of the Sea (ICES), or management-oriented, like WECAFC. Moreover, the need for a dual mandate of conservation and management excludes instruments and bodies aimed solely at the conservation of fish species, for instance the global MoU on Sharks[17] adopted under the CMS.[18]

Types and key distinctions

A principal distinction is that between RFMOs and RFMAs. Whereas the former establish an intergovernmental organization, the latter commonly establish a Conference of the Parties (COP) or a Meeting of the Parties (MOP) as their principal decision-making body.

Another key distinction concerns the institutional setting. Most RFMO/As are entirely separate, autonomous or 'standalone' bodies that have been negotiated and established outside the scope of an overarching intergovernmental body. This general rule is subject to a few exceptions. The first is CCAMLR, which is part of the Antarctic Treaty System (see Chs. 12 to 14). However, CCAMLR is not a 'typical' RFMO, but 'more than an RFMO' (see the subsection 'Qualifying as an RFMO or an RFMA'). The second exception concerns RFMO/As established under Article XIV of the FAO Constitution.[19] At present these are the General Fisheries Commission for the Mediterranean (GFCM) and the Indian Ocean Tuna Commission (IOTC). WECAFC could possibly become the third.

Although RFMO/As are largely autonomous bodies, it should nevertheless be assumed that any recommendations of the UN General Assembly (UNGA), FAO's Committee on Fisheries, the informal consultations of states parties to the Fish Stocks Agreement, or the (Resumed) Fish Stocks Agreement Review Conferences specifically directed at members of RFMO/As will be given serious consideration by them. The UNGA's recommendations relating to high-seas bottom fishing were a case in point.[20] Moreover, members of RFMO/As with competence over straddling or highly migratory fish stocks that are also parties to the Fish Stocks Agreement are bound by the objectives of the Agreement as well as the features, functions and other guidance for RFMO/As set out in Articles 8–14 of the Agreement.

RFMO/As can also be distinguished on account of their species coverage. Some only deal with one specific species (e.g. IPHC and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), others with specific groups of species (e.g. the four other 'tuna RFMOs' that deal with various tuna and tuna-like species; see Table 2.1), and yet others with all 'residual species' in a specific geographical area, for instance NAFO and NEAFC.

In terms of regulatory areas, RFMO/As can be divided into three groups:

1. high seas as well as coastal-state maritime zones: this group includes the five tuna RFMOs and some 'other species RFMO/As', for instance CCAMLR and GFCM;
2. only or mainly high seas: this group includes most other species RFMO/As; and
3. only coastal-state maritime zones: this group consists of only a few RFMOs, for instance the Pacific Salmon Commission. Membership in these RFMOs is limited to coastal states.

At the time of writing, there were five tuna RFMOs and eleven other species RFMO/As whose regulatory areas include areas of high seas or consist entirely of high seas (see Table 2.1).[21] Although participation in these RFMO/As is commonly a mix of coastal states and high-seas fishing states, some consist exclusive of coastal states (e.g. JNRFC and NEAFC; Molenaar 2019).

Table 2.1 RFMO/As with high-seas coverage

	Tuna RFMOs
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
WCPFC	Western and Central Pacific Fisheries Commission
	Other Species RFMOs
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
GFCM	General Fisheries Commission for the Mediterranean
NAFO	Northwest Atlantic Fisheries Organization
NEAFC	North-East Atlantic Fisheries Commission
NPFC	North Pacific Fisheries Commission
SEAFO	South East Atlantic Fisheries Organisation
SPRFMO	South Pacific Regional Fisheries Management Organisation
	Other Species and Particular Species RFMAs
CAOF Agreement	Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (COP)
CBS Convention	Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (COP)
JNRFC	Joint Norwegian–Russian Fisheries Commission
SIOFA	Southern Indian Ocean Fisheries Agreement (MOP)

Key functions

An appropriate starting point for determining the key functions of RFMO/As relating to the conservation and management of fisheries resources is Article 10 of the Fish Stocks Agreement, which is specifically devoted to functions of RFMO/As and contains thirteen paragraphs. A more recent understanding of the key functions of RFMO/As is provided by the common list of criteria for performance reviews of RFMOs that was developed by the 'Kobe Process' – a cooperative process among the five tuna RFMOs – on the basis of the performance criteria used for the First (2006) NEAFC Performance Review.[22] An updated version of this list, used by the Second (2016) ICCAT Performance Review[23] groups, the criteria together in the following five functional areas:

1. *Conservation and management:* includes such key functions as data collection and sharing, setting total allowable catches (TACs) for target species, capacity management, allocating fishing opportunities and implementing the ecosystem approach to fisheries (EAF) management;

2. *Monitoring, control and surveillance (MCS):* includes port state measures and integrated MCS measures (e.g. observers, catch documentation and trade-tracking schemes, restrictions on transhipment, and boarding and inspection schemes);
3. *Compliance and enforcement:* includes cooperative mechanisms for detecting and deterring non-compliance (e.g. compliance assessment schemes and lists with vessels that have engaged in IUU fishing);
4. *Governance*: includes such functions as decision-making, dispute settlement, cooperation with other RFMO/As and capacity building; and
5. *Science:* covers in particular the quality and provision of scientific advice required for the assessment of stocks of target species and EAF management more broadly.

Qualifying as an RFMO or an RFMA

As noted above, qualifying as an RFMO or an RFMA determines the applicability of particular rights and obligations under international fisheries law relevant for members as well as non-members. To date, the issue of the qualification as an RFMO or an RFMA has arisen in three cases: JNRFC, the CAOF Agreement and CCAMLR. As analysed in detail by this author elsewhere (Molenaar 2020), the former two arguably qualify as RFMAs and the latter as 'more than an RFMO'. It is submitted that the qualification of CCAMLR as 'more than an RFMO' is justified not so much by its unique objective or the key role accorded to scientific research, but above all by its integration in the Antarctic Treaty System, whose principal role is safeguarding peace. CCAMLR can therefore be regarded as performing a role in safeguarding peace in addition to its role in the conservation and management of fisheries resources.

This conclusion on CCAMLR gives rise to a further proposition: that RFMO/As can perform additional roles besides conservation and management of fisheries resources. This 'role-oriented approach to RFMO/As' is supported by the rules and practices of several (other) RFMO/As: GFCM, in relation to the exploitation of red coral and the regulation of aquaculture; JNRFC, in relation to the harvesting of marine mammals; and the North Atlantic Salmon Conservation Organization (NASCO), in relation to the regulation of aquaculture and stock rebuilding (Molenaar 2020).

The duty to cooperate through RFMO/As

Introduction

This section will focus on the duty of states to cooperate through RFMO/As and its particular relevance for free riders and new entrants, which has evolved from the more general duties to cooperate laid down in UNCLOS in relation to various categories of transboundary fish stocks as well as high-seas fishing.[24] As a preliminary matter, it is important to emphasize here that duties to cooperate are due diligence obligations, which require certain conduct rather than a certain result. As regards Article 63(1) of UNCLOS, the International Tribunal for the Law of the Sea took the view in its *SRFC Advisory Opinion*[25] that it establishes a due diligence obligation which requires

> the States concerned to consult with one another in good faith, pursuant to article 300 of the Convention. The consultations should be meaningful in the sense that substantial effort should be made by all States concerned, with a view to adopting effective measures necessary to coordinate and ensure the conservation and development of shared stocks (para. 28).

Dealing with free riders

Introduction

In the domain of international fisheries law, free riders benefit from the efforts undertaken by others on the conservation and management of fisheries resources, by either avoiding being subject to restraints on fishing and fishing activities – in other words, avoiding applicability – or by not complying with applicable restraints. Examples are fishing in excess of a TAC or not using measures relating to bycatch of non-target species or impacts on vulnerable benthic habitats. Such behaviour not only harms the status of target species and the broader marine environment but also creates a competitive advantage over those that comply with costly conservation measures (no level playing-field).

States can avoid applicability or fail to ensure compliance with these rules by acting in various capacities – for instance, as a coastal state with regard to fishing activities in its own maritime zones; as a flag state with regard to its vessels operating on the high seas or in the maritime zones of other states; as a port state with regard to foreign vessels in its ports; as a market state with regard to imported fish; or with regard to natural and juridical persons bearing its nationality. As with the well-known notion of 'flags of convenience', it is therefore also possible to speak of 'ports of convenience' or 'markets of convenience'. CCAMLR, for example, continues to experience difficulties due to trade in toothfish (*Dissostichus* spp.) by non-members.[26]

Dealing with both forms of free-rider behaviour – non-applicability and non-compliance – is complicated by the consensual nature of international law. As reflected in the fundamental principle of *pacta tertiis*, a state is not bound by a rule of international law unless it has in one way or another consented to it.[27] Within RFMO/As, the two forms of free-rider behaviour give rise to different issues, requiring different responses. Thus far, the problem of non-compliance by members with applicable rules has been addressed mainly by compliance assessment schemes, which may result in withholding benefits or imposing penalties within some limited scenarios. Although dispute settlement procedures are often available, these are rarely resorted to in practice. A famous exception is the *Southern bluefin tuna* cases instituted by Australia and New Zealand against Japan under UNCLOS.[28]

The problem of non-applicability exists in relation to members as well as non-members of RFMO/As. An example of the former occurs when members exercise their right to opt out of adopted decisions to ensure that these will not become applicable to them. The constitutive instruments of recently established RFMO/As include constraints on the use of opt-out procedures, for instance by making them subject to ad hoc review or expert panels (Harrison 2019: 89–92). To date, there have been two such review panels, both pursuant to the 2009 SPRFMO Convention.[29]

Free-rider behaviour by non-members of RFMO/As

Non-applicability is nevertheless mainly a problem in relation to non-members of RFMO/As. UNCLOS and the Fish Stocks Agreement contain three approaches for addressing this problem. First, both treaties connect the rights and jurisdiction of states through 'rules of reference' to substantive fisheries standards adopted by intergovernmental bodies.[30] Pursuant to Articles 61(3) and 119(1)(a) of UNCLOS, the obligations for coastal states and high-seas fishing states on the determination of the TAC and the establishment of other conservation measures are linked to 'any generally recommended international minimum standards, whether subregional, regional or global'. The Fish Stocks Agreement incorporates the rules of reference of UNCLOS in Articles 5(b) and 10(c). In both instruments, however, the rules of references can be regarded as 'weak' due to the qualification 'taking into account', which leaves coastal states and high-seas fishing states a wide margin of discretion.[31]

Second, parties to both treaties are subject to various duties to cooperate. The duties under UNCLOS – which relate to various categories of transboundary fish stocks as well as discrete high-seas fish stocks – leave states a considerable margin of discretion in deciding on the form and level of such cooperation. Cooperation through RFMO/As is merely one way in which this duty can be discharged. In relation to straddling and highly migratory fish stocks, however, Articles 8(3) and 17(1) of the Fish Stocks Agreement pursue a different approach by stipulating that, by becoming a party to the Agreement, a state accepts it has a duty to cooperate through RFMO/As, and that this duty can only be discharged by becoming a member or 'by agreeing to apply [their] conservation and management measures'.

RFMO/As have implemented and operationalized this latter – secondary – mode of cooperation by means of the status of cooperating non-contracting party (CNCP) or a similar cooperative status (Molenaar 2019: 116–18). The Fish Stocks Agreement implicitly presents another mode of cooperation: abstaining from fishing altogether. As parties to the Agreement accept that, pursuant to its Articles 8(4) and 17(2), only members (and CNCPs) have fisheries access, abstention is in fact mandatory for flag states that are not members or CNCPs, and could be seen as the default mode while awaiting a successful application for membership or CNCP status.

It is submitted that the Fish Stocks Agreement implements and operationalizes the general duties to cooperate as laid down in UNCLOS into a duty to cooperate through RFMO/As. As the Agreement applies only to straddling and highly migratory fish stocks, however, its duty to cooperate through RFMO/As is, strictly speaking, not applicable to discrete high-seas fish stocks. This gap in the global component of international fisheries law has nevertheless been addressed at the regional level through other species RFMO/As, *inter alia*, because their mandates also encompass discrete high-seas fish stocks, and have also actually been exercised vis-à-vis discrete high-seas fish stocks (Molenaar 2007: 99–103).[32]

The PSM Agreement also requires parties to cooperate with RFMO/As, albeit less explicitly and more qualified in comparison with the Fish Stocks Agreement because it is part of a duty to cooperate with other actors, such as relevant states, FAO and other international organizations laid down in Article 6. As regards RFMO/As, the duty to cooperate is further operationalized by requiring port states to take specific measures (e.g. denial of access and use of ports) in support of the conservation and management measures of RFMO/As and their measures to combat IUU fishing.[33] This is nevertheless conditional on these measures having been adopted and applied in conformity with international law (Molenaar 2010: 382–5).[34]

A third approach to addressing free-rider behaviour by non-members (and non-CNCPs) of RFMO/As is included in the Fish Stocks Agreement. By becoming a party to the Agreement, a state consents to the non-flag state high-seas enforcement regime in Articles 21 and 22 regardless as to whether that state is a member (or a CNCP) of the relevant RFMO/A. Since the entry into force of the Fish Stocks Agreement, however, this approach has never been used in practice.

The recognition that RFMO/As are the pre-eminent vehicles for regional fisheries regulation that is implied in the duty to cooperate through RFMO/As, gives them a clear mandate to deal with free-rider behaviour by non-members and non-CNCPs. Although such a mandate is, strictly speaking, available only vis-à-vis parties to the Fish Stocks Agreement, there are no indications that RFMO/As have taken this into account in their actions so far.

It is submitted that this is not necessarily based on the position that the relevant provisions in the Fish Stocks Agreement have become part of customary international law or are opposable to non-parties on other grounds – for instance, that the Agreement constitutes an objective regime (Rayfuse 1999). Rather, it is arguably based above all on the fact that the overwhelming majority of the actions of RFMO/As are aimed primarily at vessels rather than states, and are, in the domain of international fisheries law, regarded as withholding benefits rather than constraining rights. Examples of actions by RFMO/As primarily aimed at states are trade measures – for instance import restrictions, trade documentation and identification schemes – and catch documentation schemes (van der Marel 2019: 303–6). As regards actions aimed primarily at vessels, most RFMO/As treat fishing for regulated species or engagement in fishing-related activities in their regulatory areas by vessels not flying the flag of a member or a CNCP as IUU fishing, because such activities undermine the effectiveness of those RFMO/As. When such vessels are included in IUU vessel lists, members and CNCPs will be required to withhold a large number of benefits vis-à-vis listed vessels, including fishing licences, transhipment, landing catch, port access in general and chartering.[35]

From the perspective of international trade law, however, several of these actions aimed at vessels – for instance, prohibitions on landing and transhipment in port – are regarded as constraining rights held by the flag states of these vessels. Such actions can nevertheless be consistent with international trade law if they are justified by one or more of the general exceptions laid down in Article XX of the 1947 GATT,[36] in particular paragraph (g) 'relating to the conservation of exhaustible natural resources'. There have been a few instances where unilateral actions relating to fisheries by states and the EU have been challenged under the World Trade Organization (WTO)'s Dispute Settlement Understanding,[37] but so far there have not been any challenges against actions aimed at states or vessels that have originated from RFMO/As (Ferri 2015: ch. 5; Serdy 2016: 432–8; Churchill 2019: 340–1). The mandate of RFMO/As to deal with free-rider behaviour by non-members and non-CNCPs – whether or not they are parties to the Fish Stocks Agreement – has therefore not been challenged in the context of dispute settlement proceedings under international trade law or international fisheries law thus far. Were such a challenge to arise in the future, however, it is highly likely that it would be linked to the preferential treatment accorded to existing members through the rules and practices of RFMO/As on participation, allocation and combating IUU fishing, as discussed in the next subsection.

Additional approaches to dealing with free-rider behaviour are included in the PSM Agreement. Much of this Agreement relates to denying IUU fishing vessels entry and use of port, and builds on Article 23 of the Fish Stocks Agreement. In addition, Articles 4(1)(b) and 18(3) of the PSM Agreement recognize the right of port states to impose enforcement measures that are more onerous than denial of entry and use of port. Examples of such more onerous enforcement measures are monetary penalties and confiscation of catch. Consistency with the principle of *pacta tertiis* can for such enforcement measures be ensured through flag-state consent (upon the initiative of the flag state or upon request by the port state), a decision of an RFMO/A or some other ground of international law – for instance, a port state's residual jurisdiction derived from its territorial sovereignty. As regards decisions by RFMO/As, the limited practice of CCAMLR, ICCAT, NAFO and NEAFC thus far has related to exceptional circumstances; and it is unclear if or to what extent port states have actually made use of the enabling provisions in the PSM Agreement (Honniball 2018: subsection 5.3.5).

Another way in which the PSM Agreement seeks to address free-rider behaviour is incorporated in the first sentence of Article 20(3), which requires parties to encourage their vessels to 'use ports of states that are acting in accordance with, or in a manner consistent with this Agreement'. The second sentence encourages parties 'to develop, including through [RFMO/As] and FAO, fair, transparent and non-discriminatory procedures for identifying any State that may not be acting in accordance with, or in a manner consistent with, this Agreement'. While there does not seem to be any practice within RFMO/As on the 'negative identification approach' reflected in the second sentence of Article 20(3), various RFMO/As have developed practices modelled on the 'positive identification approach' reflected in the first sentence (Honniball 2018: subsection 5.3.1.2.). Some RFMO/As explicitly stipulate that only ports of members or CNCPs may be used.[38] Others prohibit members and CNCPs from using ports that have not been designated in accordance with applicable procedures. As these procedures entitle only members and CNCPs to designate ports, however, this means that ports of non-members and non-CNCPs cannot be used.[39]

Rules and practices of RFMO/As on participation, allocation and combating IUU fishing

The rules and practices of RFMO/As on participation, allocation and combating IUU fishing are closely linked. As a general rule, allocations of fishing opportunities and other tangible benefits – e.g. engaging in fishing-related activities – are commonly available only to members and CNCPs. As noted above, most RFMO/As treat engagement in fishing or fishing-related activities by vessels of non-members or non-CNCPs as IUU fishing, thereby triggering a range of measures to combat IUU fishing. The reality is, however, that membership or CNCP status does not guarantee an allocation of fishing opportunities. A well-known example in this regard is NAFO Resolution 1/99 'to Guide the Expectations of Future New Members with regard to Fishing Opportunities in the NAFO Regulatory Area', which stipulates that 'new members should be aware that presently and for the foreseeable future, stocks managed by NAFO are fully allocated, and fishing opportunities for new members are likely to be limited'.[40] A similar approach was embraced by NEAFC in 2003.[41] Although some other RFMO/As have adopted slightly more accommodating approaches,[42] it is evident that existing members will always be reluctant to accept quota cuts to make room for new entrants.

Another manner in which existing members are able to protect their utilization-oriented interests is through the formal rules on eligibility requirements and criteria, and the procedures on participation laid down in the constitutive instruments of RFMO/As. Some of these are very 'open' (as with ICCAT and SPRFMO), but many are comparatively 'closed' due to the 'approval role' of existing members on applications for membership. Some of the constitutive instruments of the latter group do not even contain a right to accede, but give existing members the right to 'invite to accede by consensus'. This enables any existing member to veto a request to be invited to accede. As the two newest RFMO/As – NPFC and the CAOF Agreement[43] – are part of this latter group, there is certainly no indication of a trend towards greater openness. The practice by RFMO/As on this approval role so far has been highly divergent, with for instance CCAMLR having rejected only one of many applications, and WCPFC having rejected all applications except one (Molenaar 2019: 122–3).

A majority of the RFMO/As listed in Table 2.1 above make use of the status of CNCP or a similar participatory category (Molenaar 2019: 116–18). Whereas the eligibility criteria can be assumed to be quite inclusive, applicants are required to comply with a considerable number of conditions and are often expected to make a 'voluntary' financial contribution.[44] A significant disadvantage of CNCP status – from the perspective of status-holders – is the considerable lack of stability and predictability that ensues from the RFMO/A's competence to revoke or not renew this status on an annual or biannual basis. The exercise of this competence is legitimate and understandable if a status-holder does not comply with the conditions attached to its status, but there is always a risk of abuse of competence.[45]

Disputes on participation in RFMO/As

It is clear that preferential treatment accorded to existing members and CNCPs through rules and practices on allocation and participation poses a significant obstacle to states that want to fish in the regulatory areas of RFMO/As of which they are not members or CNCPs, but that are at the same time confronted with a generally accepted mandate of RFMO/As to deal with free riders and IUU fishing, and that may be bound by a duty to cooperate through such RFMO/As on account of their formal adherence to the Fish Stocks Agreement. While there have been some dispute settlement proceedings on allocation[46] – albeit none brought by non-members – there have not yet been any in relation to participation. Such proceedings would revolve in particular around the rights to engage in fishing and fishing-related activities on the high seas pursuant to Articles 87(1)(a) and 116 of UNCLOS, and the right of states with a 'real interest' to participate in RFMO/As pursuant to Article 8(3) of the Fish Stocks Agreement, where applicable. This would probably be complemented by the argument that the relevant duties to cooperate through RFMO/As in relation to straddling, highly migratory and discrete high-seas fish stocks apply between, on the one hand, members and CNCPs and, on the other hand, non-members and non-CNCPs. In other words: cooperation is a two-way, not a one-way, street.[47]

The absence of cases on participation in RFMO/As can in part also be explained by the fact that existing dispute settlement procedures in the domain of international fisheries law are insufficiently tailored to the scenario at hand. For one thing, non-members of RFMO/As do not have access to the dispute settlement procedures included in the constitutive instruments of such RFMO/As. Non-members that are parties to UNCLOS and/or the Fish Stocks Agreement would nevertheless have access to the dispute settlement procedures of these treaties. As such procedures do not allow proceedings to be instituted against RFMOs,[48] however, the claimant could be compelled to bring separate proceedings against all members of the RFMO/A that are also parties to UNCLOS and/or the Fish Stocks Agreement.[49] The court or tribunal – assuming not more than one court or tribunal would be involved – could then decide to join these cases. The arising procedural complexities would clearly be quite overwhelming and very time-consuming and costly.

There are nevertheless also cases where applications for membership of RFMO/As were unsuccessful due to the opposition of only a few or even a single member. A recent example are the efforts by the EU to be invited to accede to the NPFC Convention,[50] and thereby become an NPFC member. Whereas NPFC had refrained from deciding on the EU's first request in 2018,[51] all NPFC members except Russia were in principle prepared to accept the EU's second request in 2019.[52] The disclosure of the fact that Russia had blocked consensus on inviting the EU to accede to the NPFC Convention is a consequence of Article 24(3) of that Convention, which stipulates that 'any Contracting Party that does not join the consensus in relation to paragraph 2 shall present to the Commission in writing its reasons for not doing so'. This feature of the NPFC Convention is not found in any other constitutive instrument of an RFMO or an RFMA. The transparency which it ensures may also help to avoid abuse of rights.

Interestingly, whereas Article 24(3) of the NPFC Convention only requires the reasoned decisions to be presented to the other members – internal transparency therefore – Russia's reasoned decisions were included in Annex E to the publicly available Report of the 5th (2019) Annual NPFC Meeting. This means that NPFC decided – presumably by either a simple or a three-quarters majority[53] – to interpret Article 24(3) broadly. Instead of making the reasoned decisions also available to the applicant – which would have gone beyond internal transparency only slightly – NPFC opted for full transparency, making the reasoned decisions freely available to all. This appears to be the first time that such a decision has ever been taken by an RFMO or an RFMA.

At the close of the 5th (2019) NPFC Meeting, the EU stated that it would examine Russia's reasons 'in the light of the prohibition on discrimination laid down in Article

8(3) of the Fish Stocks Agreement and of the NPFC's previous practice in handling cases of accession' and that the EU 'will consider all possible options in this regard'.[54] One of these options would be to institute dispute settlement proceedings against Russia under UNCLOS or the Fish Stocks Agreement, to which both the EU and Russia are parties. However, a decision to initiate intergovernmental dispute settlement proceedings is, for various reasons, commonly seen as a last resort. Instead, the EU submitted a new (third) request to be invited to accede to the NPFC Convention in advance of the 6th Annual NPFC Meeting – which, due to the Covid-19 pandemic – was held virtually in February 2021. Even though this request proved successful, the EU did not receive any allocation and will still need to engage in negotiations with other NPFC members to secure this.[55]

The Fish Stocks Agreement's duty to cooperate as a source of inspiration in the BBNJ negotiations

The Fish Stocks Agreement's approach of implementing and operationalizing the general UNCLOS duties to cooperate on fisheries into a duty to cooperate through RFMO/As, with an associated mandate for RFMO/As to deal with free-rider behaviour by non-members and non-CNCPs, has served as a source of inspiration in the BBNJ negotiations. This idea was (also) proposed by the present author in the context of a 2013 workshop convened in an earlier phase in the BBNJ process (Molenaar 2013: slide 19).[56]

The key provision in question is paragraph 6 of Article 20, titled 'Implementation', of the November 2019 Draft (further: First Draft) of the BBNJ Implementing Agreement.[57] Article 20 is included in Part III, titled 'Measures such as Area-Based Management Tools, including Marine Protected Areas', which consists of Articles 14–21.[58] Article 20 should be read in conjunction with the objectives of Part III listed in Article 14, and in particular the objective in paragraph b: 'Implement effectively obligations under the Convention and other relevant international obligations and commitments'. Article 20(6) is in brackets and stipulates:

> [A State Party that is not a participant in a relevant legal instrument or framework, or a member of a relevant global, regional, subregional or sectoral body, and that does not otherwise agree to apply the conservation and management measures established under such instruments, frameworks or bodies is not discharged from the obligation to cooperate, in accordance with the Convention and this Agreement, in the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. [Such State Party shall ensure that activities under its jurisdiction or control are conducted consistently with measures related to area-based management tools, including marine protected areas, established under relevant frameworks, instruments and bodies.]]

This text is closely modelled on paragraphs 1 and 2 of Article 17 of the Fish Stocks Agreement. However, it should be noted these paragraphs go hand in hand with paragraphs 3 and 4 of Article 8 of the Fish Stocks Agreement. The latter, however, have no counterparts in the First Draft of the BBNJ Implementing Agreement, although some other features of Article 8 of the Fish Stocks Agreement are incorporated in other provisions of the First Draft.[59]

This means that the First Draft lacks an explicit duty to cooperate through relevant legal instruments, frameworks or bodies for states engaged in relevant activities – whether within the regulatory areas of such instruments, frameworks or bodies in general, or specifically within the geographical areas covered by area-based management tools (ABMTs) established under such frameworks, instruments or bodies.

An implicit duty to cooperate with such instruments, frameworks or bodies is nevertheless incorporated in Article 20(6). Similar to the Fish Stocks Agreement, this duty can be discharged through three modes of cooperation: formal participation or membership as the primary mode; a secondary mode along the lines of CNCP status within RFMO/As; and a tertiary mode that is not based on a formal relationship with the relevant instrument, framework or body, but consists of a unilateral undertaking by the state to ensure that its activities in areas covered by ABMTs are conducted consistent with the measures related to these ABMTs. This last mode, which is in double brackets, arguably achieves a similar result as a requirement to abstain from authorizing activities that would be inconsistent with such measures. In respect of the secondary mode, the question arises whether relevant existing instruments, frameworks or bodies already have such a cooperative status in place, or whether these are envisaged to be established in the future.

Article 20(6) of the First Draft is primarily aimed at addressing the issue of *pacta tertiis*. By becoming a party to the BBNJ Implementing Agreement, a state accepts an implicit general duty to cooperate through instruments, frameworks or bodies to which it is not a party or a member, and with which it also has no other formal relationship along the lines of CNCP status within RFMO/As. The double-bracketed second sentence of Article 20(6) operationalizes this by requiring such a state to ensure that its activities in areas covered by ABMTs are conducted consistent with measures related to these ABMTs. Unlike the Fish Stocks Agreement and the PSM Agreement,[60] the First Draft does not make this duty to cooperate explicitly conditional on these instruments, frameworks or bodies as well as ABMTs and measures applicable therein being established, operated, adopted or applied in accordance with international law.

If the second sentence of Article 20(6) makes it to the final text of the BBNJ Implementing Agreement, this will raise the question as to whether it provides relevant instruments, frameworks and bodies with a mandate to take action against non-participants and their vessels and natural and juridical nationals; similar to the actions adopted by RFMO/As to combat IUU fishing. The similarities with the wording in Article 17 of the Fish Stocks Agreement certainly seem to point in that direction; such a conclusion would not necessarily be affected by the absence of an explicit duty to cooperate with relevant legal instruments, frameworks or bodies. This could mark a highly significant step towards ensuring (quasi-)universal compliance with the measures related to ABMTs, and thereby towards achieving the objectives for which they were established. However, because this mandate would cover regulation (a) of all maritime activities within the high seas and the Area (the seabed beyond juridical continental shelves); (b) for the very broad purpose of the '[long-term] conservation and sustainable use of marine biological diversity';[61] and (c) by in principle any type of measures,[62] it would be advisable not to exercise such a mandate before thoroughly examining the specific characteristics of each concrete scenario at hand. As part of that scoping exercise, account should also be taken of the experiences with combating IUU fishing in RFMO/As.

Conclusions

The international community's recognition of RFMO/As as the pre-eminent institutions of international cooperation in the domain of international fisheries law was first expressed in the Fish Stocks Agreement and was subsequently confirmed in, among others, the PSM Agreement. Such recognition is also implied in the duty to cooperate through RFMO/As to which states are bound by becoming a party to the Fish Stocks Agreement and the PSM Agreement. This duty implements and operationalizes the more general duties to cooperate laid down in UNCLOS in relation to various categories of transboundary fish stocks as well as discrete high-seas fish stocks.

Whereas membership is the primary mode of cooperation through RFMO/As, Articles 8(3) and 17(1) of the Fish Stocks Agreement acknowledge that cooperation may also occur by agreeing to apply the RFMO/As' conservation and management measures. RFMO/As have implemented and operationalized this secondary mode of cooperation by means of the status of cooperating non-contracting party (CNCP) or a similar cooperative status. The Fish Stocks Agreement implicitly presents another mode of cooperation: abstaining from fishing altogether. As parties to the Agreement accept that only members (and CNCPs) have fisheries access, abstention is in fact mandatory for flag states that are not members or CNCPs, and could be seen as the default mode while awaiting a successful application for membership or CNCP status.

The recognition that RFMO/As are the pre-eminent vehicles for regional fisheries regulation gives them a clear mandate to deal with free-rider behaviour by non-members and non-CNCPs. Although such a mandate is, in light of the fundamental principle of *pacta tertiis*, strictly speaking available only vis-à-vis parties to the Fish Stocks Agreement, there are no indications that RFMO/As have taken this into account in their actions so far. It is submitted that this is not necessarily based on the position that the relevant provisions in the Fish Stocks Agreement have become part of customary international law or are opposable to non-parties on some other ground. Instead, it is arguably based above all on the fact that the overwhelming majority of the actions of RFMO/As are primarily aimed at vessels rather than states, and are, in the domain of international fisheries law, regarded as withholding benefits rather than constraining rights. Although this is viewed differently in the domain of international trade law, so far the mandate of RFMO/As to deal with non-members and non-CNCPs has not been challenged in the context of dispute settlement proceedings under either of these two domains of international law. Were such a challenge to arise in the future, however, it is highly likely that it would be linked to the preferential treatment accorded to existing members through the rules and practices of RFMO/As on participation, allocation and combating IUU fishing.

Interestingly, the Fish Stocks Agreement's approach of implementing and operationalizing the general UNCLOS duties to cooperate on fisheries into a duty to cooperate through RFMO/As and an associated mandate for RFMO/As to deal with free-rider behaviour by non-members and non-CNCPs, has served as a source of inspiration for the BBNJ negotiations. In case the current text of Article 20(6) of the First Draft makes it to the final text of the BBNJ Implementing Agreement, this would potentially be a very significant step towards ensuring (quasi-)universal compliance with the measures related to area-based management tools, and thereby towards achieving the objectives for which they were established.

Notes

1 Arts 2, 19(2)(i), 21(1)(d), 49, 56(1)(a) and 77(1) and (4) of the UNCLOS (United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982. In force 16 November 1994 (1833 UNTS 396)).
2 Arts 116 and 86 of the UNCLOS.
3 Convention on Fishing and Conservation of the Living Resources of the High Seas of 29 April 1958. In force 20 March 1966 (559 UNTS 285).
4 See note 1 above.
5 Arts 63, 64, 66, 67 and 118.
6 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 Stocks, New York, 4 August 1995. In force 11 December 2001 (2167 UNTS 3).
7 See Part III 'Mechanisms for International Cooperation Concerning Straddling Fish Stocks and Highly Migratory Fish Stocks', and in particular Arts 8–13 and 17.
8 Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, Rome, 22 November 2009. In force 5 June 2016; text available at https://www.fao.org/treaties/results/details/en/c/TRE-000003/.
9 Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, Ilulissat, 3 October 2018. In force 25 June 2021; *OJ* 2019, L 73/3.
10 Report of the 2019 ICCAT Meeting, pp. 3–4 and Annex 6.2.
11 See Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture, https://www.fao.org/fishery/en/organization/rfb/wecafc.
12 Established by UN General Assembly (UNGA) Res. 72/249, 24 December 2017. All formal documents on the BBNJ negotiations are available at https://www.un.org/bbnj/.
13 For editorial reasons, this chapter consistently refers to members in relation to RFMO/As, even though the Fish Stocks Agreement refers to members in relation to RFMOs and participants in relation to RFMAs.
14 See the definitions of 'fishing' and 'fishing related activities' in paras (c) and (d) of Art. 1 of the PSM Agreement.
15 See Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture, www.fao.org/fishery/topic/16800/en.

16 Agreement on the Conservation of Albatrosses and Petrels, Canberra, 19 June 2001. In force 1 February 2004 (2588 UNTS 257); as amended, consolidated version at www.acap.aq.
17 Memorandum of Understanding on the Conservation of Migratory Sharks, Manila, 12 February 2010; as amended. Consolidated version available at www.cms.int/sharks.
18 Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 23 June 1979. In force 1 November 1983 (1651 UNTS 355).
19 Constitution of the Food and Agriculture Organization of the United Nations, Quebec City. Opened for signature and entered into force on 16 October 1945, as amended.
20 The best-known are those in paras 66–71 of UNGA Res. 59/25, 17 November 2004.
21 The North Atlantic Salmon Conservation Organization (NASCO) and the North Pacific Anadromous Fish Commission (NPAFC) are excluded due to their prohibitions on high-seas fishing.
22 See Performance Review by Regional Fishery Bodies: Introduction, Summaries, Synthesis and Best Practices. Volume I: CCAMLR, CCSBT, ICCAT, IOTC, NAFO, NASCO, NEAFC (FAO Fisheries and Aquaculture Circular No. 1072 (FIPI/C1072): 2012), at p. 5. The criteria are reproduced in Appendix 1.
23 Report of the Second (2016) ICCAT Performance Review, Annex 2.
24 See note 5 above.
25 Request for an Advisory Opinion submitted by the Sub-Regional Fisheries Commission (SRFC), Advisory Opinion of 2 April 2015.
26 E.g. Report of the 37th (2018) Annual CCAMLR Meeting, paras 3.4–3.5 and 13.10.
27 Vienna Convention on the Law of Treaties, Vienna, 23 May 1969. In force 27 January 1980 (1155 UNTS 331), Art. 34.
28 See *Southern bluefin tuna* cases (Nos. 3 and 4) (New Zealand v. Japan; Australia v. Japan), requests for provisional measures, Order of the International Tribunal for the Law of the Sea of 27 August 1999; and *Southern bluefin tuna* case (Australia v. Japan and New Zealand v. Japan), Arbitral Tribunal Award on Jurisdiction and Admissibility of 4 August 2000 (XXIII RIAA 1-57).
29 Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean (Auckland, 14 November 2009). In force 24 August 2012; www.sprfmo.int. See Permanent Court of Arbitration (PCA) Cases Nos 2013-14 and 2018-13.
30 See Arts 61(3) and 119(1)(a) of UNCLOS and Arts 5(b) and 10(c) of the Fish Stocks Agreement.
31 By contrast, the rules of reference relating to shipping in Arts 21(2), 94(5) and 211(2), (5) and (6)(c) of UNCLOS can be regarded as 'strong' because the qualifications used ('unless they are giving effect to'; 'conform to'; 'at least have the same effect'; 'conforming to and giving effect to'; and 'not […] other than') leave states only a limited margin of discretion in their exercise of prescriptive jurisdiction.
32 Whereas para. 12 of UNGA Res. 60/31, 29 November 2005, encouraged 'States, as appropriate, to recognize that the general principles of the Agreement should also apply to discrete fish stocks in the high seas', subsequent Annual UNGA 'Fish' Resolutions called on states individually and through RFMO/As to manage discrete high-seas fish stocks 'consistent with the general principles set forth' in the Fish Stocks Agreement (see, e.g. UNGA Res. 61/105, 8 December 2006, para. 19 and UNGA Res. 75/89, 8 December 2020, para. 47). Several other paragraphs in these

Resolutions apply explicitly to straddling and highly migratory fish stocks, as well as to discrete high-seas fish stocks.

33 Arts 9(4), 11(1)(d) and 12(3)(b).

34 This condition has been prominently included in Art. 4(3), but is also reflected in Arts 1(a) and 9(4).

35 E.g. CCAMLR Conservation Measure 10-07 (2016), para. 22.

36 General Agreement on Tariffs and Trade, 1947; https://www.wto.org/english/docs_e/legal_e/gatt47.pdf.

37 These are the *Swordfish* case between the then European Community and Chile (WTO Dispute No. DS193) and the *Atlanto-Scandian herring* case between Denmark (in respect of the Faroe Islands) and the EU (WTO Dispute No. DS469).

38 E.g. ICCAT Recommendation 19-04, para. 71.

39 See e.g. NAFO Conservation and Enforcement Measures 2021, Arts 38(1)(p)(i) and 43(1); and NEAFC Scheme of Enforcement 2021, Arts 21 and 29(f).

40 GC Doc. 99/9, Annex 13.

41 Report of the 22nd (2003) Annual NEAFC Meeting, at p. 27. The 'Guidelines for the expectation of future new Contracting Parties with regard to fishing opportunities in the NEAFC Regulatory Area' are available at http://www.neafc.org/becomingacp.

42 See e.g. NPFC Conservation and Management Measure 2019-07, para. 4.

43 See Art. 24(2) of the NPFC Convention (Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean, Tokyo, 24 February 2012. In force 19 July 2015; text available at www.npfc.int); and Art. 10(2) of the CAOF Agreement (note 9 above).

44 E.g. WCPFC Conservation and Management Measure 2009–11 'Cooperating Non-Members'.

45 E.g. the difficulties experienced by Vietnam in renewal of the status of cooperating non-member by WCPFC during 2012–15 due to the construction of large-scale tuna fishing vessels in Vietnam (see, for instance, the Report of the 12th (2015) Annual WCPFC Session, paras 65–66).

46 Namely the *Southern bluefin tuna* cases (note 28 above), the *Atlanto-Scandian herring* cases (note 37 supra and PCA Case 2013-30), and the review panels under the SPRFMO Convention, note 29 supra (PCA Cases Nos 2013-14 and 2018-13).

47 Note also the phrases 'adopted and applied consistent with the relevant rules of international law' and 'established in accordance with the Convention and this Agreement' in paras 1(b) and 1(d) of Art. 1 of the Fish Stocks Agreement.

48 See also the text accompanying note 37 above.

49 There are some precedents for simultaneously bringing multiple cases that are (largely) identical, for example the cases brought by Yugoslavia – which was succeeded by Serbia and Montenegro during the course of the proceedings – against Belgium, Canada, France, Germany, Italy, the Netherlands, Portugal, Spain, the UK and the USA before the International Court of Justice (see https://www.icj-cij.org/en/case/105).

50 See note 43 above.

51 Report of the 4th (2018) Annual NPFC Meeting, para. 8.

52 Report of the 5th (2019) Annual NPFC Meeting, para. 9.

53 Art. 8(2) of the NPFC Convention.

54 Report of the 5th (2019) Annual NPFC Meeting, Annex F.

55 Report of the 6th (2021) Annual NPFC Meeting, paras 6 –11 and Annexes D and E.

56 See also the Summary Proceedings of the 'Intersessional workshops aimed at improving understanding of the issues and clarifying key questions as an input to the work of the [BBNJ] Working Group', UN Doc. A/AC.276/6*, 10 June 2013, para. 91.

57 Doc. A/CONF.232/2020/3, 18 November 2019.

58 Arguably, Part III also comprises Annex I, 'Indicative criteria for identification of areas', through linkages in Art. 16.

59 Arts 6(1), 14(a) and 15(1). See, however, the Icelandic proposal for a new para. 4 to Art. 6 of the First Draft (document dated 15 April 2020 containing an article-by-article compilation of these textual proposals, at pp. 52–4) which closely follows the wording of Art. 8 of the Fish Stocks Agreement; including its para. 3. The Icelandic proposal builds on an earlier proposal by Norway (see Compiled Textual Proposals 3rd BBNJ Session (on file with author), at p. 80).

60 See notes 34 and 47 above and the accompanying text. See also Art. 3(1)(a) of the CAOF Agreement and the preambular paragraph beginning with 'Underlining'.

61 Art. 2 of the First Draft.

62 Whereas the First Draft uses 'conservation and management measures' in Art. 20(6), other provisions have 'sustainable use' as alternative bracketed text to 'management', and no definitions are provided for either of these.

References

Billé R., L. Chabason, P. Drankier, E. J. Molenaar and J. Rochette (2016), 'Regional Oceans Governance: Making Regional Seas Programmes, Regional Fishery Bodies and Large Marine Ecosystem Mechanisms Work Better Together', *UNEP Regional Seas Reports and Studies*, 197.

Churchill, R. (2019),'International Trade Law Aspects of Measures to Combat IUU and Unsustainable Fishing', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 319–49, London: Hart.

Ferri, N. (2015), *Conflicts over the Conservation of Marine Living Resources. Third States, Governance, Fragmentation and other recurring issues in International Law*, Torino: G. Giappichelli Editore.

Harrison, J. (2019), 'Key Challenges Relating to the Governance of Regional Fisheries', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 79–10, London: Hart.

Honniball, A. (2018), 'Extraterritorial Port State Measures: The Basis and Limits of Unilateral Port State Jurisdiction to Combat Illegal, Unreported and Unregulated Fishing'. Unpublished doctoral thesis, Utrecht University, Netherlands.

Molenaar, E. J. (2007), 'Managing Biodiversity in Areas beyond National Jurisdiction', *International Journal of Marine and Coastal Law*, 21: 89–124.

Molenaar, E. J. (2010), 'Port State Jurisdiction to Combat IUU Fishing: The Port State Measures Agreement', in D. A. Russell and D. L. VanderZwaag (eds), *Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability* Principles. *Canadian and International Perspectives*, 369–86, Leiden: Martinus Nijhoff.

Molenaar, E. J. (2013), 'Area-Based Management Tools', presentation at the workshop 'Conservation and Management Tools, Including Area-Based Management and Environmental Impact Assessments', convened by the UNGA, New York, 5 June. https://www.un.org/Depts/los/biodiversityworkinggroup/workshop2_panels_website.pdf.

Molenaar, E. J. (2016), 'International Regulation of Central Arctic Ocean Fisheries', in H. Nordquist, J. N. Moore and R. Long (eds), *Challenges of the Changing Arctic. Continental Shelf, Navigation, and Fisheries*, 429–63, Leiden: Brill/Nijhoff.
Molenaar, E. J. (2019), 'Participation in Regional Fisheries Management Organizations', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 103–29, London: Hart.
Molenaar, E. J. (2020), 'Regional Fisheries Management Organizations', in C. M. Ribeiro, F. L. Loureiro and T. Henriksen (eds), *Global Challenges and the Law of the Sea*, 81–109, Cham: Springer.
Rayfuse, R. G. (1999), 'The United Nations Agreement on Straddling and Highly Migratory Fish Stocks as an Objective Regime: A Case of Wishful Thinking?', *Australian Yearbook of International Law*, 20: 253–78.
Serdy, A. (2016), 'The Shaky Foundations of the FAO Port State Measures Agreement: How Watertight Is the Legal Seal against Access for Foreign Fishing Vessels?', *International Journal of Marine and Coastal Law*, 31: 422–41.
Takei, Y. (2013), *Filling Regulatory Gaps in High Seas Fisheries*, Leiden: Brill.
Van der Marel, E. R. (2019), 'Problems and Progress in Combating IUU Fishing', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 291–318, London: Hart.

3

Avoiding Institutional Failure: Risk Factors and Response Strategies

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Introduction

How to avoid institutional failure? Adapting resource management institutions to the challenges arising from climate-induced or other changes in the spatial distribution of marine stocks is one variant of this broader problem.[1] Efforts to create, adapt and operate governance systems to address transboundary environmental problems frequently produce results that are disappointing or even end in outright failure. On the other hand, some regimes are widely regarded as successes. The evidence supporting these propositions (Young 2011) includes qualitative accounts (Speth 2004; Park, Conca and Finger 2008; Hale, Held and Young 2013) as well as quantitative analyses (Miles et al. 2002; Breitmeier, Young and Zürn 2006; Breitmeier, Underdal and Young 2011).

How can we organize a search for factors to account for this diversity of outcomes, identifying causes of failure and conditions for solving, or at least alleviating, a range of environmental problems? This chapter explores the proposition that efforts to address environmental problems successfully over time must avoid two institutional pitfalls – reductionism and overload. We begin with a brief review of the nature of these perils, and then move on to a more extensive account of risk factors and response strategies. Thus, we focus on the third research question posed in Chapter 1, concerning ways in which actors engaged in international governance can create, adapt or implement institutional arrangements to retain high levels of problem solving. Our account should be of interest not only to analysts seeking to explain cases of success and failure but also to practitioners involved in governance systems for dealing with various environmental problems – including sustainable fisheries management under changing climatic or ecosystem conditions.

Twin perils: reductionism and overload

Institutional bargaining and the implementation of the resultant regimes feature dynamics that individual participants are unable to manage or control on their own (Young 1994). Those negotiating the terms of new or restructured regimes must walk a fine line between the pursuit of divergent interests, centred on maximizing their individual gains, and respect for common interests in an outcome that all participants prefer to a no-agreement situation. They must learn the art of navigating in the realm of 'mixed-motive interactions (Schelling 1960), producing coherent results rather than contradictory provisions or vague formulas designed to paper over serious disagreements. Much the same is true of the efforts of those responsible for operating governance systems once these are put in place. Common pitfalls in such processes take the forms of reductionism and overload.

Institutional reductionism occurs when those responsible for creating and implementing environmental regimes strip away many of the complexities of real-world situations in their desire to achieve closure on the terms of an agreement. In dealing with marine fisheries, for example, this may involve focusing on efforts to achieve maximum sustainable yields from specific stocks of fish, while setting aside a host of other issues relating to such matters as multiple species interactions, ecosystem dynamics, distributive justice, interactions with other regimes and the impacts of climate change. Although the temptation to engage in reductionism is easy to understand, the result is likely to be the creation of regimes that fail to solve problems and may even become dead letters.

Institutional overload is the mirror image of reductionism. It occurs when those responsible for designing or adapting regimes strive to incorporate all relevant factors in an effort to respond to the complexities of real-world situations. Understandable as this motivation may be, it leads to unwieldy institutional arrangements when the regimes created become too complex (Birch 1984). To continue with the marine fisheries example, it may make sense to include a concern for interactions among species and the dynamics of ecosystems, but it is asking too much to expect a fisheries regime to incorporate provisions dealing with dead zones, marine pollutants such as plastic debris and the impacts of changes in water temperatures and ocean acidification. Beyond a certain level of complexity, the result will be overload leading to gridlock.

Of course, success in solving problems and in avoiding the impacts of reductionism and overload are both matters of degree. Regimes may help to alleviate problems, even when they do not produce clear-cut solutions. Both gridlock and overload may hamper the performance of regimes to a greater or lesser degree, without necessarily making them irrelevant. But the perils of institutional reductionism and institutional overload can wreak havoc with efforts to create regimes capable of solving environmental problems, even when negotiators and administrators are aware of and understand the dangers associated with these perils.

Risk factors and response strategies

We are not in a position to quantify the incidence of success and failure in efforts to solve environmental problems. But regimes that yield disappointing results or end in failure may be more common than successful outcomes as regards efforts to devise solutions to international or transboundary environmental problems. On the other hand, there are also some success stories: regimes that have proven highly effective in addressing the problems that motivated their initial creation and that have remained viable over time (Breitmeier, Underdal and Young 2011). Examples include the Antarctic Treaty System, dating back to 1959 (Stokke and Vidas 1996), and the regime dealing with the threat to the Earth's stratospheric ozone layer articulated in the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, together with later amendments (Parson 2003).

This makes it important to identify the forces – risk factors – likely to propel governance systems toward reductionism or overload, and to consider response strategies that can help negotiators and administrators to avoid these pitfalls in specific cases. How can negotiations slide into over-simplification or fall prey to excessive complexity, without anyone sounding the alarm or taking effective steps to prevent movement along the slippery slopes of reductionism or overload? Are there forces endemic to institutional bargaining or to regime implementation that push participants in one direction or the other in ways difficult to anticipate, challenging to monitor, or hard to counter effectively in a world of actors motivated primarily by self-interest? Are there procedures that can help participants in such processes to find common ground in avoiding these perils, without compromising their bargaining strength or administrative capacity in ways that limit their ability to maximize individual gains?

The risk factors abound. For purposes of analysis here, we find it helpful to group risk factors into familiar categories dealing with the *character of the problem*, the *broader setting* and *institutional design*. In each case, we argue, charting a course that avoids the perils of reductionism and overload constitutes a necessary condition for successful problem solving.

In the following sections, we analyse risk factors that illustrate each of the three broad categories. Focusing on two factors in each category, we explore the nature of the risk and the mechanisms through which it may lead to results that run afoul of the perils of reductionism or overload. We also offer an assessment of response strategies that can prove helpful to those seeking to steer a course that minimizes the dangers of falling into the traps associated with the twin perils. Further research should focus on testing our hypothesis: that devising an appropriate response strategy constitutes a necessary condition for success in solving environmental problems.

Problem characteristics

Problems that give rise to a need for governance differ in important ways. Scholars have emphasized distinctions among collective-action problems, externalities and value conflicts, or used these distinctions to differentiate variation in the 'malignancy' of the problem (Underdal 2002). Another set of differences regarding the character of the problem has recently come into focus. While the earlier distinctions remain important, we focus in this section on risk factors relating to matters of problem dynamism and complexity, offering a preliminary account of response strategies relevant to alleviating the impact of these factors.

Dynamism

Dynamism is a matter of the extent to which the relevant systems are subject to change, and the types of change most commonly encountered. A critical concern here is the danger of institutional lock-in, which can make it difficult or impossible for those responsible for operating a regime to adapt to changing conditions, especially if the changes are nonlinear in character or evolve rapidly.

The peril of institutional reductionism is illustrated by the common practice of establishing fixed division keys in fisheries, usually based on some combination of historical fishing and zonal attachment (measured by the share of the stock biomass that occurs over time within the exclusive economic zone (EEZ) of any given coastal state) (see Chs. 8 and 14; also Henriksen and Hoel 2011). Like many reductionist practices, fixed division keys have significant merits in some circumstances. They are intended to facilitate annual quota negotiations by allowing the parties to concentrate on setting the total allowable catch in light of scientific advice, avoiding the unsustainable practice of resolving problems of allocation by raising allowable-harvest levels (Stokke 2000).

However, highly dynamic stock developments may undermine the legitimacy of such fixed division keys – for instance, when abundance or migratory patterns change in ways that make a stock available to newcomers that have no commitment to the existing regime. This is what happened around 2007 when Northeast Atlantic mackerel (*Scomber scombrus*) spread north- and westward and became available in large quantities within the EEZs of Iceland, the Faroe Islands and even Greenland (see Chs. 6, 7 and 14). None of these states and territories had a long history of exploiting this resource, whereas those that did – the EU, Norway and to some extent Russia – were not convinced that the new migratory pattern would prove lasting. That made them reluctant to recognize the newcomers as coastal states regarding this stock with legitimate claims to access to the bargaining table and shares of the quota.

Such rigidity with respect to newcomers is quite typical of regional fisheries management regimes, often embedded in procedural rules that grant every existing member a right to veto the acceptance of a new member (Serdy 2016; see Ch. 2). In the mackerel case, the combination of allocative rigidity among the traditional user-states and lack of commitment to the existing fixed-key arrangement among the newcomers rapidly led to a breakdown in negotiations, resulting in years of unilateral quotas and total harvesting pressure well in excess of scientific recommendations (see Ch. 7; also Spijkers and Boonstra 2017).

Important as it is to avoid the time-inconsistency problem that looms whenever benefit- or burden-sharing arrangements are simple and rigid, problems also arise if adaptation procedures are excessively complex or demanding. Consider the attempts by the EU and Norway to build adaptive capacity into their allocation system for North Sea herring (*Clupea herengus*), a major pelagic stock in the region, supporting annual catches that fluctuate widely. Because the spatial distribution of this stock expands into Norway's EEZ when the spawning stock grows, a sliding-scale division key was negotiated in 1986 that gave Norway an increased share of the quota whenever the spawning stock exceeded certain pre-defined thresholds. This dynamic allocation system appeared to be a reasonable operationalization of the equally reasonable zonal attachment principle. Observers and practitioners saw it as part of a promising trend in which difficult allocation questions were tackled in an increasingly science-based manner – noting, however, that it might also encourage politicization of scientific work (Engesæter and Hamre 1993).

In practice, however, the sliding scale applied in the allocation of North Sea herring created massive problems during annual quota negotiations, not least by generating strong incentives for the parties to question the scientific evidence whenever the spawning stock was assessed as being close to one of the pre-defined thresholds. After years of intensive search for alternatives, the sliding scale was finally replaced with a fixed key, which is still in place. Science-based adaptation of the quota allocation to dynamic zonal-attachment developments was intended to make the regime more legitimate and robust, but instead it generated institutional overload that undermined sustainable management.

How can those operating international institutions in highly dynamic issue-areas acquire sufficient adaptive capacity to deal with changes that make the exit option attractive to one or more of the parties, without undermining other core management tasks like the generation and provision of scientific advice? Here it is useful to consider the characteristics of strategies pursued by regional fisheries management regimes that have succeeded in adopting regulatory measures that reflect the best scientific advice even in periods when bargaining power shifts among members due to changes in zonal attachment. At least three observations seem relevant in this regard.

First, longstanding allocative arrangements are likely to be less susceptible to requests for renegotiation when zonal attachment changes in favour of one of the parties. A clear example is the more than forty-year-old agreement between Norway and Russia on equal sharing of the world's largest cod stock, Northeast Arctic cod (*Gadus morhua*) (see Chs. 8 and 14; also Stokke 2012). During the 2010s, this stock shifted north- and eastward and is now considerably more abundant in the Russian zone than previously (see Ch. 6). However, there have been no signs of Russian industry organizations or experts pushing the Russian member of the Joint Norwegian–Russian Fisheries Commission (JNRFC) to request a greater share of the quota (see Ch. 8).

A second relatively successful response strategy has been applied in the arrangement for managing Icelandic capelin (*Mallotus villosus*) in the Nordic Seas, by making their allocation keys more flexible by fixing them for shorter periods (Kvamsdal et al. 2016).

Third, the fixed allocation of North Sea herring agreed between Norway and the EU in 1998 includes a flexibility mechanism whereby the parties may trade part of their herring quota for access to other species in the region, similar to the mechanism in place in the Norwegian–Russian arrangement (Stokke 2012).

Thus, alternative paths exist for avoiding reductionism as well as overload, even in highly dynamic systems. Resilience may derive from a long track record, from benefit- or burden-sharing arrangements that are explicitly defined as temporary, or from provisions for institutional flexibility that allow states to capitalize on differences in how they value those burdens or benefits.

Complexity

Complexity is a measure of the extent to which a problem is linked to an array of issues extending beyond the core concern itself (Underdal 2010). In the case of fisheries, for example, questions arise regarding whether the relevant fish stocks are affected by developments such as increases in the temperature of the water column or the runoff of nutrients or other land-based marine pollutants that cause the spread of dead zones. Fishing operations can themselves be a significant driver of certain environmental problems, such as the destruction of benthic communities or coral reefs. In biophysical terms, problems may be more or less self-contained with regard to their links to broader systems, and the complexity of those broader systems may vary in terms of factors like hyperconnectivity, nonlinearity, directional change, and the prevalence of unexpected developments arising as emergent properties (Young 2017a, 2017b). Highly complex biophysical systems are especially demanding with regard to governance arrangements when the activities relevant to problem solving fall under the authority of different sectors of government.

The reductionist inclination is to seek to encapsulate each of these problems in order to make negotiations tractable. We humans are accustomed to thinking in terms of systems that are relatively simple. Pressure toward reductionism is likely to be reinforced if the international level of governance situates regulatory authority over various ecosystem components in separate institutions involving different sectors of government. Such separation is common in oceans management, because many international fisheries regimes came into existence before regimes for marine environmental protection emerged.

For instance, the fact that the pre-existing North-East Atlantic Fisheries Commission (NEAFC) already possessed management authority over high-seas harvesting operations goes a long way toward explaining why the mandate of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic excludes 'questions relating to the management of fisheries' (OSPAR Convention, Preamble and Article 4). Savings clauses such as this, protecting commitments already entered into in previous agreements, are common in international environmental diplomacy (van Asselt 2011) and often serve to promote institutional reductionism.

Protection of sector authority by means of savings clauses is also showcased in UN General Assembly Resolution 72/249 on the mandate of the current negotiations on conservation of marine biodiversity beyond national jurisdiction (BBNJ): '[this] process and its results should not undermine existing relevant legal instruments and frameworks and relevant global, regional and sectoral bodies' (UNGA 2017). However, it is clear that any new arrangement capable of making a difference with respect to biodiversity beyond national jurisdiction will have significant implications for existing regimes that deal with marine fisheries, commercial shipping, deep seabed mining and (potentially) certain aspects of oil and gas development.

To illustrate the peril of reductionism: when alerted by the OSPAR Commission to the need to protect rare and threatened cold-water coral reefs from the effects of bottom trawling, the NEAFC responded by pointing out that international measures constraining fisheries operations were an exclusive NEAFC competence, and that aggregation with environmental-protection interests should be dealt with at the national level (Kvalvik 2012). This turf-defensive approach increased the risk that measures taken under the two regimes, involving largely the same set of states, would prove incoherent with respect to area protection. It also implied that the regional institution with greatest expertise in defining and applying criteria for area protection would not be able to influence the economic activity that entailed the greatest risk of damaging the coral reefs.

That said, taking the opposite approach, seeking to endow an environmental institution with regulatory powers over fisheries could easily produce an important variant of institutional overload: unwillingness on the part of important member-states to cede authority to the international body due to uncertainty about its future priorities among the concerns involved. In the fisheries sector, states have typically granted regional management organizations access to their national fisheries research capabilities, wide regulatory authority regarding the conduct of harvesting operations, and (frequently) the capacity to operate reporting, monitoring and inspection procedures that enhance transparency on harvesting activities in national and high-seas areas (Stokke 2019; see Ch. 2). Thus, the potential advantages of expanding the functional scope of an international body must be weighed against the risk that states will be less prepared to cede regulatory and enforcement authority to an international body that is operated, or significantly influenced by, sectors of government that are inclined to prioritize preservation over resource use.

One response strategy aimed at steering a course between the reductionist peril (incoherent regulation) and the overload peril (an institution that is functionally broad but procedurally weak) involves setting up procedures in support of interplay management, allowing those who operate distinct institutions to improve the interaction among them (Stokke 2020). Such procedures may include coordinated decision-making; but more frequently they feature no more than adaptation, reciprocal or one-sided (Oberthür and Stokke 2011).

Interplay management by means of adaptation is evident in the NEAFC–OSPAR case: the fisheries body decided to adapt its regulations by closing certain high-seas areas to bottom trawling within the spatial boundaries defined in the environmental body's emerging network of marine protected areas (Kvalvik 2012). Thus, regulatory alignment was obtained without joint decision-making, which remained unacceptable to the resource management regime.

Accordingly, even when national-level authority regarding different parts of a complex biophysical system resides with institutions with competing priorities, interplay management, whether by coordination or adaptation, may help to achieve regulatory coherence.

Broader setting

Efforts to create or adapt environmental regimes do not unfold in a vacuum. The broader setting encompasses a range of contextual factors that influence both the negotiations of the terms of an agreement and the operation of the regime in practice. Processes of regime formation or adaptation are time- and place-sensitive: efforts to address similar needs for governance may succeed in some settings but result in scant progress in other settings. Here we offer a preliminary account of risk factors relating to the broader setting, with particular attention to factors concerning the political context and the socioeconomic environment.[2] We also explore response strategies that can avoid or alleviate the negative effects these factors can have in propelling negotiations toward the perils of reductionism and overload.

Political context

Efforts to craft the provisions of regimes are themselves political processes, but they occur within broader political settings that may influence the course of negotiations considerably. Relevant factors concern the extent to which the issues at hand are linked to deep-seated disputes or conflicts of interest, and the extent to which the political setting includes well-developed practices for cooperatively addressing needs for governance. Intense disputes and the absence of cooperative practices are likely to lead to a reductionist approach. Conversely, in examining policy arenas that deal with contentious issues, analysts often ask: are there opportunities to make progress by broadening the agenda, adding issues and actors in efforts to craft mutually acceptable outcomes? In such cases, the challenge is to avoid overload arising from outcomes of the kind referred to in describing US domestic legislation as 'Christmas tree bills' due to the convoluted nature of the deals made to build coalitions needed to reach agreement. Often, the results are governance systems that are excessively complex and that ultimately prove ineffective.

The international regime for managing Northeast Arctic cod emerged in the midst of the Cold War, with the dominant regime members – Norway and the Soviet Union – squarely placed on opposite sides of the East–West divide (Stokke 2022; see Ch. 8). Observers agree that the effectiveness of this regime for fisheries management derives in considerable part from the ability of those who negotiated it to take steps to avoid the reductionist trap of ignoring the larger and often conflict-ridden geopolitical context (Stokke et al. 1999; Hønneland 2012). Key components of this regime served to insulate the practical management tasks of scientific research, adoption of regulations and compliance activities like enforcement at sea from contested sovereignty issues that would otherwise complicate the efficient deployment of fishing capacity and responsible management measures.

An example of such insulation of mutually beneficial cooperation involves the elaborate procedures of the Mutual Access Agreement, allowing fishers to operate in each other's waters to optimize harvesting practices, deliberately aimed at avoiding fisheries incidents that might escalate into diplomatic conflicts (Stokke et al. 1999). Similarly, the parties developed the Grey Zone Agreement in the 1970s, allowing parallel inspection in an area that included a disputed segment of the Barents Sea to reduce the negative effect that acceptance of fisheries enforcement by the other party would have had on each party's claim to sovereignty (Stokke and Hoel 1991).

A reductionist approach to these negotiations, one that attended to the needs of fisheries management but ignored the complications arising from the East–West rivalry and competing sovereignty claims, would have had little chance of succeeding.

The opposite peril, institutional overload, looms whenever those responsible for administering an issue-specific regime assume responsibility for broader and deeper political problems that the institution is incapable of addressing effectively. Consider, for instance, proposals to boycott Arctic Council meetings held in Russia in order to make a firm diplomatic statement on the inadmissibility of Russia's annexation of Crimea from Ukraine in 2014. A similar weighing of concerns was relevant when Norway considered whether its post-Crimea sanctions against Russia, which included a freeze on military cooperation, should also extend to the longstanding and deep coast guard cooperation on fisheries inspection (see Chs. 8 and 9) and on search-and-rescue operations in the Barents Sea. Had the more extensive sanctions been chosen in these cases, they would have generated institutional overload. Relatively low-key institutions well-equipped for encouraging coordination in specific issue-areas of common interest would have been burdened with a problem they were not equipped to solve. There is no basis for believing that Russia would have perceived reduced cooperation in Arctic Council activities, in the work of the JNRFC, or in collaborative search-and-rescue missions in remote Arctic locations as costly enough to induce reconsideration of its geopolitical decision regarding Crimea. Efforts to use those specialized institutions for pursuing broader security objectives would have produced overload, leading to a loss of problem-solving capacity in the issue-areas involved with no significant effect on Russian behaviour regarding Ukraine.

Common denominators among efforts to find a path between reductionism and overload include insulating issue-specific practical cooperation of mutual interest from oscillations in the intensity of contextual disputes or conflicts and willingness on the part of those implementing the arrangements to refrain from burdening them with broader political objectives they are ill-equipped to serve.

Socioeconomic environment

The socioeconomic environment encompasses a range of conditions, including the overall level of economic prosperity prevailing at the time of negotiations on any given regime. Here we focus on another important governance condition: the extent to which non-state actors or social movements take an interest in the issues and seek to influence the course of negotiations.

Increasingly, non-state actors have acquired leverage in dealing with large-scale environmental issues. Already in the 1960s, environmental organizations had become involved in the work of the International Whaling Commission (Skodvin and Andresen, 2003). However, the major surge in non-state actor involvement in international environmental governance followed the end of the Cold War (Tallberg et al. 2014). Figures are definition-sensitive, but, by one estimate, the number of active non-governmental organizations with international characteristics had mushroomed from some 6,000 in 1990 to more than 50,000 only fifteen years later (Clapp and Dauvergne 2011: 8). Among the 3,500 NGOs enjoying consultative status with the

UN Economic and Social Council in 2011, more than two-thirds were working on sustainable development (Park 2013). Recently, environmental groups have played important roles in pressing for negotiations relating to Central Arctic Ocean fisheries and conservation of biodiversity beyond national jurisdictions.

Compared to their counterparts in other areas of environmental governance, fisheries regimes were slow to create procedures for involving non-state actors. Norms concerning transparency of documents and meetings achieved prominence through the 1992 UN Conference on Environment and Development. Their inclusion in the 1995 FAO Code of Conduct for Responsible Fisheries and the 1995 UN Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks triggered far-reaching changes in regional fisheries regimes (Stokke 2001). Today, the typical regional fisheries management organization allows any non-state actor that pledges to support its objectives to apply for observer status, which usually includes access to all plenary meetings (see, e.g. NEAFC 2021).

The earlier and predominantly statist approach to international fisheries management was reductionist: it failed to make use of the legitimacy and the resources for monitoring and compliance inducement that now motivate governments to involve non-state actors in almost all areas of international governance, except security and finance (Tallberg et al. 2014). As argued by Stokke in Chapter 9, for instance, the active participation in NEAFC activities by environmental organizations such as Seas at Risk, PEW Environment and WWF played a role in mobilizing a broader enforcement network that has proven vital for the adoption and implementation of region-wide port-state measures to combat pervasive illegal, unreported and unregulated (IUU) fishing in the Northeast Atlantic.

While participation by industry and civil society organizations can reinforce the legitimacy of international governance and improve the knowledge base for decision-making, the dramatic rise in the number of non-state actors seeking such involvement may also lead to institutional overload. A striking example concerns the European Court of Human Rights, which allows not only designated organizations but any national of its member-states to lodge a complaint. By 2011, the court had some 170,000 applications pending (of which 34,000 were repetitive cases), leading to an average waiting time of thirty-seven months for communication (not decision) regarding a case (Wildhaber 2013; also Shelton 2018).

In global environmental diplomacy, the sharp increase in industry and civil society interest has made it far more difficult for diplomats to engage with non-state actors as intensively as before. At the 2009 Conference of the Parties to the UN Framework Convention on Climate Change, the ~12,000 registered non-governmental organizations were more than twelve times as numerous as they had been during the first COP in 1995, a change that reduced rather than promoted their influence on negotiations (Park 2013: 281).

Institutions that steer a middle course in their management of non-state actor interests – avoiding the peril of overload without returning to statist reductionism – often establish procedures that place some responsibility for coordinating contributions on the non-state actors themselves. Consider, for instance, the 'umbrella requirement' that the Antarctic Treaty Consultative Parties have placed on non-state actors in

Antarctic affairs. The many environmental organizations taking an interest in Antarctic affairs, including all the transnational majors like Greenpeace, IUCN and WWF as well as numerous smaller groups, must coordinate their input to Consultative Meetings through the Antarctic and Southern Ocean Coalition (ASOC). Similarly, fishing companies engaged in krill fishing in the Southern Ocean, seeking some measure of influence over management decisions taken by the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR), have obtained observer status by forming ARK – the Association of Responsible Krill Harvesting Companies (see Ch. 12).

The operational details of the middle course vary. NEAFC is less restrictive than the Antarctic institutions, granting observer status and physical access to plenary meetings to individual environmental organizations. However, participation in the operational deliberations of its Permanent Committee on Management and Science is limited to two persons selected by environmental organizations with observer status (NEAFC 2021: Art. 33). Similarly, the Arctic Council has granted Indigenous Peoples' Organizations an unusually prominent place, a notch above observers, by according them Permanent Participant status, with the right to 'full consultation' on all matters addressed by the Council. To combine this non-state actor prominence with tractability, however, only those Indigenous Peoples Organizations that have members in more than one Arctic state or many members within a single state are eligible for such status.

In short, provisions for regulating non-state actor involvement in international environmental governance are essential for avoiding institutional overload, while still taking into consideration the legitimacy and resources such actors can bring to bear on problem solving.

Institutional design

Many of the response strategies for avoiding the perils of reductionism and overload involve elements of institutional design. But certain attributes of the institutions established for dealing with specific problems can themselves constitute risk factors in this respect. There is typically a gap between the ideal and the actual with regard to the performance of regimes. They rarely operate exactly as envisioned by their designers or articulated in conventions, treaties or other constitutive documents. Negotiators seeking to minimize this gap often make the principal features of a regime as simple as possible. Or they make these features highly complex and insist that those responsible for implementation follow the letter of the agreement. Both responses can lead to institutional failure. Here we consider this challenge with particular reference to decision rules and the depth and strength of substantive regime provisions.

Decision rules

Environmental regimes, including arrangements dealing with marine resources, commonly establish decision rules or procedures for arriving at collective choices. The decisions may involve a wide range of matters, such as setting total allowable catch harvest levels on a periodic basis, creating protected areas that are off-limits to fishing or establishing monitoring systems to track impacts on fish stocks. The challenge is always the same: regimes need to establish decision rules that are stringent enough to protect the interests of the members, but not so stringent as to lead to stalemate or the inability to produce decisions necessary for the operation of a regime or for adjusting it to changing circumstances.

Reductionism here typically takes the form of insisting on unanimity as the only acceptable decision rule. In its strongest form, unanimity requires explicit consent from all regime members in order to arrive at a decision, so that the unwillingness of even one member to agree to a proposed action results in failure to take any decision regarding the issue at hand. This requirement has the attraction of simplicity and may produce reasonable results concerning simple procedural issues or substantive matters that are uncontroversial. But a decision rule that requires unanimity in its strongest form can and often does lead to gridlock, where little or nothing can be accomplished.

Overload constitutes the opposite peril. Negotiators often devise decision rules that are ingenious but complex, in an attempt to avoid the peril of reductionism while still protecting the interests of key regime members. Such rules may involve subdividing the members of a regime into two or more categories (e.g. developed countries and developing countries) and requiring concurrent majorities among the members of each group in order to arrive at a formal decision. Many other forms of complexity are possible regarding the decision rules embedded in regimes. The peril is the same: highly complex decision rules entail the risk of producing paralysis, whereas reductionist rules can lead to stalemate.

How can those responsible for creating and administering regimes avoid the perils of reductionism and overload with regard to decision rules? Various practices have emerged, sometimes on an informal basis, to allow regimes to make progress in addressing problems in a manner acceptable to the parties. One strategy is to turn to the idea of consensus, on the assumption that consensus is compatible with ordinary conceptions of sovereignty (see Chs. 2, 12 and 14). Consensus occurs whenever no member of a regime feels so strongly about an issue that it is prepared to voice its opposition, explicitly and openly. The process of building a consensus often involves log-rolling or vote-trading. In effect, the parties make deals in which each party agrees to refrain from actively opposing a measure of interest to the other(s), in return for similar treatment regarding an issue of particular importance to itself. Effective regimes regularly come to rely on consensus procedures in practice, regardless of the exact language dealing with decision rules embedded in their constitutive documents (Breitmeier, Young and Zürn 2006).

Other solutions come into play with regard to the adjustment of regimes once they are up and running. The ozone regime, for example, allows amendments to phase-out schedules for ozone-depleting substances to take effect on the basis of majority voting without requiring ratification by member-states, so long as the relevant substances belong to families of chemicals already subject to regulatory action under the auspices of the regime. Amendments to conventions dealing with commercial shipping, such as SOLAS and MARPOL, take effect one year after their initial adoption, if no member of the International Maritime Organization lodges a formal objection during that period.

One way or another, regimes that make a difference in addressing environmental problems manage to develop procedures for avoiding reductionism and overload regarding decision rules, while continuing to acknowledge, at least in principle, the right of sovereign states not to be bound by decisions taken without their explicit consent.

Bindingness and level of ambition

Governance systems vary considerably in terms of bindingness and level of ambition or, in other words, in the extent to which substantive provisions constrain state behaviour. Regarding bindingness, the provisions of a regime may range from hard to soft, depending on whether they take the form of hard law set forth in a legally binding instrument, soft law under the terms of a ministerial declaration or similar document, or informal practices with no legal status in the ordinary sense of the term. Level of ambition refers to the breadth of the topics covered by a regime and the depth of commitments or the extent to which those commitments go beyond what the parties would do in the absence of an agreement.

We can envisage a spectrum of situations with regard to bindingness and level of ambition, ranging from highly ambitious arrangements articulated in the form of hard law at one extreme to much more limited arrangements with no legal status at the other. Many of those who think about international environmental agreements take it for granted that the goal in every case is to create ambitious arrangements that are as 'hard' as possible. But this assumption is questionable. If we start with the premise that form should follow function regarding the character of governance systems, the proper approach is to address these matters on a case-by-case basis, developing arrangements likely to contribute to solving the problem(s) at hand.

Reductionism here takes the form of insisting that all the provisions of a regime should be cast as hard law, especially if coupled with an assumption that there is no need for explicit compliance mechanisms to ensure that the parties fulfil their commitments. Two major problems can lead to institutional failure in such cases. One arises from a trade-off between hardness and level of ambition. When asked to make hard-law commitments, parties to environmental agreements generally limit both the breadth and the depth of the commitments they are willing to accept (Barrett 2007). Experience also indicates that ambitious commitments not accompanied by suitable compliance mechanisms tend to get watered down or fall by the wayside when it comes to implementation.

Overload, by contrast, occurs when the agreements that establish regimes include ambitious provisions covering a wide range of issues, without any central thread to lend focus or coherence to the parties' efforts to implement individual provisions. This is a source of considerable concern in the current negotiations regarding BBNJ. In such cases, institutional failure often results from desultory efforts to implement specific provisions of a regime with varying degrees of success, leading to outcomes that do not add up to a coherent strategy for addressing the concern that led to the creation of the regime in the first place.

What strategies are available to avoid the perils of reductionism and overload with regard to issues concerning the form and strength of substantive provisions? Experience in the realm of international environmental governance suggests several possibilities. One strategy involves differentiating among the provisions of a regime, making some legally binding and allowing others to take the form of softer commitments or even voluntary pledges. An example is the 2015 Paris Climate Agreement, structured generally as a legally binding arrangement in which the Nationally Determined Contributions of the individual parties are treated as voluntary pledges (Cherry, Hovi and McEvoy 2014).

Another strategy is to opt for modest breadth and depth of commitments at the outset, coupled with procedures for raising the regime's level of participation and ambition over time. Examples here include adding protocols to a framework convention to expand the range of issues covered, as with the 1979 Convention on Long-Range Transboundary Air Pollution, or expanding the list of controlled substances, as in the case of the 2001 Stockholm Convention on Persistent Organic Pollutants.

A third strategy involves providing assistance to parties that are willing to participate but lack the capacity needed to implement ambitious substantive provisions. Such assistance may involve technology transfer, training programmes or financial support. In every case, the challenge is to tailor the strategy so as to avoid the perils of reductionism and overload with regard to bindingness and level of ambition.

Conclusions

There are two ways to think about the analysis presented in this chapter, one *positive* and the other *normative*. The positive perspective emphasizes the goal of explaining observed patterns of success and failure in efforts to create new environmental regimes or to adapt or reconfigure less effective regimes or regimes facing changing circumstances. Many initiatives fail, but some succeed. This we explain in terms of the effects of risk factors that push negotiations toward the perils of reductionism and overload, even in cases involving experienced negotiators who are aware of the dangers of these traps. Sometimes it is possible to steer a course that allows for safe passage between the twin perils of reductionism and overload. But this can occur only when the negotiators are cognizant of the pitfalls and are prepared to work together to avoid these perils, even while making concerted efforts to pursue their individual interests. This, we believe, explains why success is exceptional rather than routine when it comes to creating and implementing environmental governance systems.

By contrast, the normative perspective involves offering advice to those responsible for negotiating and implementing the terms of environmental agreements. What can our analysis offer that may be of interest to those engaged in institutional bargaining or responsible for implementing the resultant regimes? We advise these actors to pay careful attention to risk factors and response strategies. Every case is unique in some respects. But it is always important to consider the relevance of risk factors regarding the character of the problem, institutional design and the broader setting, and, we argue, it is necessary to formulate response strategies that can help in steering clear of the associated traps of reductionism and overload.

Notes

1 This chapter includes material drawn from Young and Stokke (2020) as well as previously unpublished material.
2 Elsewhere we examine a third dimension: the *cognitive* setting (Young and Stokke 2020).

References

Barrett, S. (2007), *Why Cooperate? The Incentive to Supply Global Public Goods*, Oxford: Oxford University Press.

Birch, A. H. (1984), 'Overload, Ungovernability and Delegitimation', *British Journal of Political Science*, 14: 135–60.

Breitmeier, H., A. Underdal and O. R. Young (2011), 'The Effectiveness of International Environmental Regimes: Comparing and Contrasting Findings from Quantitative Research', *International Studies Review*, 13 (4): 579–605.

Breitmeier, H., O. R. Young and M. Zürn (2006), *Analyzing International Environmental Regimes: From Case Study to Database*, Cambridge, MA: MIT Press.

Cherry, T. L., J. Hovi and M. D. McEvoy, eds (2014), *Toward a New Climate Agreement: Conflict, Resolution and Governance*, London: Routledge.

Clapp, J. and P. Dauvergne (2011), *Paths to a Green World: The Political Economy of the Global Environment*, 2nd edn, Cambridge, MA: MIT Press.

Engesæter, S. and J. Hamre (1993), 'Scientific Input to International Fishery Agreements', *International Challenges*, 13 (2): 85–106.

Hale, T., D. Held and K. Young (2013), *Gridlock: Why Global Cooperation Is Failing When We Need It Most*, Cambridge: Polity Press.

Henriksen, T. and A. H. Hoel (2011), 'Determining Allocation: From Paper to Practice in the Distribution of Fishing Rights Between Countries', *Ocean Development and International Law*, 42: 66–93.

Hønneland, G. (2012), *Making International Fisheries Agreements Work: Post-Agreement Bargaining in the Barents Sea*, Cheltenham: Edward Elgar.

Kvalvik, I. (2012), 'Managing Institutional Overlap in the Protection of Marine Ecosystems on the High Seas: The Case of the North East Atlantic', *Ocean & Coastal Management*, 56: 35–43.

Kvamsdal, S. F., A. Eide, N. A. Ekerhovd, K. Enberg, A. Gudmundsdottir, A. H. Hoel, K. E. Mills, F. J. Mueter, L. Ravn-Jonsen, L. K. Sandal, J. E. Stiansen and N. Vestergaard (2016), 'Harvest Control Rules in Modern Fisheries Management', *Elementa: Science of the Anthropocene*, 4: 000114.

Miles, E. L., S. Andresen, E. M. Carlin, J. B. Skjærseth, A. Underdal and J. Wettestad (2002), *Environmental Regime Effectiveness: Confronting Theory with Evidence*, Cambridge, MA: MIT Press.

NEAFC (North-East Atlantic Fisheries Commission) (2021), 'Rules of Procedure'. https://www.neafc.org/basictexts.

Oberthür, S. and O. S. Stokke, eds (2011), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change*, Cambridge, MA: MIT Press.

OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) (1992). Adopted in Paris, 22 September 1992. Latest amendment (annexes) 2007. https://www.ospar.org/convention/text.

Park, J., K. Conca and M. Finger (2008), *The Crisis of Global Environmental Governance*, London: Routledge.

Park, S. (2013), 'Transnational Environmental Activism', in R. Falkner (ed.), *Handbook of Global Climate and Environment Policy*, 268–85, Chichester: John Wiley & Sons.

Parson, E. A. (2003), *Protecting the Ozone Layer: Science, Strategy and Negotiation in the Shaping of a Global Environmental Regime*, Oxford: Oxford University Press.

Schelling, T. C. (1960), *The Strategy of Conflict*, Cambridge, MA: Harvard University Press.

Serdy, A. (2016), *The New Entrants Problem in International Fisheries Law*, Cambridge: Cambridge University Press.

Shelton, D. (2018), 'Performance of Regional Human Rights Courts', in T. Squatrito, O. R. Young, A. Føllesdal and G. Ulfstein (eds), *The Performance of International Courts and Tribunals*, 114–53, Cambridge: Cambridge University Press.

Skodvin, T. and S. Andresen (2003), 'Nonstate Influence in the International Whaling Commission, 1970–1990', *Global Environmental Politics*, 3 (4): 61–86.

Speth, J. G. (2004), *Red Sky at Morning: America and the Crisis of Global Governance*, New York, NY: Oxford University Press.

Spijkers, J. and W. J. Boonstra (2017), 'Environmental Change and Social Conflict: The Northeast Atlantic Mackerel Dispute', *Regional Environmental Change*, 17: 1835–51.

Stokke, O. S. (2000), 'Managing Straddling Stocks: The Interplay of Global and Regional Regimes', *Ocean and Coastal Management*, 43 (2–3): 205–34.

Stokke, O. S., ed. (2001), *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*, Oxford: Oxford University Press.

Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.

Stokke, O. S. (2016), 'Geopolitics, Governance, and Arctic Fisheries Politics', in E. Conde and S. S. Iglesias (eds), *Global Challenges in the Arctic Region: Sovereignty, Environment and Geopolitical Balance*, 170–95, London: Routledge.

Stokke, O. S. (2019), 'Management Options for High Seas Fisheries: Making Regime Complexes More Effective', in J. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 51–79, London: Hart.

Stokke, O. S. (2020), 'Interplay Management', in F. Biermann and R. Kim (eds), *Architectures of Earth System Governance: Institutional Complexity and Structural Transformation*, 165–85, Cambridge: Cambridge University Press.

Stokke, O. S. (2022), 'Arctic Geopolitics, Climate Change, and Resilient Fisheries Management', *Ocean Yearbook* 36: 440–74.

Stokke, O. S. and A. H. Hoel (1991), 'Splitting the Gains: Political Economy of the Barents Sea Fisheries', *Cooperation and Conflict*, 26: 49–65.

Stokke, O. S. and D. Vidas, eds (1996), *Governing the Antarctic: The Effectiveness and Legitimacy of the Antarctic Treaty System*, Cambridge: Cambridge University Press.

Stokke, O. S., L. G. Anderson and N. Mirovitskaya (1999), 'The Barents Sea Fisheries', in O. R. Young (ed.), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, 91–154, Cambridge, MA: MIT Press.

Tallberg, J., T. Sommerer, T. Squatrito and C. Jönsson (2014), 'Explaining the Transnational Design of International Organizations', *International Organization*, 68: 741–74.

Underdal, A. (2010), 'Complexity and Challenges of Long-term Environmental Governance', *Global Environmental Change*, 20: 386–93.

Underdal, A. (2002), 'One Question, Two Answers', in E. L. Miles, A. Underdal, S. Andresen, J. Wettestad, J. B. Skjærseth and E. M. Carlin, *Environmental Regime Effectiveness: Confronting Theory with Evidence*, 3–46, Cambridge, MA: MIT Press.

UNGA (United Nations General Assembly) (2017), Resolution 72/249. International legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. A/RES/72/249.

van Asselt, H. (2011), 'Legal and Political Approaches in Interplay Management: Dealing with the Fragmentation of Global Climate Governance', in S. Oberthür and O. S. Stokke (eds), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change*, 59–85, Cambridge, MA: MIT Press.

Wildhaber, L. (2013), 'The European Court of Human Rights and its Discontents: Turning Criticism into Strength', in S. Flogaitis, T. Zwart and J. Fraser (eds), *Criticism and Case-overload: Comments on the Future of the European Court of Human Rights*, 9–17, Cheltenham: Edward Elgar.

Young, O. R. (1994), *International Cooperation: Protecting the Environment in a Stateless Society*, Ithaca, NY: Cornell University Press.

Young, O. R. (2011), 'The Effectiveness of International Environmental Regimes: Existing Knowledge, Cutting-edge Themes, and Research Strategies', *Proceedings of the National Academy of Sciences of the United States of America*, 108: 19853–60.

Young, O. R. (2017a), *Governing Complex Systems: Social Capital for the Anthropocene*, Cambridge, MA: MIT Press.

Young, O. R. (2017b), 'Beyond Regulation: Innovative Strategies for Governing Large Complex Systems', *Sustainability*, 9 (6): 938.

Young, O. R. and O. S. Stokke (2020), 'Why is it Hard to Solve Environmental Problems? The Perils of Institutional Reductionism and Institutional Overload', *International Environmental Agreements*, 20: 5–19.

4

The EU as a Fisheries Actor: Internal and External Policies

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The European Union is often regarded as a global actor *sui generis*, and has been subject to much controversy on its role in international relations in recent decades (Niemann and Bretherton 2013: 262). Despite the persistent sensitivity of member-states in this field, the EU's supranational institutions have gained considerable influence and agenda-setting clout in foreign-policy issues, ranging from international food standards to climate negotiations and, more recently, international sanctions (Groen and Niemann 2013; van Schaik 2013; Riddervold and Rosén 2016).

Studies have shown the linkages between internal policy development and the EU as a foreign-policy actor in domains such as trade, climate negotiations and human rights (Groenleer and Van Schaik 2007; Groen and Niemann 2013; Pomorska and Vanhoonacker 2015). However, some policy areas remain poorly understood or under-researched, especially as regards domains where EU competences differ and diverging interests collide, change and develop over the course of time. One such area is *fisheries*. Although several studies have highlighted the negative consequences of EU fisheries in external waters, and the linkages to the concept of sustainability (Bretherton and Vogler 2008; Belschner 2015: 985; Peñas Lado 2016: 220), there has been limited research on how the making of EU fisheries policies directly affects EU external policies beyond the domain of fisheries as such.

This chapter examines one case of an *extended* EU foreign-policy issue that cannot be neatly classified as being either foreign policy or fisheries policy. Not only does the latter influence the former: the two are inherently intertwined in a re-constitutive relationship where actions in the fisheries domain limit the room for manoeuvre in the realm of foreign policy. Our case study is the Arctic, a region where the EU has expressed explicit foreign-policy interests, as well as being heavily engaged in various forms of fisheries. The main problem within this regional case concerns a multilateral dispute over mackerel, discussed in Chapter 7, and a bilateral dispute between two close economic and political partners, the EU and Norway, over licences to catch snow crab (*Chionoecetes opilio*) in the maritime zones around Svalbard, examined in Chapter 10. Decisions on these issues are not made within the 'traditional' realm of EU foreign policy (and thus mainly by the member-states), but within the realm of fisheries policy, where the European Commission (hereafter 'Commission') has exclusive competence derived from the EU member-states. Similarly, Chapter 13 shows that the EU has multiple interests and voices when formulating geographically focused policies – also *within* policy domains such as fisheries, where the member-states have ceded competence and authority to the supranational level.

We start from the premise that individuals and intra-institutional dynamics matter as regards studying policy and its related developments in Brussels (Smith 2013; Kuus 2014). 'Policy documents do not emerge from a pre-given political mandate; they actually emerge from lengthy processes of drafting, consultation, and negotiation. The task is to examine not only policy implementation but also its conception' (Kuus 2014: 39).

Fisheries is a complicated matter, as the external dimension – fishing in non-EU waters – is closely related to and dependent on other EU policies, such as trade, development and *foreign* policy (Peñas Lado 2016: 219). Fisheries is one of the EU's common policies that has always had a strong external dimension (Vaquer i Fanés 2003: 61). That foreign policy determines the choices available in external fisheries policies seems rather obvious; however, that fisheries policy may restrict foreign policy involves a different way of viewing EU policymaking and its unique features. We will show how a supranational portfolio may have unintended consequences for an intergovernmental portfolio, in essence pushing a foreign policy issue that member-states would otherwise not have wished to pursue. This is thus a study of *spillover* – as a concept within studies of EU policy and decision-making – in practice, and its consequences.

Further, we add to the knowledge of *how* policies in this interplay are made in the corridors of Brussels, building on the body of literature concerned with EU policy decision-making in fisheries and other sectors as well (Mulazzani and Malorgio 2014; Gegout 2016; Zimmermann 2017). We seek to add a small, yet crucial, piece to the understanding of the EU as a foreign-policy actor. As such, this is part of tackling the third research question as stated in the Introduction (Ch. 1) regarding *how* institutions adapt to stock-shifts. The EU is a special type of actor, being both an international institution in its own right *and* one of the most central actors in fisheries management across most of the cases in this book and in world at large. Thus, understanding the EU and the links between foreign policy and fisheries policy is a crucial component in unpacking both institutional adaptation and actors' preference shifts as climate change impacts existing cooperation on managing fish stocks.

When foreign policy meets fisheries

The EU as a foreign-policy actor

Although EUropean[1] integration already rested on various dimensions of external relations, the actual concept of an EU foreign policy came with the 1992 Maastricht Treaty (Treaty on European Union/TEU) and the introduction of the Common Foreign and Security Policy (CFSP) (Keukeleire and Delreux 2014: 2; Peterson and

Helwig 2018: 196). In order to achieve better consistency and coordination, the Treaty of Lisbon not only expanded the responsibilities of the High Representative of the Union for Foreign Affairs and Security Policy (hereafter 'HR') but also introduced the European External Action Service (EEAS) (Raspotnik 2018: 68). The EEAS is to assist the HR in putting the EU's foreign policy into effect, together with the member-states and their diplomatic services. The Council of the European Union (hereafter 'Council') and the HR are to ensure the unity, consistency and effectiveness of EU foreign-policy actions (TEU, Art. 26).

The Treaty of Lisbon and the related upgrade/creation of the HR/EEAS have been hailed as solutions to the lack of coherent EU actorness in the world, able to close the capability–expectations gap of EU foreign-policy performance (Helwig 2013: 238). However, whereas the Treaty of Lisbon made a great supranational leap forward, the HR and the EEAS must be seen as a 'classic' EUropean compromise between favouring further integration of foreign policy and rejecting a stronger supranational role in that field (Helwig 2013: 239). The HR and the EEAS are not supranational institutions like the Commission or the EP, nor are they intergovernmental in nature like the Council (Helwig, Ivan and Kostanyan 2013: 6).

The EU's foreign policy is essentially determined by questions of competence and legitimacy, as these elements clarify who is authorized to act externally (Neumann and Rudloff 2010: 9–10). However, neither is there a '*single* EU foreign policy in the sense of one that replaces national policies' nor does the 'EU' act as a coherent international actor with a single voice (Peterson and Helwig 2018: 198; italics in the original). On matters of 'low politics', such as trade, environment or economic issues, the EU often manages to defend its interests with a single voice. However, on matters of high politics, such as traditional diplomacy or national sovereignty, the EU fails to speak as one – a gap between economic unity and political division that has endured because the Community method is more decisive than the intergovernmental CFSP system (Peterson and Helwig 2018: 197–8).

Mainstream IR studies have struggled to capture the EU's nature as a foreign-policy actor due to their rigid focus on statehood – which the EU has not – and rationality, with the EU often lacking clearly defined, rational interests (Niemann and Bretherton 2013: 263). Whereas some scholars argue that foreign policy is driven mainly by the member-states, their interests and related bargaining (the intergovernmental approach), others stress the importance of expanding institutional mechanisms on the content, scope and impact of EU foreign policy (neo-institutionalism). However, there are also other conceptions that aim to move beyond these approaches.

Instead of merely serving the purposes for which they were created, institutions may be seen as actors with their own preferences, bargaining with other actors – in this case, mostly the EU member-states (Risse-Kappen 1996; Fierke and Wiener 1999). An institution like the Commission follows its own preferences and agenda, seeking to ensure its relevance and survival by expanding its competences and importance when creating policy (Vanhoonacker 2005: 69). That fact invalidates the rationalist idea that institutions act like secretariats: the Commission constitutes its own agendas and can be shown to have developed policies that favour itself, more than what a neutral secretariat would have done (Risse-Kappen 1996).

One approach that takes this latter point into account applies multi-level governance theory to explain the interaction between the supranational and the state levels (Smith 2003, 2004). Institutions are influential in the policy process and its implementation, but member-states hold primacy in the field of foreign policy. On the other hand, domestic organizations and the regional level arguably have a stronger influence on foreign policy than normally theorized by intergovernmentalism (Hooghe and Marks 2001). Leaders balance international dispute negotiations with their respective domestic constituencies (Putnam 1988: 460), especially in the case of the EU's external policies. Institutions play an active role in the policy-cycle, which in turn can be analysed at the various levels of governance without neglecting the member-states, the regional level or the institutions themselves. Policy should then be seen as an interplay between the EU institutions and the member-states, all with their own agendas, instead of as an outcome of intergovernmental negotiations or solely as policy initiatives by a lead authority (here: the EEAS).

This assumption entails two pivotal questions: 'Who is the EU?' and 'What is meant by "the EU" when it comes to EU-policymaking?' For the Arctic case, we accept two propositions simultaneously: that internally any 'EU-policy' is a patchwork of various institutional interests with sometimes diverging voices – specifically, the Commission and its Directorate-General for Maritime Affairs and Fisheries (DG MARE), the EEAS, the EP, as well as certain member-states; but that externally, the Arctic states have perceived the EU's policy output as coming from one singular, cohesive actor.

Here we aim to open the internal black box of an externally perceived unitary actor and counteract a persistent simplification of the institutions of geopolitics, specifically those of the EU (Kuus 2014: 36–7). Here we follow Kuus' assumption that the 'union is both an institution and a process of continuous dialogue and negotiation among the member states' (Kuus 2014: 44). Moreover, also the institution 'EU' is further composed of various institutions, which themselves consist of numerous departments and individuals.

The EU as a fisheries actor

From the early 1980s, the European Community has established itself as a 'significant actor within the politics of world fisheries' (Bretherton and Vogler 2008: 408). Today the EU's Common Fisheries Policy (CFP) sets out the rules for the conservation of fish stocks and the development of the structure and economics of fishing fleets (van Hoof and van Tatenhove 2009: 726). Aimed at managing a common resource sustainably, from environmental, economic and social perspectives, the CFP allows EUropean fishing fleets equal access to all EU waters and fishing grounds.

Further, to enable member-states to continue fisheries in areas beyond EUropean jurisdiction, the Community began negotiating on behalf of its member-states to join Regional Management Fisheries Organizations (RFMOs) or establish bilaterally negotiated fisheries agreements with third countries. Thus was born the external dimension of the EU's fisheries policy (Popescu 2015: 6). Although this external-dimension level has been a key feature of the CFP from the outset, its principles were enshrined in the basic regulations only through the 2013 reform, effective from 2014.

The Commission plays a central role in setting related policies due to the EU's exclusive competences for 'conservation of marine biological resources under the common fisheries policy' (Treaty on the Functioning of the European Union/TFEU, Art. 3), which also cover the allocation of fishing quotas.

From a foreign-policy perspective, the CFP clearly falls under the Community system of foreign policymaking, a point which highlights the external dimension of the internal-policies aspect. However, as policy implementation is left to the member-states, the result is a structure that has an intergovernmental element in addition to its supranational basis (van Hoof and van Tatenhove 2009: 728). Upon recommendation from the Commission, the Council's Agriculture and Fisheries configuration (AGRIFISH) adopts measures on the determination and allocation of quotas – total allowable catches (TAC) (TFEU, Art. 43.3).[2] Each member-state then has exclusive competence to allocate its national quotas within its industry (Peñas Lado 2016: 388).

Today, the EU is a global player in the development of international fisheries law and multilateral fisheries governance, and a key actor in international fisheries management. The EU's external fleet represents about a quarter of total EU fleet capacity, and provides over a quarter of the EU's total catches. A member in fourteen out of eighteen RFMOs globally, the EU has also concluded various bilateral agreements with third countries, of reciprocal or compensatory nature (Belschner 2015: 985; Peñas Lado 2016: 220).

The external dimension of EU fisheries is of fundamental importance to the CFP, for several reasons. It is a major source of economic activity and jobs; it contributes to the supply of EU markets; it turns the EU into a legitimate actor in the multilateral governance of fishing worldwide; and – important for the case at hand – it overlaps with other policies of the EU, like foreign policy, as (ideally) the EU never imposes its views on with third countries, but negotiates them (Peñas Lado 2016: 218).

However, the Union's global fisheries activities have at times contradicted the 'declared support for the norms of sustainable development' (Bretherton and Vogler 2008: 408). In particular, the CFP's external dimensions have been criticized for deviating from the basic principles of sustainability and precaution (Belschner 2015: 986). Several cases have drawn attention to the negative and potentially disastrous effects of EU external fisheries on local ecosystems as well as on the economies of third countries (Corten 2014; Miller, Bush and Mol 2014). According to Bretherton and Vogler, the external dimension of fisheries is inherently determined by the fundamental contradiction 'between the needs and demands of the EU-based fishing industry and its customers, and the sustainable development objectives of the Union' (2008: 414). This is an inconsistency that the CFP has not yet been able to solve, as major parts of (EUropean) fish stocks remain overfished, and the profit margins of EU fishermen keep declining (Khalilian et al. 2010: 1178).

At the heart of this issue lies the overcapacity to fish in EU member-states due to subsidies of fishing industries (Churchill 1999; Sumaila et al. 2010; Le Manach et al. 2019), as well as the complex nature of EU external fisheries policymaking in Brussels where a multitude of actors seek to promote their interests (Vaquer i Fanés 2003; Zimmermann 2017). Here *coherence* emerges as a key concept in explaining the deficiencies in the EU's fisheries policies. There is a lack of *vertical coherence* (between the EU level and member-state policies) and *horizontal coherence* (across policy domains of relevance for fisheries) (Bretherton and Vogler 2008; den Hertog and Stroβ 2013). We place emphasis on the latter: the *links* across policy domains where the EU is engaged. How, then, to amalgamate the idea of the EU as a foreign-policy actor, and the EU as a fisheries actor?

The artificial divide between fisheries and foreign policies

Cui bono? Hijacking the EU machinery

There are many ways in which an issue can find its way onto the EU agenda. In the snow-crab case, as outlined in Chapter 10, all the core EU institutions have been involved. However, our rounds of interviews with officials working in or with the EU on this issue indicated that the initial drivers for pursuing the matter were the interests of specific member-states. As one EU institution official put it: 'This issue [snow crab] is clearly driven by continuous pressure by member-states who have entitlements' (Interview 1).[3] In this case, the Commission and its DG MARE operate on behalf of member-state interests.

The EU has multiple interests and voices – also within a policy domain like fisheries, where the member-states have ceded competence and authority to the supranational level. However, their voices may be hijacked by special interests if there are few counter-positions and an issue seen as being of limited importance.

The various EU institutions can play a role in external fisheries issues – *if* these issues are of minor significance within the larger EU hierarchy of issues. With more pressing concerns arising daily in the Council or the European Council writ large, the limited external effects of allocation of licences and quotas lack sufficient impact to warrant attention from all member-states, except when special interests come to the fore. This point – ignored in many recent studies of the foreign-policy nexus in Brussels – is relevant for the cases at hand, but could also help to explain several other instances of foreign-policy outcomes that do not immediately seem advantageous to the EU, or its stated objectives.

Returning to the concept of 'multi-level governance', foreign policy can indeed be separated from fisheries policy – at least on paper. As shown in Chapter 10 in the case of the snow-crab dispute, the EEAS has attempted to avoid this issue and has not deemed it relevant for the EU's Arctic policy endeavours (Interview 2). This distinction, albeit understandable, is somewhat naïve. As underscored in statements of some MEPs interviewed for this chapter and in the general EP debate in Strasbourg in early 2018 (European Parliament 2018), many other actors had already connected the dots between these two policy domains. The EU's foreign policy and its fisheries policy are indeed intertwined.

However, *within* the EU system in Brussels, the various DGs and EEAS sought to keep the issues separate. This 'limited dispute' has been kept separate, as an issue pertaining to fisheries – by DG MARE and the EEAS, the EU member-states and Norway. From 2007/8 onwards, the EU has engaged in Arctic affairs; and Svalbard and/or larger questions of governance have occasionally arisen, especially in the EP (Raspotnik 2018: 93–119). It is predominantly the EP, or some of its MEPs, who would (still) like to see a larger debate on Arctic governance. As put by MEP Wałęsa: 'Discussions about Arctic governance are long overdue. The EU should talk about the Arctic's future' (Interview 3). Similarly, as MEP Pietikäinen put it: 'We need to work to preserve the Arctic. In the longer run I think we should work for a regime in the Arctic like what we have for the Antarctic' (Interview 4).

Thus, we can note a slight distinction between the fisheries issue regarding snow-crab quotas, and Arctic governance as per the latter statements, which is unequivocally foreign policy. Although some actors in Brussels obviously saw it advantageous to combine the two, the EU bureaucracy (DG Mare and EEAS) worked actively to keep the issues separated. What does this tell us about linking these two policy domains?

Policy – also within this realm – must be seen as an interplay between the EU institutions and the member-states, as well as the external environment in which the EU exists. The legal component of the dispute over snow-crab access links the issue to a larger and more sensitive matter of relevance to both the Arctic policy of the EU *and* its general stance as a foreign-policy actor. The disagreement with Norway over the geographical applicability of the Svalbard Treaty involves both foreign policy and fisheries policy.

It seems clear that the EU's heavy involvement in external fisheries created the functional need for an equivalent foreign policy, as EU engagement in the Arctic region is related to all these issues (Raspotnik 2018: 123–7; Østhagen and Raspotnik 2019). In turn, the EU's efforts have involved an unconventional Arctic policy mix of internal, cross-border and external policies. The distinction between foreign and fisheries policies becomes blurred here, because the use of foreign-policy tools is essential to develop successful policies for trade and the environment (Østhagen 2011).

This creates a technical spill over, as the expertise regarding these topics is developed and located in the supranational institutions. The argument that the Commission functions merely as a secretariat for member-state interests does not hold in the intersection between foreign and fisheries policy. The external policy dimensions of the CFP enable the Commission and – to some extent – the EP to exert considerable influence, with impact on the outcomes of decisions made in Brussels that have a clear foreign-policy dimension.

Explaining inconsistencies and paradoxes in EU foreign policy

In terms of theorizing the EU's multiple roles and policies, we can now attempt to draw some lines. Naturally, with so many different voices involved, there can be no single approach. In the end, EU foreign policy is only as good as the quality of consensus among its member-states; and both effectiveness and success are relative, as it still remains unclear how to measure these. Whereas 'the EU' is undoubtedly a global power in some policy areas – as in trade as well as fisheries – it lacks the same kind of self-assertion in other domains (Peterson and Helwig 2018: 220). From a fisheries perspective, the picture is similarly complex, as three entities – the Commission, Council and EP – must agree on policy prioritization and the definition of objectives (Mulazzani and Malorgio 2015: 9).

Thus, as Vaquer i Fanés (2003) has shown in his study of the EU's external fisheries negotiations with Morocco, a multi-level approach to fisheries is not only useful: it is essential for capturing the differing interests at a domestic, national (member-state) and supranational (EU) level. In turn, opening up the 'black box' of Brussels and combining it with a multi-level governance approach – as done here with the Arctic snow-crab case – shows exactly *how* fisheries and foreign policies are connected, and what this in turn entails for policy outcomes at the EU level.

These concepts can help to explain the apparent paradoxes that emerge in the EU's foreign policymaking – in the snow-crab case *and* in fisheries more generally. One issue that comes to fore in the foreign policy–fisheries policy nexus is that of *sustainable development*, an area where the EU has recently shown considerable ambitions to assert influence (Bretherton and Vogler 2008: 404). A core component of EU Arctic policy (Raspotnik 2018: 135–6), as well as the larger climate and growth initiative (Kovačič 2017; Langan and Price 2017), the Union's external fisheries policies have directly contradicted this goal at times (Daw and Gray 2005; Khalilian et al. 2010; Belschner 2015).

In the snow-crab case, the most cautious approach – from an environmental perspective – would arguably be to await the creation of a Barents Sea management plan based on deeper understanding of the effects of the westward expansion of this new species, as well as its harvesting. If the EU aims to promote sustainable development in both its Arctic policies and the CFP, why do its actions concerning Svalbard and the snow-crab issue point in a different direction? Similarly, the case of the 'Turbot War' in the 1990s exemplifies this, as Canada's efforts to protect its own fisheries were partly motivated by unsustainable overfishing by EU vessels of the stocks off the coast of Newfoundland (Missios and Plourde 1996).

On the one hand, EU member-states and their fishers are keen to exploit economic opportunities, no matter how minor in comparison with fisheries elsewhere or other economic activities in the North. On the other hand, the Commission/EEAS actively promote the principles of sustainable management and precaution when it comes to marine living resources in the north, *especially* those that are newcomers to the Arctic region due to the ecological changes underway. The two positions that 'the EU' holds in this case – one specific and one general – contradict each other and highlight the EU's multi-headed nature on such issues.

Fisheries represent a major external component in the form of quota agreements, RFMOs and general collaboration across maritime boundaries on managing shared fish stocks. However, the external dimensions of this policy domain tend to be kept separate from larger foreign-policy concerns and objectives. For 'regular' actors on the international stage (states), that might be logical, as foreign policy is often streamlined by a coordinating ministry (normally the Ministry of Foreign Affairs) in order to balance various interests and goals.

However, the EU is a different 'beast' altogether (Risse-Kappen 1996). As put by Kuus (2014: 38–9), politics in the instance of the EU is more concerned with practices at different locations (physical as well as competence-related) than necessarily a set of universal principles and traditional anchored power politics. The EU's Northern approach has in many ways been that of a 'geopolitical' actor – pursuing certain policy-interests in a geographically defined space of growing relevance (Raspotnik and Østhagen 2019). However, the EU's *sui generis* policymaking system has also produced an intra-institutional Arctic policy perhaps created more for internal than external purposes.

Because of the particular EU set-up where some policy domains are under supranational control – like fisheries – whereas others – like foreign policy – are intergovernmental, complex and rather curious policy-outcomes result. EU practices vis-à-vis the Arctic region have been a contradictory mix of intra-institutional interests and agendas (ranging from climate concerns to regional development and foreign-policy objectives), as well as reacting to external events in the Arctic. Unlike traditional state-structures, the EU's multi-voice-, multi-actor-approach towards a geographic region where both supranational and intergovernmental competencies are involved has led to the fragmented Arctic approach described above. This becomes particularly obvious when we try to open the black box of institutional expertise and regional awareness/knowledge (Kuus 2014: 40). However, in some ways that is precisely the *nature* of the beast.

Here we see how member-states became trapped in a foreign-policy conundrum not of their own making. A policy initiative originating in the field of fisheries and aimed at safeguarding the economic interests of a few EU fishers ended up hijacking the EU external policy system, and could – if not kept compartmentalized and separated – have severe consequences for the EU's larger foreign-policy ambitions in the Arctic.

Concluding remarks

The analyses of the snow-crab dispute between the EU and Norway (Ch. 10) and the EU's engagement in Antarctic (Ch. 13) illustrate how a relatively minor issue in fisheries policies can also be relevant to the study of the foreign policy of the EU. Limited (economic) interests may succeed in hijacking broader political and strategic interests. We have seen how individual voices are able to drive an agenda, also within a domain that concerns EU foreign policy. This shows how narrowly defined issues with clear and comprehensible interests often gain priority over longer-term strategies and considerations. As regards the EU as a foreign policy and fisheries actor, several lessons stand out here.

First, and as noted by Keukeleire and Delreux (2014: 1), EU foreign policy is indeed *multifaceted* (including the external dimensions of internal policies such as fisheries), *multi-method* (combining various policymaking methods) and *multi-level* (involving both the national and the EUropean levels).

Second, with the EU's Arctic and Antarctic efforts still salient in the EU's global strategy and internal considerations, it is relevant to see whether niche policy domains/regions are more easily hijacked by actors *not* directly involved – as the EP did with regard to the external dimension of the CFP, a domain under the competence of the

Commission and to some extent the Council. The case examined here proves this hijacking possibility – but the question remains: is it a one-off instance?

Finally, this issue has highlighted how the artificial distinctions between foreign policy and other domains – in this case, fisheries – often employed in scholarly conceptions of EU policy studies are inherently flawed. We have seen how the interaction with third parties (here: Norway) can alter the policy dynamics involved, so simply equating internal with external EU policies is inadequate.

This chapter has made clear the multifaceted process in which EU policies with an external dimension – whether identified as 'foreign policy' or not – come about. Describing EU foreign policy as something separate from other EU policy domains fails to hold up under scrutiny: fisheries and foreign policy are not two distinct policy areas. On the other hand, the fact that one domain is defined as a Community competence, whereas the other is mainly intergovernmental, does not automatically lead to a spillover effect whereby the Commission and the EP gradually expand their influence vis-à-vis the member-states. Instead, as this case has shown, the various EU institutions have their independent interests, which have developed in the institutional and political context in which they are placed. The effect of each institution and the extent to which certain actors will be able to utilize it to their advantage depends on the multi-level governance *structure* of the specific issue in question. This point is central not only for understanding the EU writ large – it is especially crucial in explaining EU positions and actions in fisheries management institutions, as these come under strain.

Interviews

1. Commission officials. Brussels, 15 February 2018.
2. EEAS Official. Brussels, 19 February 2018.
3. Jarosław Leszek Wałęsa, MEP. Brussels, 20 February 2018.
4. Sirpa Pietikäinen, MEP. Brussels, 20 February 2018.

Notes

1 We use the spelling 'EUropean' to highlight the idea that Europe cannot be reduced to the EU only. This means that every time we use the adjective 'EUropean' we either refer to something of, from, or related to the European Union (= EU). Any reference without a capital U either directly relates to the entire continent 'Europe' or to specific names, e.g. European Commission.

2 Although the Treaty of Lisbon introduced co-decision (between the Council and the EP) as the 'ordinary legislative procedure' for the CFP, the adoption of catch limits remains an exclusive competence of the Council, under TFEU Art. 43 (3), with the EP entirely excluded from these decisions, see Peñas Lado 2016: 440.

3 In total twelve semi-structured interviews were conducted in February 2018 in Brussels (and four used as references in this chapter). As all interviewees had the

option of remaining anonymous, full names and details of their positions remain with the authors, with the exception of two MEPs who agreed to be mentioned by name. Interviews lasted between 45 and 80 minutes, with a set of open questions as the basis of the conversation.

References

Belschner, T. (2015), 'Not so Green after All? The EU's Role in International Fisheries Management: The Cases of NAFO and ICCAT', *Journal of European Public Policy*, 22 (7): 985–1003.

Bretherton, C. and J. Vogler (2008), 'The European Union as a Sustainable Development Actor: The Case of External Fisheries Policy', *Journal of European Integration*, 30 (3): 401–17.

Churchill, R. (1999), 'The EU as an International Fisheries Actor – Shark or Minnow?' *European Foreign Affairs Review*, 4 (4): 463–83.

Corten, A. (2014), 'EU–Mauritania Fisheries Partnership in Need of More Transparency', *Marine Policy*, 49: 1–11.

Daw, T. and T. Gray (2005), 'Fisheries Science and Sustainability in International Policy: A Study of Failure in the European Union's Common Fisheries Policy', *Marine Policy*, 29 (3): 189–97.

European Parliament (2018), 'Debates, Thursday, 18 January 2018, EU–Norway Dispute on Snow Crab Fisheries in Svalbard'.

Fierke, K. M. and A. Wiener (1999), 'Constructing Institutional Interests: EU and NATO Enlargement', *Journal of European Public Policy*, 6 (5): 721–42.

Gegout, C. (2016), 'Unethical Power Europe? Something Fishy about EU Trade and Development Policies', *Third World Quarterly*, 37 (12): 2192–210.

Groen, L. and A. Niemann (2013), 'The European Union at the Copenhagen Climate Negotiations: A Case of Contested EU Actorness and Effectiveness', *International Relations*, 27 (3): 308–24.

Groenleer, M. L. P. and L. G. van Schaik (2007). 'United We Stand? The European Union's International Actorness in the Cases of the International Criminal Court and the Kyoto Protocol', *Journal of Common Market Studies*, 45 (5): 969–98.

Helwig, N. (2013), 'EU Foreign Policy and the High Representative's Capability–Expectations Gap: A Question of Political Will', *European Foreign Affairs Review*, 18 (2): 235–54.

Helwig, N., P. Ivan and H. Kostanyan (2013), *The New EU Foreign Policy Architecture: Reviewing the First Two Years of the EEAS*. Brussels: Centre for European Policy Studies (CEPS).

Hertog, L. den and S. Stroβ (2013), 'Coherence in EU External Relations: Concepts and Legal Rooting of an Ambiguous Term', *European Foreign Affairs Review*, 18 (3): 373–88.

Hoof, L. van and J. van Tatenhove (2009), 'EU Marine Policy on the Move: The Tension between Fisheries and Maritime Policy', *Marine Policy*, 33 (4): 726–32.

Hooghe, L. and G. Marks (2001) *Multilevel Governance and European Integration*, Oxford: Rowman & Littlefield.

Keukeleire, S. and T. Delreux (2014), *The Foreign Policy of the European Union*, 2nd edn, Basingstoke: Palgrave Macmillan.

Khalilian, S., R. Froese, A. Proelss and T. Requate (2010), 'Designed for Failure: A Critique of the Common Fisheries Policy of the European Union', *Marine Policy*, 34 (6): 1178–82.

Kovačič, A. (2017), 'European Union and Sustainable Development Indicators', *Management of Sustainable Development*, 9 (2): 19–29.

Kuus, M. (2014), *Geopolitics and Expertise: Knowledge and Authority in European Diplomacy*, Chichester: Wiley-Blackwell.

Langan, M. and S. Price (2017), 'The EU and "pro-Poor" Contributions to Sustainable Development in the Post-2015 Consensus', *Third World Thematics: A TWQ Journal*, 1 (4): 431–36.

le Manach, F., L. Bisiaux, S. Villasante and C. Nouvian (2019), 'Public Subsidies Have Supported the Development of Electric Trawling in Europe', *Marine Policy*, 104: 225–31.

Miller, A. M. M., S. R. Bush and A. P. J. Mol (2014), 'Power Europe: EU and the Illegal, Unreported and Unregulated Tuna Fisheries Regulation in the West and Central Pacific Ocean', *Marine Policy*, 45: 138–45.

Missios, P. C. and C. Plourde (1996), 'The Canada–European Union Turbot War: A Brief Game Theoretic Analysis', *Canadian Public Policy*, 22 (2): 144–50.

Mulazzani, L. and G. Malorgio (2014), 'The External and Commercial Dimensions of the EU Fisheries Policy: An Institutional Approach Applied to the Whitefish Case', *Marine Policy*, 46: 123–31.

Mulazzani, L. and G. Malorgio (2015), 'Is There Coherence in the European Union's Strategy to Guarantee the Supply of Fish Products from Abroad?', *Marine Policy*, 52: 1–10.

Neumann, A. and B. Rudloff (2010), 'Impact of EU Policies on the High North: The Cases of Climate Policy and Fisheries', EXPO/B/AFET/FWC/2009-01/Lot 2/01. Brussels: Directorate General for External Policies, European Parliament. https://www.europarl.europa.eu/thinktank/en/document/EXPO-AFET_DV(2010)433790.

Niemann, A. and C. Bretherton (2013), 'EU External Policy at the Crossroads: The Challenge of Actorness and Effectiveness', *International Relations*, 27 (3): 261–75.

Peñas Lado, E. (2016), *The Common Fisheries Policy: The Quest for Sustainability*, Chichester: Wiley-Blackwell.

Peterson, J. and N. Helwig (2018), 'The EU as a Global Actor', in D. Kenealy, J. Peterson and R. Corbett (eds), *The European Union: How Does It Work?*, 5th edn, 194–215, Oxford: Oxford University Press.

Pomorska, K. and S. Vanhoonacker (2015), 'Europe as a Global Actor: The (Un)Holy Trinity of Economy, Diplomacy and Security', *Journal of Common Market Studies*, 53 (Supplement S1): 216–29.

Popescu, I. (2015), 'Beyond the European Seas: The External Dimension of the Common Fisheries Policy'. In-Depth Analysis. European Parliament Research Service (EPRS). https://www.europarl.europa.eu/thinktank/en/document/EPRS_IDA(2015)571323.

Putnam, R. D. (1988), 'Diplomacy and Domestic Politics: The Logic of Two-Level Games', *International Organization*, 42 (3): 427–60.

Raspotnik, A. (2018). *The European Union and the Geopolitics of the Arctic*, Cheltenham: Edward Elgar.

Raspotnik, A and A. Østhagen (2019), 'What about the Arctic? The European Union's Geopolitical Quest for Northern Space', *Geopolitics*, 26: 1–25.

Riddervold, M. and G. Rosén (2016), 'Trick and Treat: How the Commission and the European Parliament Exert Influence in EU Foreign and Security Policies', *Journal of European Integration*, 38 (6): 687–702.

Risse-Kappen, T. (1996), 'Exploring the Nature of the Beast: International Relations Theory and Comparative Policy Analysis Meet the European Union', *Journal of Common Market Studies*, 34 (1): 53–80.

Smith, M. E. (2003). *Europe's Foreign and Security Policy: The Institutionalization of Cooperation*, Cambridge: Cambridge University Press.

Smith, M. E. (2004), 'Toward a Theory of EU Foreign Policy-Making: Multi-Level Governance, Domestic Politics, and National Adaptation to Europe's Common Foreign and Security Policy', *Journal of European Public Policy*, 11 (4): 740–58.

Smith, M. E. (2013), 'The European External Action Service and the Security-Development Nexus: Organizing for Effectiveness or Incoherence?', *Journal of European Public Policy*, 20 (9): 1299–315.

Sumaila, U. R., A. S. Khan, A. J. Dyck, R. Watson, G. Munro, P. Tydemers and D. Pauly (2010), 'A Bottom–up Re-Estimation of Global Fisheries Subsidies', *Journal of Bioeconomics*, 12 (3): 201–25.

Vanhoonacker, S. (2005), 'The Institutional Framework', in C. Hill and M. E. Smith (eds), *International Relations and the European Union*, 67–90, Oxford: Oxford University Press.

van Schaik, L. (2013), 'The EU's Growing Pains in Negotiating International Food Standards', *International Relations*, 27 (3): 292–307.

Vaquer I Fanés, J. (2003), 'The Domestic Dimension of EU External Policies: The Case of EU–Morocco 2000–01 Fisheries Negotiations', *Mediterranean Politics*, 8 (1): 59–82.

Zimmermann, H. (2017), 'Balancing Sustainability and Commerce in International Negotiation: The EU and Its Fisheries Partnership Agreements', *Journal of European Public Policy*, 24 (1): 135–55.

Østhagen, A. (2011), 'Utenrikspolitisk entreprenørskap: EU og utviklingen av en Arktis-politikk', *Internasjonal Politikk*, 69 (1): 7–35.

Østhagen, A. and A. Raspotnik (2019), 'Why Is the European Union Challenging Norway over Snow Crab? Svalbard, Special Interests, and Arctic Governance', *Ocean Development & International Law*, 50 (2–3): 190–208.

5

Marine Stewardship Council Certification of Northeast Atlantic Mackerel: Processes and Outcomes

Geir Hønneland

Introduction

Certification by private sustainability schemes has become a prerequisite for export-oriented fisheries around the world. The golden standard of seafood certification is accreditation by the Global Sustainable Seafood Initiative (GSSI)[1] – and the first global scheme to achieve such accreditation was the Fisheries Standard of the Marine Stewardship Council (MSC).[2] Since its establishment in 1997, the MSC has worked not only to develop increasingly rigorous standards for certification but also to get wholesale supply chains and retailers to commit to purchasing MSC-certified seafood only. As a consequence, seafood exporters face not only lower prices for non-MSC-certified products: they are effectively barred from the most lucrative markets if their fish is not MSC-certified.

Becoming and remaining certified requires continuous behavioural adaptation from fisheries through a fine-meshed system of conditions attached to certification. The MSC Certification Requirements – which consist of the MSC Fisheries Standard and the MSC Fisheries Certification Process (FCP) – apply only to a limited extent to fishing companies as such. They primarily involve an assessment of the management systems, with requirements as to their outcome (e.g. the status of target and bycatch stocks and other ecosystem components, such as bottom habitats), management measures (like harvest-control rules and biological reference points) and availability of information (as in the form of stock assessments). Hence, the involvement of management authorities at national and international levels is necessary: it is the interaction between fishing companies and management authorities that is meant to drive the sustainability of fisheries forward. If a fishery is certified 'with conditions', its representatives must work with management authorities (or scientists or other stakeholders) to meet these conditions within set timelines in order to remain certified. In many instances, this implies that national laws, regulations and policies must be changed.

There is a burgeoning social science literature on private fisheries certification schemes in general, and the MSC in particular. Many contributions focus on the perceptions and effects of the MSC beyond fisheries management as such, addressing, inter alia, consumer willingness to pay for certified products (see, e.g. Lim et al. 2018), the legitimacy of the MSC Standard among stakeholders (see, e.g. Gulbrandsen and Auld 2016) and the environmental, economic and social effects of MSC certification (see, e.g. Arton et al. 2020).[3] This chapter takes an 'inside' perspective on MSC certification, analysing the MSC Certification Requirements as a 'semi-legislative'/'regulatory' system and evaluating the effects of certification. The research question is to what extent MSC certification has affected fisheries management (regulations) and fishing practices (fisher behaviour). The empirical focus is on the Northeast Atlantic mackerel (*Scomber scombrus*) fisheries, which are extensively discussed from a public management and international perspective elsewhere in this volume (Chs. 7 and 14). The present chapter discusses to what extent private certification has had an impact on fisheries management and fishing practices beyond the effects of national regulations and international agreements. It thereby contributes to answering the overarching research question three in this book, concerning adaptation of management institutions in response to challenges deriving from changes in the spatial distribution of fish stocks (see Ch. 1). Results from a comparable investigation of the Barents Sea cod and haddock fisheries, as well the local fishery for Arctic lumpfish in Greenland, Iceland and Norway, are also provided.

The empirical investigation is based on MSC assessment reports (see Table 5.1). However, information on the condition of the fisheries, stakeholder comments, objections and work undertaken to meet conditions following certification is not generally available in aggregate form. To compile the necessary information, I have examined all assessment and reassessment reports, as well as annual surveillance audit reports (between five hundred and a thousand pages per five-year certification period for each fishery), for the ten fisheries covered in this study.[4] An analytical reservation with regard to causation: it may be possible to point empirically to a chronological link between MSC certification, revised regulations and fisher behaviour; sometimes the sources (MSC assessment reports) claim that there is also a causal link. However, it is beyond the scope of this chapter to test alternative explanations to the behaviour observed.

MSC certification requirements

The main actors in an MSC assessment are the Conformity Assessment Body (CAB), the MSC itself, the accreditation body Assurance Services International (ASI) and the fishery client seeking certification. The MSC is the scheme owner – it produces the standards and issues certificates, but is not directly involved in the assessments, except for providing technical reviews of the assessment reports. The MSC is a non-governmental, non-profit organization headquartered in London. Its assessments are performed by certification bodies, CABs, which compete for assignments among fishery clients on a commercial basis. CABs must be accredited by ASI in order to perform MSC assessments; they are under constant scrutiny by the accreditation body through document review and physical inspection. The 'fishery client' is any entity applying for certification for one or more fishing vessels – it may be a company, a regional or national association, or a group of companies or associations from several countries.

The MSC has three main types of programme documents, sometimes referred to collectively as the Certification Requirements: standards (containing substantive requirements for certification); process requirements (to assessments according to the standards); and guidance documents (on how the standards and process requirements are to be interpreted). These documents are revised in five-year cycles. In the following, the MSC Standard v2.01[5] and the FCP v2.1[6] are described.

Procedural requirements: the MSC Fisheries Certification Process

The first step in a full assessment is to confirm that the fishery is within scope for MSC certification (FCP 7.4). A fishery is within scope if the target species are not amphibians, reptiles, birds or mammals (FCP 7.4.2.1), and if poisons or explosives are not used (FCP 7.4.2.2). Further, the fishery must not be conducted under a controversial unilateral exemption to an international agreement (FCP 7.4.3), be heavily disputed[7] or fail to contain a mechanism for solving disputes (FCP 7.4.5). Nor may it include entities that have been successfully prosecuted for forced or child labour (FCP 7.4.4).

The next step is to define the Unit of Assessment (UoA). The UoA shall include the target stock(s); the fishing method or gear type(s), vessel type(s) and/or practices; and the group of vessels whose fishing operations are to be covered by the assessment (FCP 7.5.2). At a later stage in the process, the client – the company or group of companies seeking certification – must decide on the Unit of Certification (UoC) (FCP 7.5.3): whether the whole UoA or just a part of it is to be covered by the specific certificate. Other vessels in the UoA whose fishing activities have been covered by the assessment are termed 'other eligible fishers' and may join the certificate through a sharing agreement with the client (FCP 7.5.7). This is normally not done free of charge, as the certification process entails considerable costs for the client.

The public announcement of an assessment involves posting on the MSC website the Announcement Comment Draft Report (ACDR) (FCP 7.15.1). The ACDR is an almost-full version of the assessment report, but with indicative scoring *ranges* rather than specific scores (see below). Every assessment process involves a site visit, where the assessment team conducts interviews with stakeholders in the fishery, like scientists, managers, representatives of enforcement bodies, industry groups and non-governmental organizations (NGOs). The fishery is scored according to a fine-meshed system of Scoring Issues (SIs) – known as the Assessment Tree (see the next section) – attached to various performance indicators (PIs), within the three MSC Principles: Principle 1 (P1) on the status of the target stock(s), Principle 2 (P2) on the ecosystem impact of the fishery and Principle 3 (P3) on the management system. Specific requirements are assigned to each SI, the Scoring Guideposts (SGs) for scores at 60, 80 and 100. For a fishery to pass the assessment, no SI may score less than 60, and the average weighted score of each of the three Principles must be at 80 or above.

Hence, a fishery may score 60 on one PI, but then it must achieve a 100 score on another PI in order to reach an average of 80 on that Principle. Most PIs consist of a several SIs, and scores are given at increments of five points (FCP 7.17.5).

If a score between 60 and 80 is given for an individual SI, one or more 'auditable and verifiable conditions [for certification]' must be set by the assessment team (FCP 7.18.1). The team shall draft conditions that, when implemented, are to result in improved performance to at least the 80-level within the five-year period during which the certificate is valid (FPC 7.18.1.3). These conditions are to include milestones that the client must meet at each annual surveillance audit (see below) during the five-year certification period. The milestones shall, inter alia, identify 'measurable improvements and outcomes (using quantitative metrics) expected each year' (FCP 7.18.1.4(a)). Once the CAB has determined the conditions and milestones to be attached to the fishery and has taken into account all available information as per the last day of the site visit, the assessment team completes the Client and Peer Review Draft Report (CPRDR) (FCP 7.19). The CPRDR is sent to the client for comments and production of a Client Action Plan (CAP), detailing how the client intends to work towards meeting the annual milestones in the conditions set by the assessment team in order to bring the score up to 80 within the five-year certification period. The CPRDR also goes to the MSC Peer Review College, where two suitable peer reviewers are drawn from a pool of qualified experts. When the assessment team has responded to the comments from the client and the peer reviewers, the Public Comment Draft Report (PCDR) is posted on the MSC website for public comments during a thirty-day period (FCP 7.20). The PCDR also goes back to the peer reviewers for a second round of comments (FCP 7.20.9) and to the MSC for 'Technical Oversight' (FCP 7.20.10). The latter involves a 'legality check' in which the scoring of each SI is controlled, taking into account the wording of the guideposts, the relevant guidance and interpretations as well as the assessment team's justification and documentation of its scores. When the team has responded to the comments from stakeholders, peer reviewers (second round) and the MSC, the Final Draft Report is produced and published on the MSC website (FCP 7.22), followed by an objection period of fifteen working days (FCP 7.23). The Independent Adjudicator, who is a civilian judge, attorney or professor of law appointed by the MSC, decides whether the assessment team has committed any procedural error(s) 'material to the determination or the fairness of the assessment' (PD 2.1.1.1). The decision of this Independent Adjudicator is final (PD 2.7–2.8).

The MSC certificate is valid for five years. The state of the fishery, as well as progress towards the set milestones for any conditions attached to the certificate, is monitored by the assessment team at annual surveillance audits (FCP 7.28). If a fishery client is behind target at a surveillance audit, remedial action is defined. If the fishery is not back on track for the next surveillance audit, it is suspended from MSC certification. A corrective action plan must be produced within ninety days of suspension, and if the terms of the plan are not complied with in the set timeframe, the certificate is withdrawn (FCP 7.28.16.2.b). If fishery clients intend to remain certified beyond the first five-year period, reassessment must be commenced no later than ninety days after the fourth anniversary of the certificate (FCP 7.30).

The substantive requirements: the MSC Fisheries Standard

The MSC Fisheries Standard is organized in the 'Assessment Tree', which spells out the specific requirements (guideposts) against which a fishery is assessed: 89 SIs spread over 28 PIs within the three MSC Principles, with components as a mid-level category between principles and PIs. The principles are thematically defined, but the PIs can also be grouped into outcome, management and information indicators. For outcome indicators, it is required that the fish stocks and other components of the ecosystem (like habitats) are at acceptable levels; for management indicators, that adequate management measures are in place; and for information indicators, that there exists sufficient information to enable appropriate management decisions.

Principle 1 (P1) is defined as follows:

> **Principle 1: Sustainable target fish stocks**
> A fishery must be conducted in a manner that does not lead to overfishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.
>
> (MSC Fisheries Standard, p. 5)

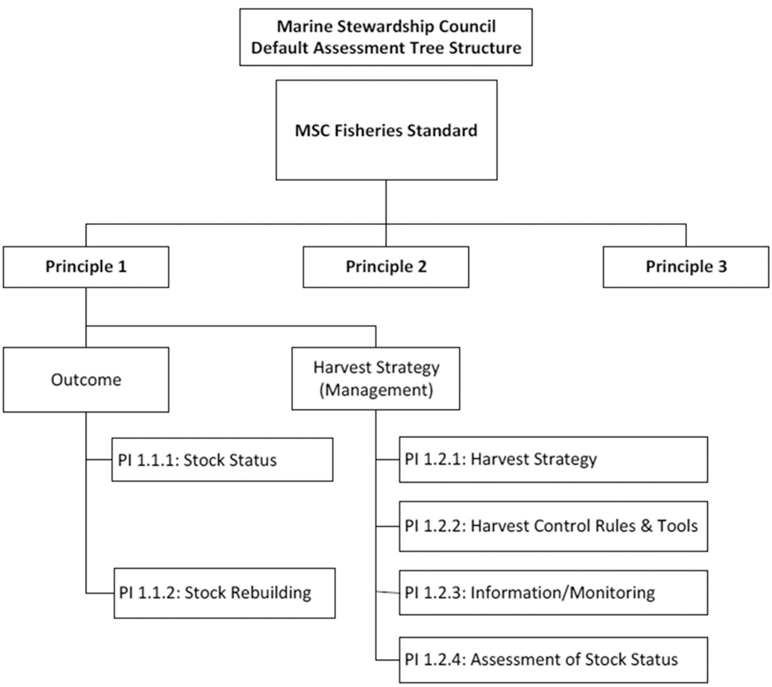


Figure 5.1 Principle 1 default Assessment Tree (MSC Fisheries Standard, p. 11).

As shown in Figure 5.1, P1 consists of one outcome and one management component; several PIs also include elements of information indicators. Component 1 has only two PIs: one on the status of the stock (PI 1.1.1) and one on stock rebuilding (PI 1.1.2). In order to pass PI 1.1.1 (achieve a score of 60), it must be 'likely' (defined as at least 70 per cent probability) that the target stock is above the point where recruitment would be impaired (PRI). To pass without conditions, i.e. to score 80 or above, it must be *highly* likely (with 80 per cent probability) that the stock is above PRI, and the stock must be fluctuating around a level consistent with maximum sustainable yield (MSY). To achieve a score of 100, there must be a high degree of certainty (at least 95 per cent probability) that the stock is above PRI and that it has been fluctuating around or been above MSY over several years. PI 1.1.2 on stock rebuilding is scored only if SG 80 is not met for PI 1.1.1, and sets specific requirements for a rebuilding strategy. Component 2 of P1 comprises PIs related to the existence of a harvest strategy (PI 1.2.1), a harvest-control rule (PI 1.2.2), information to support the harvest strategy (PI 1.2.3) and scientific stock assessments (PI 1.2.4).[8]

Principle 2 (P2) is defined as follows:

> **Principle 2: Environmental impact of fishing**
> Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated, dependent and ecologically related species) on which the fishery depends.
>
> (MSC Fisheries Standard, p. 5)

The P2 Assessment Tree (see Figure 5.2) has five thematically defined components: on primary species; secondary species; endangered, threatened and protected (ETP) species; habitats; and the wider ecosystem. Primary and secondary species both concern bycatch – the former of species that are managed by biological reference points, the latter of species that are not. Each component is split into PIs

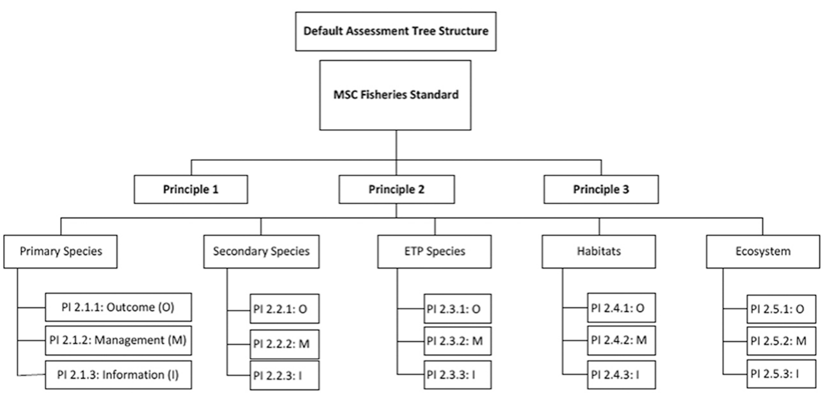


Figure 5.2 Principle 2 default Assessment Tree (MSC Fisheries Standard, p. 27).

on outcome, management and information. P2 is the most complex of the three MSC Fisheries Standard Principles: not only does it contain a higher number of SIs than P1 and P3 taken together (49, as opposed to 21 and 19, respectively), it also has a more comprehensive set of guidance for interpretation and scoring. Since 2015, assessment teams must not only assess the environmental impacts of the client fishery (the UoA) but also the accumulative impact of all MSC fisheries in the same region.

Principle 3 (P3) is defined as follows:

> **Principle 3: Effective management**
> The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.
>
> (Fisheries Standard, p. 5)

P3 is split into two components (see Figure 5.3): one on the wider management framework of the fishery (at both national and international levels) and one on the fishery-specific management system, i.e. the system directly involved in the management of the UoA fishery. Whereas P1 and P2 focus mainly on the status of ecosystem components and the appropriateness of specific management measures (whether they have, or are likely to have, the intended effects), P3 concerns *structure* and *process*, e.g. whether appropriate legislation (PI 3.1.1), dispute-resolution mechanisms (PI 3.1.1), opportunities for industry and other stakeholders to get involved in the management process (PI 3.1.2) and appropriate objectives for the fishery (PIs 3.1.3 and 3.2.1) are in place.

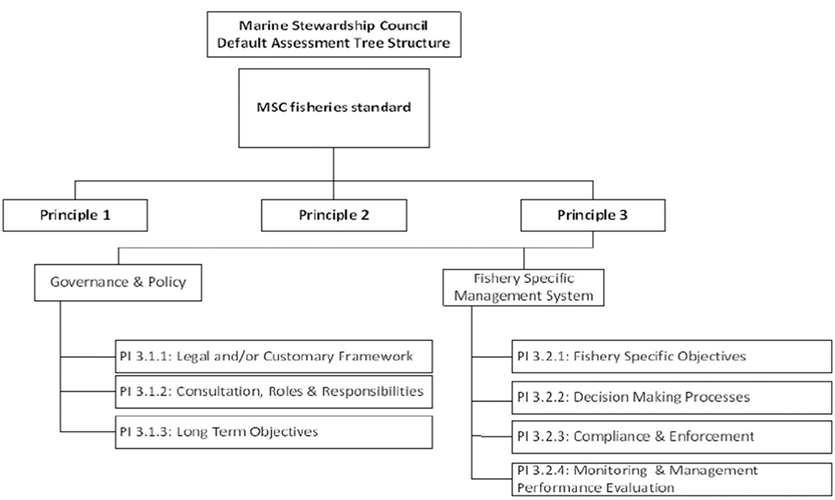


Figure 5.3 Principle 3 default Assessment Tree (MSC Fisheries Standard, p. 62).

MSC certification of the Northeast Atlantic mackerel: processes

We now move to an analysis of how the MSC Certification Requirements have been applied in practice. What potentially dictates behavioural adaptation are the conditions attached to MSC certificates: the specific requirements for improvements that must be achieved during the five years the certificates are valid. The *contents* of the conditions are presented in the next section; this section focuses on the *processes* that led to them. Conditions follow from the expert opinion of the assessment teams appointed by the CABs (one expert per Principle), but are influenced by inputs from peer reviewers, stakeholders and objectors to certification and, in the final instance, the MSC's Independent Adjudicator.

All information in the running text below refers to Table 5.1 in this chapter. That information, in turn, is taken from the assessment reports for each fishery listed in

Table 5.1 Assessment and reassessment results of mackerel fisheries in the Northeast Atlantic certified as per 2019, compiled by the author based on assessment reports available on the MSC website

Fishery/client*	Announced/ certified	Conditions	Stakeholder submissions**	Objections
		INITIAL ASSESSEMENT		
Scottish Pelagic Sustainability Group	31.5.2007/ 21.1.2009	Four conditions (different numbering than today), main focus on strategies to reduce slippage mortality and overfishing, and implement new harvest-control rule	None	None
Norwegian Fishermen's Sales Organization for Pelagic Fish	31.1.2008/ 30.4.2009	Four conditions (different numbering than today), main focus on recording of slippage and bycatches, and implementation of new harvest-control rule	None	None
Pelagic Freezer Trawler Association (Netherlands)	7.2.2008/ 8.7.2009	PIs 1.2.2, 2.3.2, 2.3.3	None	None
Irish Pelagic Sustainability Group	6.8.2008/ 24.8.2009	PIs 1.2.2, 1.2.3, 2.2.3, 2.3.1, 2.3.2, 2.3.3., 3.1.4, 3.2.5,	None	None
Irish Pelagic Sustainability Association	30.10.2008/ 14.7.2010	PIs 1.2.1, 1.2.2, 1.2.3, 2.3.1, 2.3.2, 2.3.3, 3.2.2	Mevagissey Fisherman's Association (non-material)	None.

Danish Pelagic Producers Organisation	6.11.2008/ 16.7.2009	PIs 1.2.2, 3.1.3, 3.2.1, 3.2.2 (all about management plan/ HCR)	None	None
Faroese Pelagic Organisation	21.5.2009/ 12.4.2011	PIs 1.2.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2***	None****	Marine Scotland/ Scottish Government (objection accepted by the Independent Adjudicator)
Swedish Pelagic Federation Producer Organisation	6.4.2010/ 3.9.2011	PIs 1.2.1, 3.1.1, 3.2.2	None	None
Northern Ireland Pelagic Sustainability Group	4.11.2014/ 7.11.2016	PIs 1.2.2, 3.1.1	None	None
Icelandic Sustainable Fisheries	22.12.2016/ 10.10.2017	PIs 1.2.2, 2.4.1, 2.4.2, 3.1.3	None	None
		REASSESSMENT		
Mackerel Industry Northern Sustainability Group*****	10.7.2014/ 10.5.2016	PIs 1.2.2, 3.1.1	None	None
Faroese Pelagic Organisation******	31.3.2015/ 15.6.2016	PIs 1.2.2, 3.1.1	None	None

* The official names of the fisheries in the MSC system and the clients have been shortened here to save space; ** Only submissions following publication of the PCDR are included in the table; many fisheries also received stakeholder submissions at earlier stages of the assessment. Technical oversight comments from MSC are not included although formally they fall under stakeholder comments; *** There was an objection to the fishery which the Independent Adjudicator accepted. The conclusion was that the fishery failed. The assessment report is published even if a fishery fails – conditions for other PIs remain, but no condition is set for the PI that fails; **** In their objection to this fishery, Marine Scotland noted that they had not been contacted as a potential stakeholder during the assessment, and that they would have submitted comments if they had been; ***** Coalition of Danish Pelagic Producers Organisation, Irish Pelagic Sustainability Association, Irish Pelagic Sustainability Group, Norwegian Fishermen's Association, Pelagic Trawler Freezer Association (Netherlands), Scottish Pelagic Sustainability Group and Swedish Pelagic Federation Producer Organisation, i.e. seven of the ten previously certified clients; ****** Strictly speaking, this was the initial certification of the Faroese fisheries: it had failed its first attempt, following the Marine Scotland objection accepted by the Independent Adjudicator. But it underwent a full assessment at that point also.

Appendix 1. It follows from the context which report is the source of each piece of information;[9] page references are provided only for direct citations, using the coding provided in the footnote to the Appendix (e.g. 1-FA = 1st full assessment report; 4-SA = 4th surveillance audit report).

As follows from Table 5.1, several Northeast Atlantic mackerel fisheries entered MSC assessment in 2007/8. The clients were pelagic fisheries associations from Denmark, the Faroe Islands, Ireland, the Netherlands, Norway and Scotland. Associations from

Iceland, Northern Ireland and Sweden followed a few years later. Average (and median) assessment duration was seventeen months. Quite a few conditions were attached to these fisheries, related mainly to the challenge of slippage in pelagic fisheries (discard of fish before it enters the vessel) and the implementation of a new harvest-control rule set for the mackerel fishery at that time. Notably, none of these fisheries received any material stakeholder submissions,[10] which indicates that no major NGOs had focused on these fisheries, unlike other fisheries in the Northeast Atlantic at the time.[11]

In June 2010, an unusual situation arose: the public authorities of one country filed an objection to an MSC assessment of a fishery from another country, on the basis of political disagreement at state level. (Objectors would normally be NGOs or commercial actors, such as competing companies.) It was Marine Scotland – Scotland's executive agency for fisheries – on behalf of the Scottish Government that objected to the preliminary results (as presented in the PCDR) of the assessment of the Faroese mackerel fishery by the certification body DNV (later DNV GL). As described above, the MSC objection procedure includes several stages where agreement between the parties is encouraged. This objection went through all these stages, including preliminary consultations, full written adjudication and oral hearings – lasting nearly eight months – without agreement being reached. Hence, the case ended with a final decision by the Independent Adjudicator. Quite unusually, the objection received unsolicited letters of support from industry and science organizations in other countries, albeit with an interest in the fishery themselves (the Norwegian Fishermen's Sales Organization for Pelagic Fish, the Norwegian Shipowners' Association and EU's Pelagic Regional Advisory Council), while the fishery client received formal support from its own public authorities, the Faroese Ministry of Fisheries. Hence, the objection was raised to the political level in Scotland and the Faroe Islands, with semi-public institutions from coastal states Norway and the EU intervening in support of the objector.

In its Notice of Objection, Marine Scotland claimed that the passing score of PI 3.1.1 on the existence of a well-functioning overall management framework was not warranted. The assessment team had referred to the tripartite agreement involving the EU, the Faroe Islands and Norway as the basis for its conclusion that this requirement had been met. Marine Scotland, for its part, asserted that as of 1 January 2010 that agreement no longer existed, due to the withdrawal of the Faroe Islands. It also invoked the MSC scope criterion (see previous section) that a fishery cannot be certified if it operates under a 'controversial unilateral exemption to an international agreement' (FCP 7.4.3) – which it claimed the Faroese withdrawal from the coastal-states agreement amounted to.

The fishery client responded that the Faroe Islands had worked decisively to revise the 2000 agreement, which gave EU and Norway 90 per cent of the total allowable catch (TAC), with only 5 per cent each to the Faroe Islands and Russia. The basis for this claim was that far more mackerel had become available in Faroese waters in recent years; moreover, it had become clear that spawning also took place there. As the result of stalled negotiations, the EU and Norway had denied Faroese vessels access to their waters, where Faroes vessels traditionally fish during parts of the year – making it necessary for the Faroe Islands to increase unilaterally their quota share for fishing in their own maritime zones. In its submission to the Independent Adjudicator, the

Faroese Ministry of Fisheries claimed that Marine Scotland was incorrect in stating that the Faroe Islands had withdrawn from an international agreement. According to the ministry, the trilateral cooperation involving the EU, the Faroe Islands and Norway in the management of mackerel had merely been an ad hoc annual arrangement.

The major party opposing the objector during an MSC objection process is not the fishery client, but the CAB. Throughout the objection process, the DNV had consistently rejected the arguments of Marine Scotland. Admittedly, it lowered the score on PI 3.1.1 from 80 (unconditional pass) to 70 (pass with conditions) during this time. However, that was not a result of the objection, but of harmonization discussions with CABs responsible for other mackerel fisheries, due to the deteriorating situation in negotiations among the coastal states.

In her Final Decision, Independent Adjudicator Melanie Carter dismissed Marine Scotland's claim that the fishery was out of scope for MSC certification. She did not address the substantive issue of whether the actions of the Faroe Islands represented a controversial unilateral exception to an international agreement, as the scope for certification according to the MSC Standard is determined prior to onset of the assessment – which in this case was before it had become clear that the coastal states would not reach agreement for 2010. However, she concluded that 'the lack of an agreed allocation key for the Total Allowable Catch ("TAC") for 2010 is such that the score for Performance Indicator 3.1.1 cannot be justified on the grounds that it was unreasonable for the Certification Body to have come to this view (p. 244)'. The objection was accepted – and the Faroese mackerel fishery was not certified.

At the time of the Faroese assessment, mackerel catches had already been in excess of the advice of the International Council for the Exploration of the Sea (ICES) for several years. Iceland had in the two preceding years taken for itself a quota of 20 per cent of the TAC recommended by ICES, whereas Norway, the EU and the Faroe Islands had set quotas that did not take the Icelandic quota into consideration. This did not go unnoticed by the CABs responsible for the Northeast Atlantic mackerel fisheries assessments. In February 2010, a harmonization meeting among the CABs was held, where it was agreed to invoke a condition on PI 1.2.2, due to fishing mortality being higher than envisaged by the harvest-control rule. (This came in time for the condition to be included in the Faroese PCDR.) A condition introduced as the result of extraordinary events during the course of a certification period may be given a timeline of less than the ordinary five years. The new condition to the mackerel fishery was to be met by the end of 2011. That deadline was not met; thus, on 30 March 2012, all mackerel fisheries in the Northeast Atlantic were suspended from MSC certification.

To allow the continued validity of a certificate, despite its suspension, certified fisheries are required to present and implement a Corrective Action Plan. The NEA Atlantic Mackerel MSC Corrective Action Plan was accepted on 26 June 2012. Seven of the originally certified (now suspended) mackerel clients created the Mackerel Industry Northern Sustainability Alliance (MINSA) to implement the Corrective Action Plan. The plan contained four elements: lobbying, science, trade-related measures and media interaction. In brief, the clients agreed to engage with management bodies, scientists and the media to promote the need for a coastal-states agreement for mackerel. The deadline for implementation of the Corrective Action Plan was set to 30 April 2014.

Following a variation request to the MSC, however, the harmonized two-year condition from 2010 was extended to a regular five-year condition, with deadline 30 April 2015. On 10 July 2014, the reassessment of the seven fisheries now part of MINSA was announced (with two UoAs: one for the Norwegian and one for the EU component of the fishery). The deadline for lifting the suspension (in effect, to avoid withdrawal of the certificate) was extended to 10 June 2015, to allow for harmonization discussions with the two mackerel fisheries then undergoing their first full assessment: the Northern Ireland Pelagic Sustainability Group and the Faroese Pelagic Organisation (the latter making a new try after failing on its first attempt). On 10 June, however, the CAB (Acoura Marine, now Lloyd's Register) announced that the suspension of all Northeast Atlantic mackerel fisheries was extended until such time as the MINSA fishery should complete its reassessment: 'At the end of the MINSA assessment, a) if MINSA is certified, new certificates would be issued and the suspension would be lifted; or b) if MINSA is not certified, previous certificates would expire/be withdrawn at that point.'[12] On 10 May 2016, MINSA had passed assessment, without any stakeholder submissions or objections. The Faroese fishery followed a month later.

All the mackerel fisheries were again MSC-certified, four years after their certificates had been suspended – but without the fundamental problem of coastal-state agreement having been solved. With fresh five-year conditions on PIs 1.2.2 and 3.1.1, basically requiring the clients to continue lobbying, the deadline for having a coastal-state agreement in place was effectively postponed until 2021, ten years after the Independent Adjudicator had ruled that the mackerel fisheries should not be certified without agreement among the coastal states as to allocation keys. Then in 2019 came a new suspension, but now for a different reason: the declining mackerel stock.

MSC certification of Arctic and Antarctic fisheries: outcomes

'A completed condition means a fishery's score meets best practice', reads the MSC website,[13] accompanied by the information that 92 per cent of certified fisheries have had at least one condition attached to them, to be met during the five-years' validity of the certificate. From 2016 to 2018, 288 conditions were invoked – half of them on P2, the remainder evenly distributed between P1 and P3. The most common type of action required was research, followed by assessment of the fishery's impact and 'technical action' (such as gear modifications).[14]

The previous section outlined how external actors have sought to affect the outcome of assessments. We now turn to the conditions set by the assessment teams and how fishery clients have gone about meeting the requirements of the conditions. How has their own behaviour been adapted, and to what extent have they succeeded in influencing management practice, including legislation, at the national and international levels? What has been achieved in terms of more sustainable fisheries management and fishing practices?[15]

Before returning to the mackerel case, we briefly examine one Southern Ocean and two other Northeast Atlantic fisheries for comparison.[16] The first round of MSC assessments in the Southern Ocean resulted in a large number of improvement conditions and stakeholder submissions, as well as three extensive objection processes. Stakeholder submissions, objections and conditions set by the assessment teams mainly concerned the lack of information about population dynamics of the target stocks and their interaction with the wider ecosystem. Hence, remedial actions focused on generating such information, whether through direct measures in fishery clients' own fishing activities (e.g. sampling programmes), support for research (financially or by letting scientists use their vessels) or engagement with the wider epistemic community (including scientists, managers and NGOs). Some clients committed to 100 per cent observer coverage, although the requirement of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was only to have observers on board 50 per cent of the time. Clients also established a close working relationship with the WWF, and together they formed the Association of Responsible Krill Fishing Companies (ARK), which also works to further krill research through cooperation between the industry and scientists. In 2019, the ARK companies contributed to financing the first synoptic survey of Southern Ocean krill since 2000 (see also Stokke's Ch. 12).[17]

In the Barents Sea cod and haddock fisheries, there was an odd P1 and P3 condition in the early assessments; however, most conditions (and all conditions since 2013) have been on P2, in particular related to ETP species and habitats. All stakeholder submissions since 2013, and all three objections, have concerned the impact of bottom trawling on habitats. Half of the clients in the Barents Sea are Russian fishing companies. Remarkably, given their unwillingness to share certificates, all the Russian clients have addressed their habitat-related conditions jointly; the scientific research institute PINRO and WWF-Murmansk (the local branch of WWF-Russia) are also on board.[18] This cooperation among the companies involves four elements: first, a new semi-pelagic, 'near-bottom' trawl has been designed and tested, which, if put to use in the commercial fisheries, will considerably reduce the impact on bottom habitats. This project is financed by the clients jointly, according to an agreed cost-distribution key. Second, a programme for registration of benthic encounters has been designed by the WWF and implemented on client vessels.[19] Third, in 2016, the Russian clients jointly created the Coordination Council for the Development of Sustainable Fisheries in the North and signed the Agreement on the Coordination of Actions of Fishing Companies to Minimize the Impact of Bottom Trawl Fishery on the Benthic Ecosystems in the Barents Sea and Norwegian Sea.[20] Fourth, under the Coordination Council agreement, the client companies have committed to not entering new fishing grounds in the Barents Sea (areas in the northern parts of the Barents Sea which are becoming more accessible due to changes in ice coverage) until these areas have been appropriately researched.[21] Judging from information in the annual surveillance audit reports, there is little doubt that these developments follow directly from the clients' endeavours to meet their MSC conditions. However, there is no evidence that management practices, national legislation or international agreements between Norway and Russia in their Joint Fisheries Commission have been affected by the MSC assessments. All of the Norwegian fleet and more than 85 per cent of the Russian fleet are MSC-certified;[22] the relevant authorities on both sides are consulted at each annual surveillance audit, so they are well aware that their national fleets are in the

MSC programme. But there has been utter silence from the responsible authorities about the private certification schemes. A search for 'MSC' or 'Marine Stewardship Council' on the websites of Norwegian and Russian fisheries management bodies,[23] or in the protocols of the Joint Norwegian–Russian Fisheries Commission,[24] yields not a single hit. Private certification is apparently not something the Norwegian and Russian authorities wish to flag as part of the overarching management of their fisheries.[25]

The conditions to third-country fisheries[26] also relate mainly to P2, in particular to the protection of ETP species and habitat structures. The requirements to the fishery clients, all of which were met during the five-year certification period, included recording of bycatches beyond what is required by Norwegian and Russian regulations; voluntary adherence to fishing grounds 'with a historic footprint' (documented to the assessment team at annual surveillance audits by vessel-monitoring system (VMS) logs); production of company-level strategies, codes of conduct and action plans to avoid encounters with sponge and coral garden habitats; and obligatory training of crews on identifying ETP species and habitat structures.[27]

In the small-scale lumpfish fisheries in Greenland, Iceland and Norway, the direct effects of MSC certification are more immediately apparent. Problems identified at initial certification were lack of appropriate reference points, harvest-control rules and management plans, as well as strategies for reducing bycatch of seabirds and marine mammals. New reference points and harvest-control rules have been produced in Greenland and are underway in Norway.[28] Monitoring of bycatch of seabirds (in Iceland, also of marine mammals) has been increased in all three countries, and new mitigation strategies have been produced.[29] It has been said that MSC certification is a 'to be or not to be' requirement to get lumpfish roe sold on the global market, so fishing companies go to great lengths to get the authorities to adopt the precautionary measures necessary for them to achieve and retain MSC certification.[30] In April 2020, a press release from the Icelandic Ministry of Fisheries and Agriculture was explicit about the role of certification in connection with a precautionary seasonal halt of the lumpfish fishery: this was said to be due to the need to keep fishing 'in accordance with scientific advice' and 'to ensure that the existing certifications are not lost.'[31] Here we can note a direct link between MSC requirements and national regulations, as explicitly stated by the relevant authorities themselves.

Ten mackerel clients from nine countries (two from Ireland) have undergone MSC assessment. In the first round of assessments, slippage and implementation of a new management plan were identified as areas for improvement. Clients were required to report slippage and produce strategies for reducing it, which they did. Overshoot of the recommended TAC was an emerging issue also before the Faroe Islands (in the view of the other states) withdrew from the established regime by unilaterally setting its national quota. Thus, all MSC fishery clients received a condition that required them to 'work with' their respective national authorities to persuade these states to come to agreement. A typical formulation from an annual surveillance audit report on a client's progress towards meeting their conditions is the following:

> SPSG has vigorously canvassed for settlement of a coastal states agreement for the division of mackerel quota within the agreed TAC, but to date such an agreement

has yet be achieved. The SPSG has been an active participant in twelve negotiating sessions intended to bring about a settlement of quota allocations between the relevant coastal states.

(SFSG fishery, 4th Surveillance Audit Report, p. 15)

From 2010 onwards, the fisheries received a new condition under P3 (either PI 3.1.1 or 3.2.2), according to which a new coastal-states agreement, bringing total catches in line with ICES advice, must be in place within five years, for the fisheries to remain certified. As noted, the mackerel certificates were suspended in 2012, but were reinstated when the 'all-European' MINSA fishery was certified in 2016. A coastal-state agreement was not any nearer than in the preceding years, but the conditions – on PI 1.2.2 related to the management plan and PI 3.1.1 on the overarching management framework – were now reset to point zero: an agreement would have to be in place within five years. In the meantime, the clients were obliged to continue 'working with the authorities' – the surveillance audit reports are full of references to the many meetings attended by the clients and the letters sent to ministries, directorates, commissions and others, urging governments to come to agreement. This was all to no avail; as of autumn 2021, a coastal-states agreement was still not in sight. As noted, the Northeast Atlantic mackerel fisheries had their certificates suspended again in 2019, this time because the stock size had decreased below permitted levels.

Of these four cases, mackerel is the one where it is most difficult to see any improvements as a result of MSC certification. Little has been achieved, beyond updated information on slippage in the fishery, and company strategies for reducing it. Of course, it might be argued that it is an improvement in itself that the fishing industries in eight European countries became driving forces in arguing for sustainable TAC levels. Fisher behaviour has indeed been affected – but in the corridors of negotiations, not in the fishing fields. And decade-long endeavours to influence the behaviour of decision-makers have proven futile.

Conclusions

MSC certification is no panacea, but it seems to have found a niche as a supplement to national legislation and international agreements, as is evident in several Southern Ocean and Northeast Atlantic fisheries. In the Southern Ocean, fisheries had suffered from lack of data and information on fish stocks and the ecosystem: MSC certification led to new research initiatives and voluntary collection of data by fishers, and new epistemic communities were formed at the national and international levels. In the Arctic lumpfish fisheries, certification became a catalyst for the speedy production of reference points and harvest-control rules. In the Barents Sea, the MSC filled an important gap in an otherwise well-developed management regime: the protection of bottom habitats, which had never been a prioritized issue in the established management regimes in Norway or Russia – perhaps because the marine environment has been the remit of the environmental authorities, not fisheries management. In that regard, the MSC has both filled a regulatory gap and potentially contributed to bridging an institutional gap between different sectors of government in the coastal states.

In the mackerel fisheries, the MSC itself has been more active than in other Arctic fisheries assessments. Normally, the MSC limits its role to producing the Certification Requirements, providing technical oversight comments to assessment reports, and issuing certificates. In the Northeast Atlantic mackerel fisheries, however, the MSC apparently involved itself in the harmonization of scores between fisheries (usually done by the CABs alone) and, not least, the prolongation of certificates beyond what is usual. After four years of suspension, the mackerel certificates were reinstated in 2016, despite no progress in negotiations among the coastal states, where the stalemate had been the reason for suspension in the first place. The deadline for having an agreement in place was effectively postponed until 2021, ten years after the Independent Adjudicator had ruled against certification of the Northeast Atlantic mackerel fishery due to the lack of such an agreement among the coastal states. Meanwhile, the fisheries remained certified – until the stock itself fell below acceptable levels, and the fishery was suspended for that reason in 2019.

The mackerel fishery might have become one of MSC's big success stories, if the engagement of all the clients with their national authorities had produced the intended effects. This would have then been the story of how the fishing industries across northern Europe joined forces to convince their respective national authorities to come to agreement – in itself a massive demonstration of the power of private certification. As that failed to happen, the mackerel story is perhaps not the MSC's finest hour – what remains is the impression of a scheme owner that may have gone a bit too far in seeking to keep one of the biggest, classic European fisheries within its portfolio.

Notes

1 See the GSSI website, https://www.ourgssi.org/.
2 See the MSC website, https://www.msc.org/.
3 This is just a small selection of topics covered in the literature about MSC. A search in the Web of Science database for academic journals (accessed 21 April 2020) generates 161 articles, of which 131 have been published since 2012. The largest disciplinary categories are Environmental Studies (53), Fisheries (41) and International Relations (39). A large number of the articles are empirical studies of MSC assessments in specific geographic regions. I have not come across other studies of MSC assessments in the Arctic, but some of the Russian Barents Sea fisheries are analysed in articles about MSC assessments in Russia (Gulbrandsen and Hønneland 2014; Pristupa et al. 2016; Lajus et al. 2018).
4 I am myself a certified MSC auditor, involved in fishery assessments as expert on MSC Principle 3 (the management system) and leader of assessment teams. The empirical investigation of this article is based solely on publicly available documents – hence, I see no conflict of interest or other ethical problems. On the positive side, my practical experience and training in applying the MSC Standard have helped me navigate the voluminous body of documentation available on MSC assessments.

5 MSC Fisheries Standard Version 2.01, 31 August 2018 (effective 28 February 2019), London: Marine Stewardship Council; available at https://www.msc.org/docs/default-source/default-document-library/for-business/program-documents/fisheries-program-documents/msc-fisheries-standard-v2-01.pdf?sfvrsn=8ecb3272_13.

6 MSC Fisheries Certification Process Version 2.1, 31 August 2018 (effective 28 February 2019), London: Marine Stewardship Council; available at https://www.msc.org/docs/default-source/default-document-library/for-business/program-documents/fisheries-program-documents/msc-fisheries-certification-process-v2.1.pdf?sfvrsn=5c8c80bc_24.

7 The guidance states that 'outstanding disputes of substantial magnitude involving a significant number of interests will normally disqualify a fishery from certification. However, the existence of controversies or disputes are of themselves not enough to stop a fishery from being eligible for certification. [. . .] The judgement should be whether a dispute compromises the ability of the management system to provide sustainable management (G7.4.5).'

8 A harvest-control rule is defined as 'a set of well-defined pre-agreed rules or actions used for determining a management action in response to changes in indicators of stock status with respect to reference points' (MSC-MSCI vocabulary).

9 For example, all information about the Scottish Pelagic Sustainability Group assessment is taken from the assessment report for that fishery listed in Appendix 1. All information on fulfilment of previous conditions is taken from the 4th surveillance audit report in the preceding certification cycle.

10 The Irish Pelagic Sustainability Alliance fishery received a submission from a local fishermen's association, which was in essence a question about MSC procedures.

11 This includes the Barents Sea cod and haddock fisheries and the lumpfish fisheries in Greenland, Iceland and Norway, which received substantial attention from environmental NGOs, including several objections. See Hønneland (2021a, 2021b). A summary of the effects of MSC certification on these fisheries is provided below.

12 Stakeholder announcement – Ref: Extension of the suspension of all NE Atlantic mackerel fisheries within the MINSA group until such time as the MINSA fishery completes reassessment, Edinburgh: Acoura Marine; available at https://fisheries.msc.org/en/fisheries/minsa-north-east-atlantic-mackerel/@@assessments, p. 1. The announcement was signed by representatives of the three CABs involved in the mackerel assessments: Acoura Marine, DNV GL and Intertek Fisheries Certification. It is unclear who made this decision, but the MSC itself was probably involved, and most likely also made the decision, although this does not follow from the announcement.

13 MSC, 'How MSC Certified fisheries are improving', https://www.msc.org/what-we-are-doing/our-collective-impact/fisheries-improving.

14 Ibid.

15 As in the preceding section, all information is taken from the MSC assessment reports for the respective fisheries; see Appendix 1 for list of reports and their coding for reference.

16 This is taken from Hønneland (2021a, 2021b).

17 Aker BioMarine, 'Krill industry Antarctic conservation in motion', https://www.akerbiomarine.com/blog/krill-industry-antarctic-conservation-in-motion. This was not directly related to an MSC condition for the fishery, but the Aker BioMarine first reassessment report (1-RA, p. 5) highlighted the lack of synoptic surveys since 2000 as the main challenge for the fishery. The more time that passed since the

last synoptic survey, the greater the chances that a condition would eventually be introduced to the krill certificates. In financing the survey, therefore, the clients were acting proactively to avoid a future condition.

18 See, e.g. the FIUN assessment, 1-RA, p. 179.

19 Ibid., p. 189.

20 See, e.g. the FIUN assessment, 1-SA (under first reassessment), p. 16.

21 By contrast, the achievements of the Norwegian client are less clear – as opaquely described in the 4th surveillance audit report summing up activities over the last five-year period: 'The client engaged with IMR and DoF from the time of the original certification to formalise earlier voluntary arrangements for minimising adverse interactions between fishing and sensitive marine habitats. Vessels continue to contribute data to the MAREANO programme on an opportunistic basis' (Norwegian Seafood Council assessment, 4-SA, p. 27).

22 All Norwegian vessels are covered by the Norway North East Arctic cod certificate. The number of Russian vessels certified is approximate, based on numbers of vessels indicated in the various assessment reports.

23 https://www.regjeringen.no/no/dep/nfd/id709/ (Ministry of Industry and Fisheries, Norway), https://www.fiskeridir.no/ (Directorate of Fisheries, Norway), http://www.fish.gov.ru/ (Federal Fisheries Agency, Russian Federation).

24 https://www.jointfish.com/ (website of the Joint Norwegian–Russian Fisheries Commission).

25 One reason might be that the authorities view the MSC as a 'competitor' and/or inappropriate 'intruder' in national fisheries management.

26 Fisheries from Estonia, the Faroe Islands, France, Germany, Greenland, Iceland, Spain and the UK are certified for the Barents Sea cod and haddock fishery; see Hønneland (2021a).

27 See, e.g. Greenland cod and haddock assessment, 3-SA, pp. 18–19.

28 Greenland lumpfish assessment, 4-SA, pp. 26–27; Norway lumpfish assessment, 2-SA, pp. 37–43.

29 Greenland lumpfish assessment, 4-SA, pp. 28–30; Iceland lumpfish assessment, 3-SA, pp. 17–20; Norway lumpfish assessment, 2-SA, pp. 39–43, p. 51.

30 Anecdotal evidence, based on the author's own experience.

31 'Breyting á reglugerð um veiðar á grásleppu 2020', published on the website of the Government of Iceland on 30 April 2020, https://www.stjornarradid.is/efst-a-baugi/frettir/stok-frett/2020/04/30/Breyting-a-reglugerd-um-veidar-a-grasleppu-2020/. The English formulation follows from Google Translate. The statement was imprecise: the certificate was already lost, but assessment was underway to get it reinstated.

32 In this list of MSC assessment reports, the official MSC names of the fisheries are provided first, for reference in the MSC website's 'Track a Fishery' function (https://fisheries.msc.org/en/fisheries/). Then in square brackets follow the client; FA = full assessment; SA = surveillance audit; RA = reassessment. Hence, '2-SA' means the second annual surveillance audit in the five-year certification cycle. The names of the certification bodies, as formal publishers of the reports, are also given. '1-FA 2010, 1-SA 2011, 2-SA 2012, 3-SA 2013, 4 -SA 2014, Moody Marine; 1-RA 2015, Food Certification International' means that all reports up until 2014 were published by Moody Marine; the 2015 report was issued by Food Certification International.

References

Arton, A., A. Leiman, G. Petrokofsky, H. Toonen and C. S. Longo (2020), 'What Do We Know about the Impacts of the Marine Stewardship Council Seafood Ecolabelling Program? A Systematic Map', *Environmental Evidence*, 9: 1–20.

Gulbrandsen, L. H. and G. Auld (2016), 'Contested Accountability Logics in Evolving Nonstate Certification for Fisheries Sustainability', *Global Environmental Politics*, 16: 42–60.

Gulbrandsen, L. H. and G. Hønneland (2014), 'Fisheries Certification in Russia: The Emergence of Non-State Authority in a Postcommunist Economy', *Ocean Development and International Law*, 45: 341–59.

Hønneland, G. (2021a), 'Marine Stewardship Council (MSC) Certification of Arctic Fisheries: Processes and Outcomes', *Arctic Review on Law and Policy*, 11: 133–56.

Hønneland, G. (2021b), *Blue Governance in the Arctic and Antarctic: Private Fisheries Certification and the Law of the Sea*, London: Palgrave Macmillan.

Lajus, D., D. Stogova and E. C. H. Keskitalo (2018), 'The Implementation of Marine Stewardship Council (MSC) Certification in Russia: Achievements and Considerations', *Marine Policy*, 90: 105–14.

Lim, K. H., W. Hu and R. M. Nayga Jr. (2018), 'Is Marine Stewardship Council's Ecolabel a Rising Tide for All? Consumers' Willingness to Pay for Origin-Differentiated Ecolabel Canned Tuna', *Marine Policy*, 96: 18–26.

Pristupa, A. O., M. Lamers and B. Amelung (2016), 'Private Informational Governance in Post-Soviet Waters: Implications of the Marine Stewardship Council Certification in the Russian Barents Sea Region', *Fisheries Research*, 182: 128–35.

Appendix 1: MSC assessment reports[32]

Danish Pelagic Producers Organisation North East Atlantic mackerel [Danish Pelagic Producers Organisation] (1-FA 2009, 1-SA 2010, 2-SA 2011, 3-SA 2012, 4-SA 2013, DNV GL) (https://fisheries.msc.org/en/fisheries/danish-pelagic-producers-organisation-north-east-atlantic-mackerel/@@view)

Faroese Pelagic Organisation North East Atlantic mackerel [Faroese Pelagic Organisation] (1-FA 2011, 1-SA 2012, 2-SA 2013, 3-SA 2014, 4-SA 2015, 1-FA [de facto 2nd FA; the first one failed] 2016, DNV GL) (https://fisheries.msc.org/en/fisheries/faroese-pelagic-organisation-north-east-atlantic-mackerel/@@view)

FIUN Barents & Norwegian Seas cod and haddock [Fishing Industry Union of the North, Russia] (1-FA 2013, 1-SA 2014, 2-SA 2015, Food Certification International; 3-SA 2016, 4-SA 2017, 1-RA 2018, Acoura Marine) (https://fisheries.msc.org/en/fisheries/fiun-barents-norwegian-seas-cod-and-haddock/@@view)

Greenland cod, haddock and saithe trawl fishery [Sustainable Fisheries Greenland] (1-FA 2015, Intertek Fisheries Certification, 1-SA 2016, 2-SA 2017, 1-RA 2019, Acoura Marine) (https://fisheries.msc.org/en/fisheries/greenland-cod-haddock-and-saithe-trawl-fishery/@@view)

Greenland lumpfish [Sustainable Fisheries Greenland] (1-FA 2015, 1-SA 2016, 2-SA 2017, 3-SA 2018, 4-SA 2019, 1-RA 2020, DNV GL) (https://fisheries.msc.org/en/fisheries/greenland-lumpfish/@@assessments)

Iceland Gillnet lumpfish [Iceland Sustainable Fisheries] (1-FA 2014, 1-SA 2015, 2-SA 2016, 3-SA 2017, Vottunarstofan Tún) (https://fisheries.msc.org/en/fisheries/icelandic-gillnet-lumpfish/@@assessments) Fishery withdrawn in 2017; entered new assessment in 2020 under the name 'ISF Iceland lumpfish' (2-FA 2020, SAI Global) (https://fisheries.msc.org/en/fisheries/isf-iceland-lumpfish/@@assessments)
Irish Pelagic Sustainability Association (IPSA) western mackerel [Irish Pelagic Sustainability Association] (1-FA 2010, 1-SA 2011, 2-SA 2012, 3-SA 2013, 4-SA 2014, Food Certification International) (https://fisheries.msc.org/en/fisheries/irish-pelagic-sustainability-association-ipsa-western-mackerel/@@view)
Irish Pelagic Sustainability Group (IPSG) western mackerel pelagic trawl [Irish Pelagic Sustainability Group] (1-FA 2009, 1-SA 2010, 2-SA 2011, 3-SA 2012, 4-SA 2013, Food Certification International) (https://fisheries.msc.org/en/fisheries/irish-pelagic-sustainability-group-ipsg-western-mackerel-pelagic-trawl/@@view)
ISF Iceland mackerel [Iceland Sustainable Fisheries] (1-FA 2017, 1-SA 2018, 2-SA 2019, SAI Global) (https://fisheries.msc.org/en/fisheries/isf-iceland-mackerel/@@view)
MINSA North East Atlantic mackerel [Mackerel Industry Northern Sustainability Group] (1-FA 2016, 1-SA 2017, 2-SA 2018, Acoura Marine; 3-SA 2019, Lloyd's Register) (https://fisheries.msc.org/en/fisheries/minsa-north-east-atlantic-mackerel/@@view)
North East Atlantic mackerel pelagic trawl, Purse-Seine and handline [Norwegian Fishermen's Sales Organization for Pelagic Fish] (1-FA 2009, 1-SA 2010, 2-SA 2011, 3-SA 2012, 4-SA 2013, DNV GL) (https://fisheries.msc.org/en/fisheries/north-east-atlantic-mackerel-pelagic-trawl-purse-seine-and-handline/@@view)
Northern Ireland Pelagic Sustainability Group (NIPSG) Irish Sea-Atlantic mackerel & North Sea herring [Northern Ireland Pelagic Sustainability Group] (1-FA 2016, 1-SA 2017, Acoura Marine; 2-SA 2019, 3-SA 2019, Lloyd's Register) (https://fisheries.msc.org/en/fisheries/northern-ireland-pelagic-sustainability-group-nipsg-irish-sea-atlantic-mackerel-north-sea-herring/@@view)
NFA Norway ling & tusk and NFA Norway lumpfish [Norwegian Fishermen's Association] (1-FA 2017, Acoura Marine; 1-SA 2019, 2-SA 2020, DNV GL) (https://fisheries.msc.org/en/fisheries/nfa-norway-ling-tusk-and-nfa-norway-lumpfish/@@assessments)
Norway North East Arctic cod [Norwegian Seafood Council] (1-FA 2010, 1-SA 2011, 2-SA 2012, 3-SA 2013, 4-SA 2014, 1-RA 2015, DNV GL) (https://fisheries.msc.org/en/fisheries/norway-north-east-arctic-cod-offshore-12nm/@@assessments)
Pelagic Freezer Trawler Association North East Atlantic mackerel pelagic trawl [Pelagic Freezer Trawler Association (Netherlands)] (1-FA 2009, 1-SA 2010, 2-SA 2011, 3-SA 2012, 4-SA 2013, Moody Marine) (https://fisheries.msc.org/en/fisheries/pelagic-freezer-trawler-association-north-east-atlantic-mackerel-pelagic-trawl/@@view)
SPFPO North East Atlantic mackerel [Swedish Pelagic Federation Producer Organisation] (1-FA 2011, 1-SA 2012, DNV GL) (https://fisheries.msc.org/en/fisheries/spfpo-north-east-atlantic-mackerel/@@view)
SPSG Ltd western component of north east Atlantic mackerel [Scottish Pelagic Sustainability Group] (1-FA 2009, 1-SA 2010, 2-SA 2011, 3-SA 2012, 4-SA 2012, Food Certification International) (https://fisheries.msc.org/en/fisheries/spsg-ltd-western-component-of-north-east-atlantic-mackerel/@@view)

Part Three

Northern Seas

6

Northern Seas: Climate and Biology

Jan Erik Stiansen, Geir Odd Johansen, Anne Britt Sandø
and Harald Loeng

Introduction

The segments of the Northern Seas examined here are the Nordic Seas (the Norwegian, Greenland and Icelandic Seas) and the Barents Sea (Figure 6.1). Basically, the division of the three Nordic Seas follows the deep topography. The Norwegian and Barents Seas are transition zones – for warm, saline water on its way from the Atlantic to the Arctic Ocean, and for cold, less saline water from the Arctic to the Atlantic. The Fram Strait between Greenland and Svalbard is the only deep-water connection the Arctic Ocean has with rest of the world oceans. The Greenland–Scotland Ridge forms an undersea barrier between the deep waters of the Nordic Seas and the North Atlantic, limiting the exchange of deep water.

Higher up in the water it is logical to consider all this as one dynamic unit, the Nordic Seas, with frontal zones dividing Arctic and Atlantic water masses. In this chapter we use the term 'Norwegian Sea' in a wider sense, which also may include parts of the other Nordic Seas where abiotic and biotic conditions are similar. Several fish species migrate between these areas. For example, Norwegian spring-spawning herring (*Clupea harengus*) spawns on the Norwegian continental shelf, has its nursery area in the Barents Sea and migrates into the Norwegian Sea when it has attained a length of 20–22 centimetres (Holst et al. 2004). Blue whiting (*Micromesistius poutassou*) and mackerel (*Scomber scombrus*) have their main feeding areas in the Nordic Seas but may migrate into the western Barents Sea. The most abundant zooplankton species, *Calanus finmarchicus*, overwinter in the deep Norwegian Sea, and then ascend to the surface to spawn in the spring. A part of the Norwegian Sea population drifts into the Barents Sea with the currents as they ascend to the upper layers. For a complete overview of the physical and biological conditions in the Norwegian and Barents Seas, see the works edited by Skjoldal (2004), Sakshaug et al. (2009) and Jakobsen and Ozhigin (2011).

The pathways by which climate variability may affect ecological processes vary across a broad range of temporal and spatial scales. Climate variability affects fish species directly through physiology, including metabolic and reproductive processes, as well as through their biological environment (predators, prey, species interactions) and abiotic environment (habitat type and structure) (Hollowed et al. 2013a). Ecological responses to climatic variations may be immediate or lagged, linear or nonlinear; they may result from interactions between climate and other sources of variability (Hollowed et al. 2013a) and from the amplification of climate effects due to fishing (Planque et al. 2010; Simpson et al. 2011; Haug et al. 2017). There is ample evidence of the effects of climate variability on marine ecosystems in terms of, for instance, fish recruitment, fish growth and abundance and distribution of fish species associated with short- and long-term temperature changes. However, a better understanding of many aspects of the interaction between the atmosphere and the ocean, and between climate and the marine ecosystem, is needed to reduce the high levels of uncertainty associated with current predicted responses to climate change (Hollowed et al. 2013a, 2103b; Hollowed and Sundby 2014; Hollowed et al. 2018). Being able to predict ecosystem responses to future climate change in the Arctic is of great importance to scientists, managers and fishing communities.

In this chapter we begin by describing the physical and biotic conditions in the Barents and Norwegian Seas separately. Then, when discussing future climate conditions and the impacts on the fish stocks we consider the two jointly, as future climate developments are likely to be similar, and the factors affecting the fish stocks are largely the same.

Physical conditions

Barents Sea

The Barents Sea is one of the shallow shelf seas that collectively form the Arctic continental shelf. Its western boundary is defined by the shelf break towards the Norwegian Sea, the eastern boundary by Novaya Zemlya, the southern boundary by Norway and Russia, and the northern boundary by the continental shelf break towards the deep Arctic Ocean (Figure 6.1). It covers 1.4 million km^2 and has an average depth of 230 m (Loeng 1991). Maximum depths, ~500 m, are situated at the western shelf break. Stretching from 70° to over 80°N, the Barents Sea is subject to large seasonal variations in light levels, ranging from twenty-four hours of darkness in the winter to twenty-four hours of sunlight in summer seasons. In addition, seasons in the north are delayed compared to further south, with summer maximum temperatures in September and winter minimum in March in the Barents Sea.

Relatively warm coastal ($T > 3$°C, $S < 34.7$) and Atlantic ($T > 3$°C, $S > 35$) waters enter the Barents Sea between Bear Island and northern Norway, dominating the southern part of the sea. As these waters transit the Barents Sea, they are modified through mixing and atmospheric cooling, and exit principally to the north of Novaya Zemlya (Figure 6.1). Arctic waters ($T < 0$°C, $34.3 < S < 34.7$) dominate the northern Barents Sea, entering between Franz Josef Land and Novaya Zemlya and to a lesser degree between Franz Josef Land and Spitsbergen (Loeng 1991). Between the Arctic and Atlantic water there is an area with mixed water (0 °C < T < 3 °C), which includes the locally formed Barents Sea Water and Barents Sea Bottom Water (Ozhigin et al. 2011).

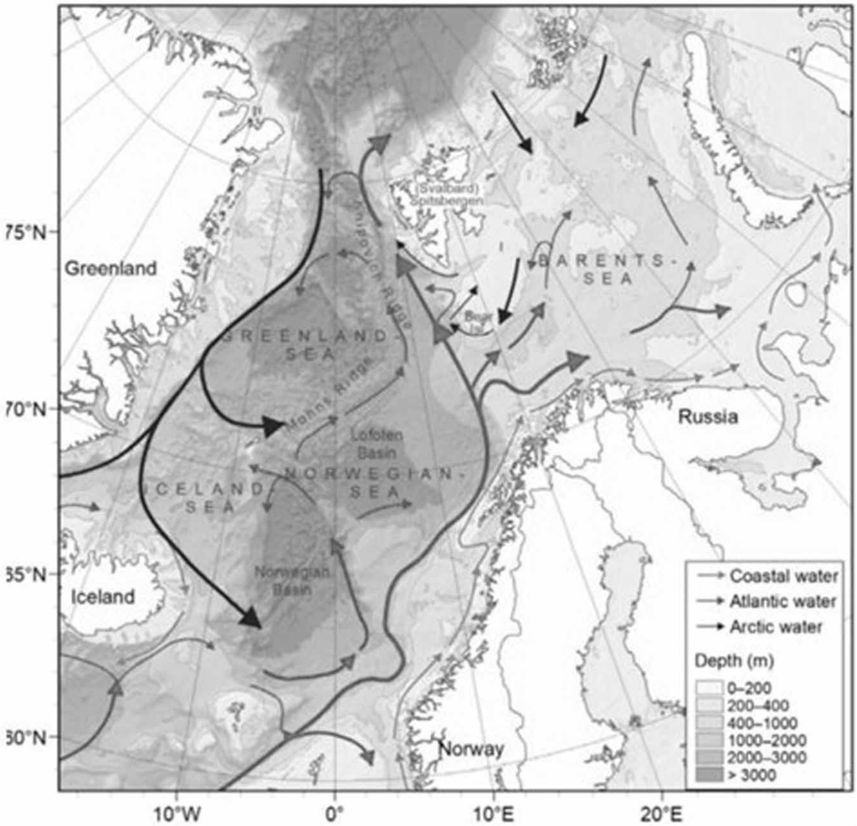


Figure 6.1 Overview of bathymetry and main water currents in the Northern Seas.

Like the atmosphere, the ocean undergoes variability at many temporal scales, from daily to centennial and even longer. Here we are primarily interested in ecosystem responses to ocean variability, which unfold mostly at inter-annual time-scales, or longer. Figure 6.2 shows temperature variations in the Barents Sea since 1900. Three types of natural variability may be seen, as noted by, for instance, Drinkwater et al. (2011): 1) annual variations, 2) decadal variations and 3) multi-decadal variations (sixty–eighty years). In addition to natural variability there is a component of climate change, which acts on a decadal to centennial timescale. The early 1900s were cold, followed by a strong warming that started in the early 1920s and peaked in the late 1930s. A slow but steady decrease continued until the late 1970s, followed by a strong temperature increase up to 2015. The most recent data show a slight decrease in the temperature of Atlantic waters since then (see, e.g. ICES 2020a).

The North Atlantic is a region characterized by large multi-decadal variations (Kushnir 1994; Knight et al. 2005; Keenlyside et al. 2008), and observations show periods of sixty–eighty years (Keenlyside et al. 2008). Skagseth et al. (2008) noted that

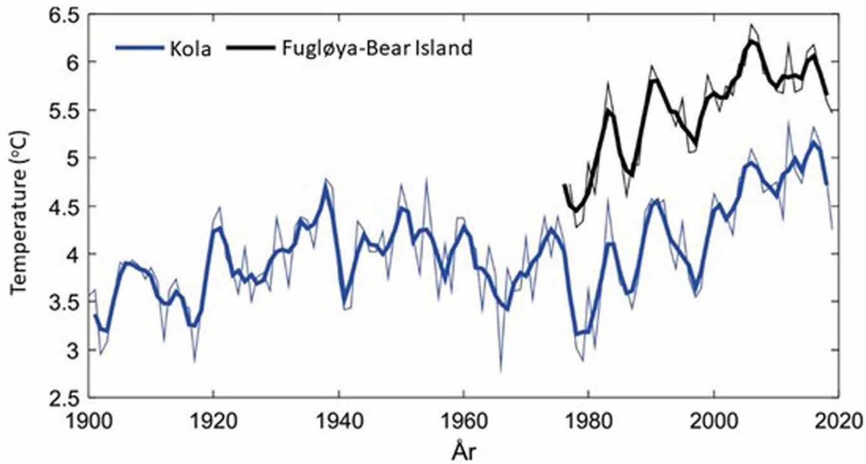


Figure 6.2 Annual temperatures in two main sections in the Barents Sea. Lower line (full timeline): the Russian section in the southern Barents Sea northwards from the Kola Peninsula (Kola section); Upper line: the Norwegian section at the western Barents Sea opening (Fugløya–Bear Island section).

long-term variations in the Barents Sea followed the index for the Atlantic Multidecadal Oscillation (AMO). Despite considerable uncertainty about the mechanisms underlying multi-decadal oscillations, the meridional overturning circulation (MOC) is recognized as important (Keenlyside et al. 2008). Some models indicate reduced MOC during the next decades; and the ensuing cooling in the subpolar ocean may postpone the anthropogenic heating expected in the North Atlantic Ocean to the mid-2020s (Kerr 2008; Wood 2008), whereas anthropogenic heating is expected to continue in the Arctic Ocean (Nummelin et al. 2017).

Norwegian Sea

The Norwegian Sea consists of two deep basins, the Norwegian Basin and the Lofoten Basin (Figure 6.1), and is separated from the Greenland Sea in the north by the Mohn Ridge and from the shallower Iceland Sea in the south by the Jan Mayen Ridge. It has a surface area of about 1.1 million km^2 with an average depth of about 1,800 m, resulting in a total volume of ~ 2 million km^3. The Norwegian Sea represents 49 per cent of the Nordic Seas; the Greenland and Icelandic Seas, 42 per cent and 9 per cent, respectively (Skjoldal 2004).

All three seas in the Nordic Seas are closely dynamically linked in the upper layers that consist of warm, saline (> 35) Atlantic water in the east and cold, fresher (< 34.4) Polar water from the Arctic in the west (Blindheim 2004). Mixing occurs between these two water masses, especially in the Greenland Sea. The resultant water mass, called Arctic water, tends to be cold (T < 0°C) with salinities of 34.4–35, and is situated geographically between the Atlantic and Polar waters (Blindheim 2004). The Arctic

Front separates Arctic from Atlantic waters; and the more northwesterly Polar Front separates Polar and Arctic waters.

The Norwegian Sea is characterized by warm Atlantic water on the eastern side and cold Arctic water on the western side, separated by the Arctic Front. Atlantic water enters the Norwegian Sea through the Faroe–Shetland Channel and between the Faroe Islands and Iceland via the Faroe Current (Figure 6.1). Atlantic water flows north as the Norwegian Atlantic Current, which splits when it reaches northern Norway: some enters the Barents Sea; the rest continues north into the Arctic Ocean as the West Spitsbergen Current (Loeng and Drinkwater 2007).

Climate variability in the Norwegian Sea can be described in terms of the temperature and salinity of the Atlantic water (Figure 6.3). The temperature in the Norwegian Sea has been above the long-term mean since 2000. It reached a record high in the Svinøy section in 2007, whereas annual temperature averages in 2018 were close to the long-term mean at the section Svinøy–NW. Further north, the temperature still was above the long-term mean. Salinity increased until around 2010, subsequently decreasing in the entire ocean. In the Svinøy section, the 2018 annual salinity averages were the lowest since the end of the 1970s (ICES 2019c). However, if we include observations from a larger area of the Norwegian Sea we get a slightly different result. Data from the Argo floats revealed a recent freshening and warming trend in the Norwegian Sea during the entire period 2011–18 that could be partly explained by two different mechanisms: reduced ocean heat loss to the atmosphere, and advection of fresher Atlantic water into the Norwegian Sea (Mork et al. 2019). These results are valuable for model validation and a monitoring framework regarding the predictability of the climate variability in this region (Mork et al. 2019).

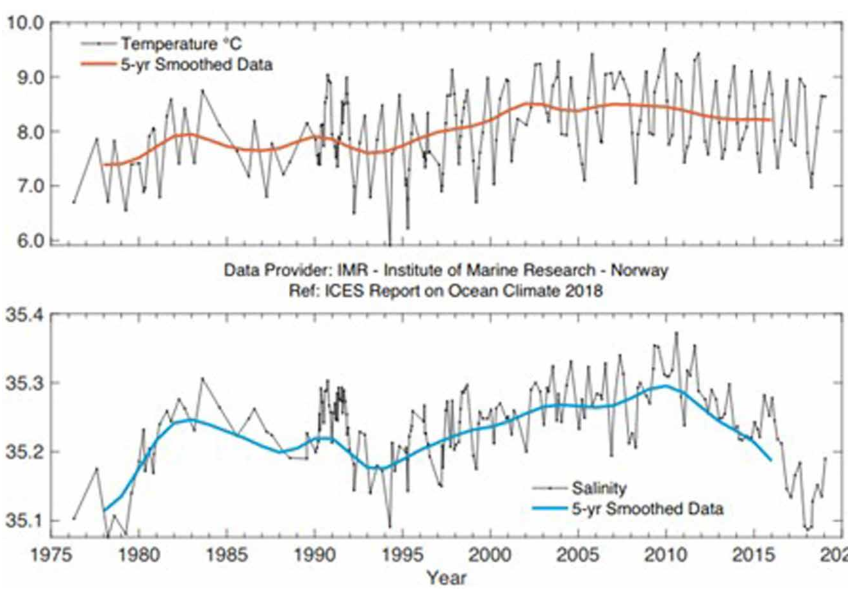


Figure 6.3 Temperature and salinity of Atlantic water in the Svinøy section (ICES 2019c).

The fresher Norwegian coastal current runs along the entire Norwegian coast. It originates as outflow from the Baltic Sea, refuelled with Norwegian rivers on its path up to the northern coast of Russia, where it dilutes into the Barents Sea.

Biotic components

Barents Sea

The Barents Sea is among the high-productive seas in the arctic and sub-Arctic realms (Sakshaug et al. 2009). Species abundance is significantly influenced by bottom-up regulation through ocean climate and biological production, and by top-down regulation through predation. Like most marine ecosystems, the Barents Sea has undergone changes in the past, including collapses and subsequent recoveries of key species like herring and capelin (Dolgov et al. 2011), as well as a sharp increase in the abundance of invasive species such as red king crab (*Paralithodes camtschaticus*) and snow crab (*Chionoecetes opilio*). Understanding the dynamics of this system requires in-depth knowledge of species interactions and how these vary with fluctuations in key species and under variable climatic conditions. A simplified picture of the food web is given in Figure 6.4.

As the Barents Sea is a spring-bloom system, primary production is close to zero during winter. The timing of the phytoplankton bloom varies throughout the Barents Sea; there may also be considerable inter-annual variability (Skogen et al. 2018; Sandø

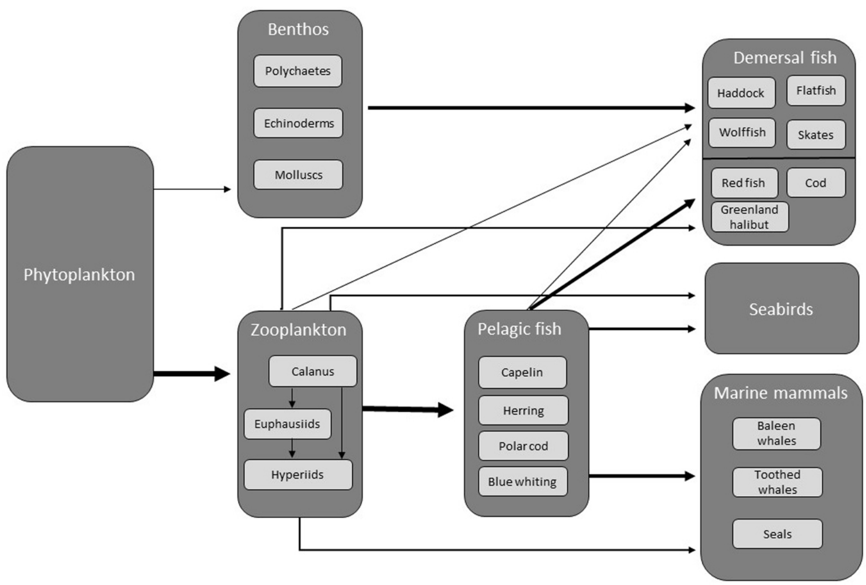


Figure 6.4 General scheme of the food web in the Barents Sea. Redrawn from Dolgov et al. (2011).

et al. 2021). The spring bloom starts in the southwestern areas, spreading north and east as stratification is established. Stratification of water masses in the Barents Sea may occur in several ways: 1) through fresh surface water from melting ice along the marginal ice zone; 2) through solar heating of surface layers in Atlantic water masses; 3) through lateral dispersion of waters in the southern coastal region (Rey 1981). As in other areas, diatoms are the dominant phytoplankton groups in the Barents Sea (Rey 1993). Diatoms dominate the first part of the spring bloom, in concentrations that can reach up to several million cells per litre. They require silicate in order to grow; when this is consumed, other phytoplankton groups, such as flagellates, take over.

In the Barents Sea ecosystem, zooplankton forms a link between phytoplankton (primary producers) and fish, mammals and other organisms at higher trophic levels (Figure 6.4). Zooplankton biomass in the Barents Sea may vary significantly from year to year, and crustaceans are important. The calanoid copepods of the genus *Calanus* play a key role in this ecosystem. *C. finmarchicus* is most abundant in Atlantic waters; *C. glacialis* in Arctic waters. Both form the largest component of zooplankton biomass. Calanoid copepods are mainly herbivorous, and feed on diatoms in particular (Mauchline 1998). Krill (euphausiids) is another zooplankton that plays a significant role in the Barents Sea ecosystem as food for fish, seabirds and marine mammals. Krill species are believed to be omnivorous, filter-feeding on phytoplankton during the spring bloom, and on small zooplankton otherwise (Melle et al. 2004). The composition of species and amount of zooplankton imported from the Norwegian Sea is determined by the intensity of Atlantic water inflow (Drobysheva et al. 2003).

More than 3,000 species of benthic invertebrates live in the Barents Sea (Sirenko 2001). These benthic ecosystems have considerable value – in direct economic terms, and in their ecosystem functions. Scallops, shrimp (*Pandalus borealis*), red king crab and snow crab are benthic residents harvested in the region. Important fish species such as haddock (*Melanogrammus aeglefinus*), catfish and most flatfishes feed primarily on benthos. Many species of benthos are also of interest for bio-prospecting or as a future food resource: these include sea cucumber, snails and bivalves. Many benthic animals, especially the bivalves, filter particles from the ocean, cleaning it effectively. Others scavenge on dead organisms, returning valuable nutrients to the water column. Detritus feeders and other active diggers regularly move the bottom sediments around, increasing sediment oxygen content and overall productivity – much like earthworms on land.

Nearly one hundred fish species turn up regularly in trawl catches during scientific surveys in the Barents Sea (Dolgov et al. 2011). However, the bulk of the fish biomass there is contained in relatively few species: only ten species comprise approximately 90 per cent of the biomass (Bjelland and Holst 2004; Fossheim et al. 2006). Cod (*Gadus morhua*), haddock, capelin (*Mallotus villosus*) and Greenland halibut (*Reinhardtius hippoglossoides*) are the key commercial species at present, with the bulk of catches for the first two species caught in the Barents Sea. In ecological terms, there is close interaction between many fish species in the Barents Sea and the Norwegian Sea. Because of circulation patterns, the Barents Sea serves as a nursery area for the offspring of several fish stocks that spawn along the western and northwestern coasts of Norway; these include herring, cod, haddock and saithe.

Marine mammals are top predators and play a significant role in the ecosystem. There are about twenty-five species of marine mammals that occur regularly in the Barents Sea. Some are not full-time residents, and use temperate areas for mating, calving and feeding; others stay in the Barents Sea all year round. Marine mammals may consume up to 1.5 times the amount of fish caught in fisheries. For example, minke whales and harp seals may each year consume 1.8 million and 3–5 million tonnes of prey of crustaceans, capelin, herring, polar cod and gadoid fish, respectively (Haug et al. 2011). Functional relationships between marine mammals and their prey appear closely related to fluctuations in marine ecosystems.

Altogether thirty-three species of seabird are thought to breed regularly in the Barents Sea, which has one of the largest concentrations of seabirds in the world (Anker-Nilssen et al. 2000). Its twenty million seabirds harvest approximately 1.2 million tonnes of biomass from the area each year (Barrett et al. 2002). Their food preferences include meso-zooplankton, larger crustacea, juvenile fish (including cod, saithe and herring) and small pelagic fish like capelin and polar cod (Fauchald et al. 2011)

Norwegian Sea

The varying depths of the Norwegian Sea make it logical to divide the ecosystem into three vertical categories: the deep bathypelagic zone (below approximately 1,000 m), with deep-water species and benthic organisms; the mesopelagic zone (between approximately 200 m and 1,000 m); and the upper epipelagic zone (0 to approximately 200 m). Although there is some interaction among these zones, in this chapter we focus on the upper layer, where the main historical commercial pelagic species are found. Figure 6.5 shows the key actors in the Norwegian Sea ecosystem.

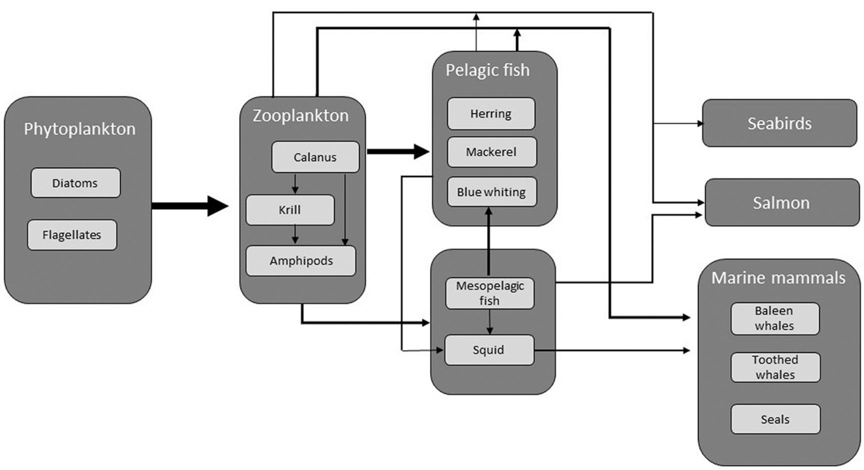


Figure 6.5 Simplified diagram of the food web of the Norwegian Sea ecosystem. Redrawn from Skjoldal (2004).

Plant production by phytoplankton forms the basis of the food web. Several species of diatoms and flagellates may be regarded as the main actors in terms of energy flow to higher trophic levels. Rey (2004) has provided a detailed description of the seasonal changes in the phytoplankton in the Norwegian Sea. During winter and early spring, phytoplankton production and biomass tend to be low, composed mostly of small flagellates. Production, mainly by diatoms, begins in early March and continues through April in response to high nitrates and increasing light levels, but at highly variable rates. By early May, the spring bloom of diatoms develops as stratification increases. However, chlorophyll-a concentrations seldom exceed 3 mg/m^3, due to grazing by zooplankton. The spring blooms first develop in the coastal waters over the Norwegian Shelf, but there is no clear latitudinal trend in the Norwegian Sea as to the timing of the blooms. In summer, production decreases, with the proportion of diatoms dropping to 30 per cent, replaced by coccolithophorids, dinoflagellates and other flagellates.

Zooplankton serve as a link between phytoplankton and higher trophic levels such as fish, whales and seabirds – through predation in the case of the former, and as prey for the latter. Copepods, *Calanus* spp. in particular, are the most numerically abundant zooplankton group (Melle et al. 2004) and play an important role in the ecosystem. *C. finmarchicus* is the dominant herbivore and lives primarily in Atlantic or coastal waters. Overwintering in the deep Norwegian Sea, it ascends in the spring with much of its production transported or actively moving onto the shelves or into the Barents Sea. It has an annual life cycle: each new generation develops during spring and summer, nourished by the seasonal phytoplankton bloom. The larger *C. hyperboreus* has a similar life cycle, but is mostly confined to the colder waters of the western Norwegian Sea (Melle et al. 2004). It usually has a two-year life cycle, overwintering at depth and returning to the surface layer in the early spring to feed on phytoplankton blooms. However, depending upon food and environmental conditions, the cycle can vary from one to three years (Melle and Skjoldal 1998). In addition, three species of krill and some species of amphipods are important in the Norwegian Sea (Skjoldal et al. 2004).

Several small species of mesopelagic fish live at medium depths, typically 200–1,000 m (Salvanes 2004). Altogether thirty families of mesopelagic fishes have been identified worldwide (Salvanes and Kristoffersen 2001); in the Norwegian Sea, four species are the most abundant (Salvanes 2004). There are also cephalopods in the Norwegian Sea, such as cuttlefish, squids and octopuses (Bjørke and Gjøsæter 2004). European flying squid (*Todarodes sagittatus*) is the best-known among these species in Norwegian waters.

In the upper layer, three pelagic species dominate among the commercially important fish stocks in the Norwegian Sea: Norwegian spring-spawning herring, mackerel (*Scomber scombrus* L) and blue whiting (*Micromesitus poutassou*). These three fish stocks exhibit seasonal and annual variations in spatial distribution, and they may overlap horizontally and vertically (ICES 2019a). Where there is overlapping, density-dependent competition for food and predation can be expected. All the species are potential predators on eggs and larvae; mackerel is also a potential predator on juveniles. Consequently, cannibalism and interspecific predation is likely to play an important role in the dynamics of these pelagic stocks. Density-dependent growth has been observed for mackerel (Olafsdóttir et al. 2016) and for Norwegian spring-spawning herring. Further, several studies on diet composition have shown a high overlap (see overview in ICES 2016) and even intraguild predation between species, such as Northeast Atlantic mackerel predation on Norwegian spring-spawning herring larvae on the Norwegian Shelf area (Skaret et al. 2015). The Norwegian Sea and adjacent waters serve as the main summer feeding grounds for these three pelagic fish stocks (Skjoldal et al. 2004; Langøy et al. 2012; ICES 2018). They are able to adapt their feeding strategy to different conditions – including herring preying in cold water masses, where they show significantly higher feeding incidence and stomach fullness (Bachiller et al. 2016). In recent years, the geographical distribution overlap between mackerel and herring has been most pronounced in the southwestern part of the Norwegian Sea. In 2018 there was very little overlap between mackerel and herring in the central Norwegian Sea (ICES 2019a). The cumulated spawning-stock biomass (SSB) of these three species increased from approximately 6 million tonnes in the early 1980s to 14 million tonnes in the mid-2000s and has since fluctuated between 13 and 15 million tonnes (ICES 2019b, Figure 6.6).

The marine mammals found in the Norwegian Sea belong to three main groups: baleen whales, toothed whales and seals. Most of them are long-distance migrants, swimming to their feeding areas in the summer months. There are only eleven marine mammals resident year-round in the Norwegian Sea and the surrounding Arctic areas (Nøttestad and Olsen 2004). The ecological role of marine mammals is a function of the prey available, and is linked to the ecology and behaviour of these prey species. The most readily available prey in the Norwegian Sea is pelagic zooplankton (krill and calanoid copepods), followed by pelagic fish species, and squid in the deeper layers.

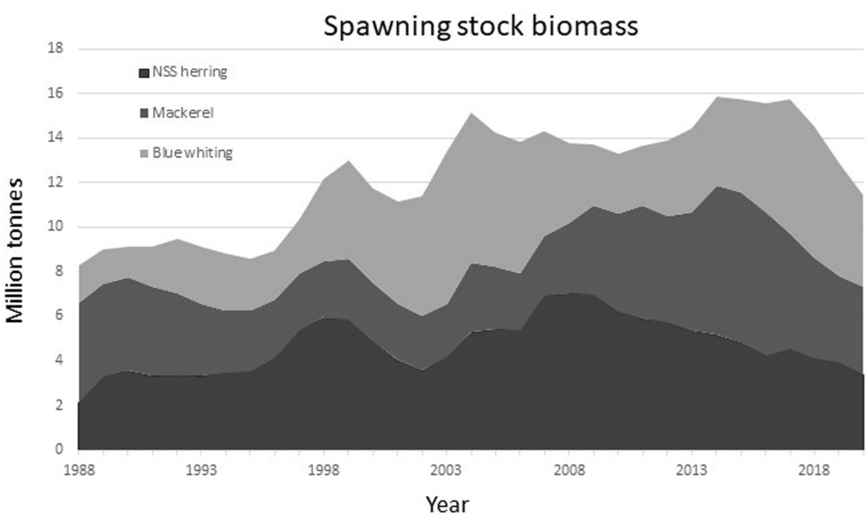


Figure 6.6 Cumulative spawning-stock biomass for Norwegian spring-spawning herring (NSSH), mackerel and blue whiting, 1988–2021 (updated figure from ICES 2019b with data from ICES 2021).

The Norwegian Sea is an important area for some of the largest seabird populations in the Northeast Atlantic. They breed along the Norwegian coast, in the Shetland and Faroe Islands, Iceland and Jan Mayen: altogether 4.5 million pairs breed in the Norwegian Sea (Anker-Nilssen and Lorentsen 2004).

Important biological resources

The Institute of Marine Research in Norway gives advice on ten species in the Barents Sea and twenty-six in the Norwegian Sea. Some of these species are found in both seas – like redfish (*Sebastes mentella*), which is managed under the Norwegian Sea but is also caught in the Barents Sea. Here we have chosen only two species for closer analyses in each of the seas. In the Barents Sea, cod has been the most important commercial species for many years, whereas snow crab is a relatively new commercial species in the Barents Sea. In the Norwegian Sea we focus on the two most commercial important species, mackerel and Norwegian spring-spawning herring. Figure 6.7 shows the general distribution of these species as observed prior to 2020. Note that the distribution maps show where the species have been observed. Within this area the

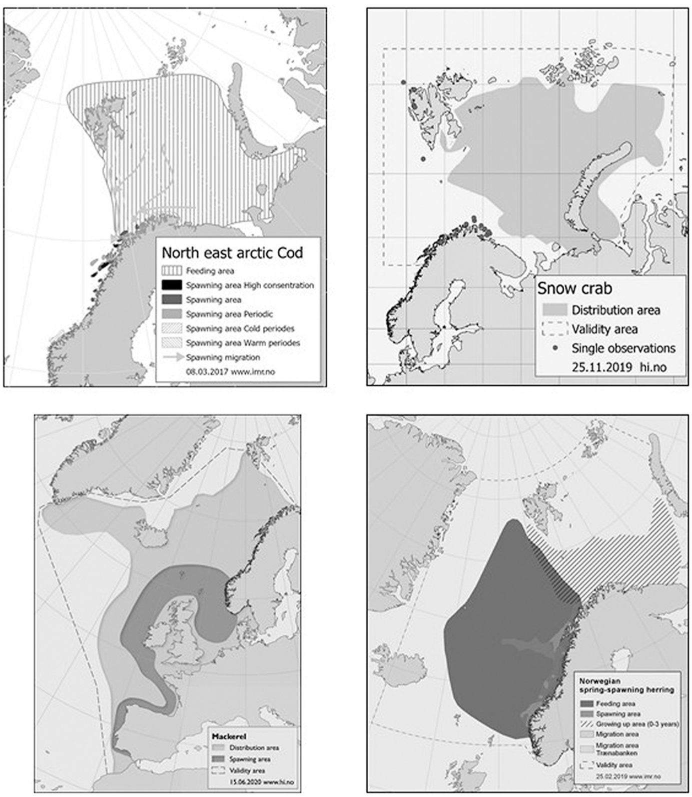


Figure 6.7 Spawning areas and distribution area of Northeast Arctic cod (*upper left*), snow crab (*upper right*) mackerel (*lower left*) and herring (*lower right*). (IMR official maps).

species have seasonal spawning and feeding migration patterns, as well as variation in abundance and location on annual and multi-decadal timescales.

Barents Sea case: Northeast Arctic cod

Northeast Arctic cod (*Gadus morhua*) is the most valuable commercial demersal species inhabiting the shelf areas off Norway and in the Barents Sea. Cod used to live mainly in the southern Barents Sea, around Bear Island and Hopen, and along the coast of Spitsbergen (Yaragina et al. 2011). After 2010, the cod stock have been observed north to the continental shelf break north of Svalbard at approximately 82°30'N (Figure 6.8).

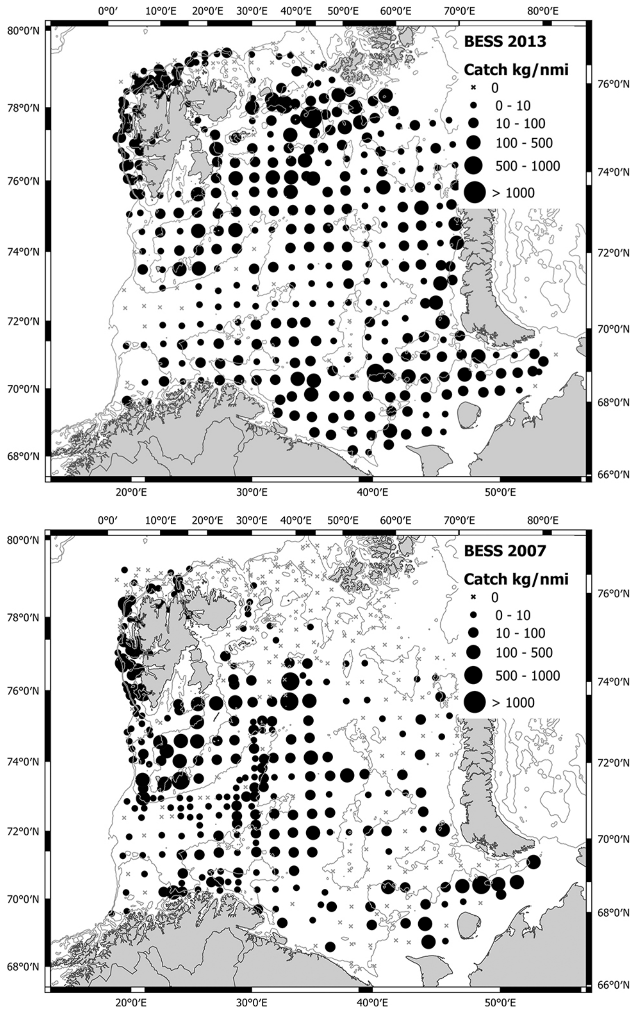


Figure 6.8 Distribution of Northeast Arctic cod autumn 2007 (left) and 2013 (right) from the Joint Norwegian/Russian Ecosystem survey in the Barents Sea (BESS).

The entire Barents Sea is the feeding ground for both young and adult Northeast Arctic cod. The mature part of the stock starts spawning migration to the Norwegian coast in the winter. Spawning take place in March/April at locations spread along most of the western coast of Norway, with main spawning grounds between the coasts of Møre and Finnmark, and a focal site around Lofoten (Sundby and Nakken 2008). Eggs and larvae drift in the Norwegian coastal current back into the Barents Sea, where they settle at the bottom in the autumn.

In recent decades, cod has increased its distribution area northwards, with the northernmost distribution observed in 2012 and 2013. Cod typically avoid bottom temperatures less than 0 °C. Changes in distribution are closely linked to changes in water temperature. The warming of the Barents Sea since the late 1990s has made larger areas available for cod. However, the size of the cod stock has also increased – and a large stock necessarily requires a larger feeding area. Maximum biomass (2013, Figure 6.9) occurs at the same period as maximum distribution area in the Barents Sea has been observed (Figure 6.8). The northerly distribution between 2010 and 2020 is due to a combination of favourable temperature conditions and a very large cod stock.

There have been great variations in the biomass of cod since the mid-1940s (Figure 6.9). From a biomass maximum in 1946, at 4 million tonnes (age 3 and older), the stock decreased till the early 1980s, and then increased, having now reached a high level of about 3 million tonnes.

Cod plays a dominant role in the Barents Sea ecosystem as an important predator due to its high abundance, long migration and omnivorous feeding habits, which influence practically all trophic links. Northeast Arctic cod consumes a very wide range of food items and can switch relatively easily to prey that is more abundant

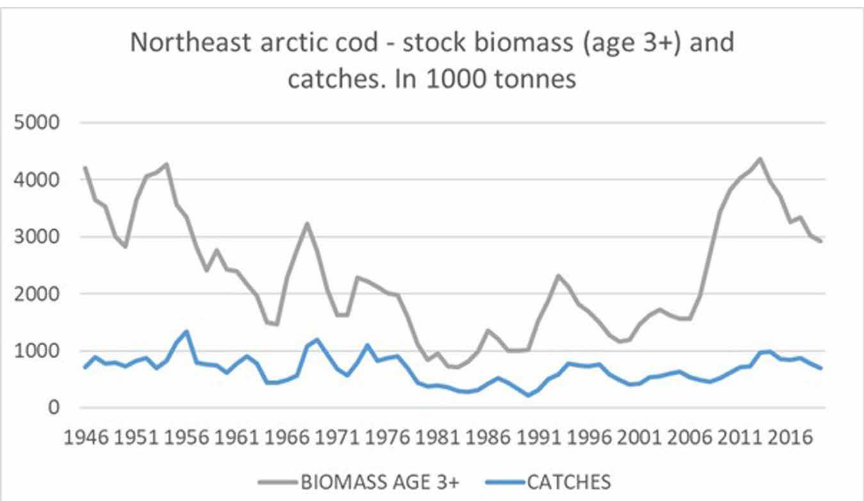


Figure 6.9 Biomass and catches of Northeast Arctic cod in the Barents Sea (ICES 2020b).

in a given season and area (Yaragina et al. 2011). Cod juveniles are mainly plankton feeders; older fish feed on large crustaceans and fish, including cannibalism on its own species. Larger fish species predominate in the diet of the oldest cod. More than two hundred species have been identified in the stomachs of adult cod; the most dominant species are shown in Figure 6.10. Fish are the main prey, constituting around 70 per cent of the food biomass; zooplankton and shrimps are much less important, at 7–8 per cent in average (Dolgov et al. 2011). There are distinct size-related differences in diet composition between different length groups of cod. The composition of the cod diet is variable, with capelin (*Mallotus villosus*) as the most important food item. The proportion of capelin in the cod diet fell drastically during the two capelin collapses in 1986–9 and 1995–8. However, during the 2002–6 collapse, the decrease was less pronounced (Dolgov et al. 2011). Cannibalism increased during the first capelin collapses (1986–90).

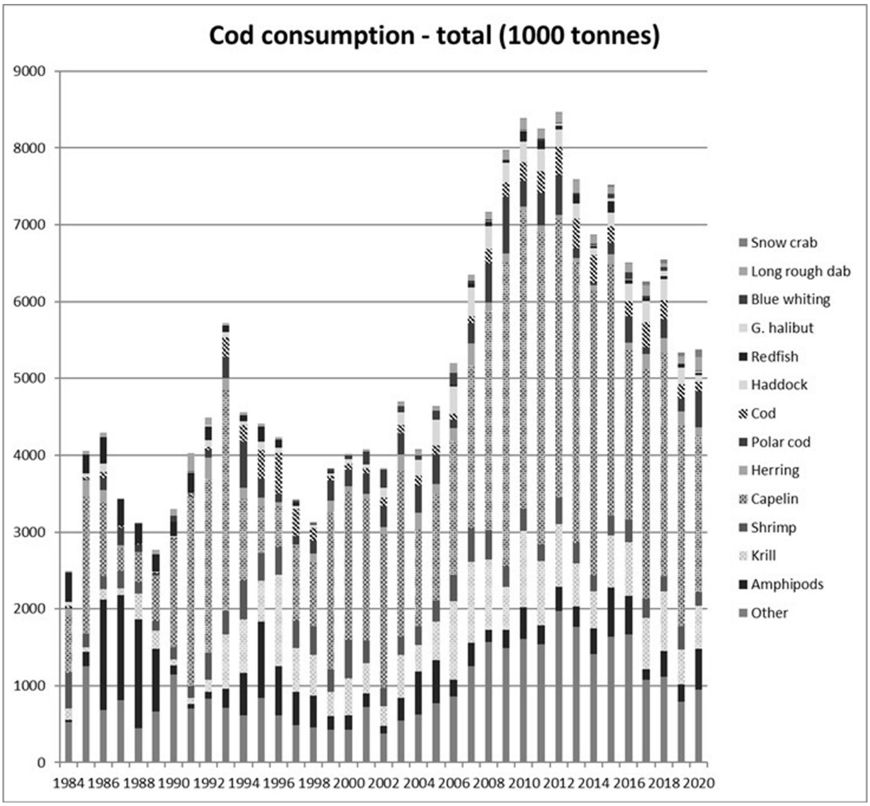


Figure 6.10 Northeast Arctic cod consumption of various species (ICES 2020b, updated with data to 2020).

Barents Sea case: snow crab

Snow crab is considered an invasive species in the Barents Sea (Araya-Schmidt 2019). It is unknown how or when this species began to populate the Barents Sea (Hansen 2016), but the first findings in the southeastern part of the Barents Sea were reported by Kuzmin et al. (1999). Snow crab has increased steadily in abundance and distribution each year (Alvsvåg et al. 2009; Pavlov and Sundet 2011); current distributions are shown in Figure 6.7. Snow crab is currently found in areas with bottom temperatures ranging from −0.7 to 3.4 °C and at depths between 180 and 350 m (Alvsvåg et al. 2009). Already a self-producing population in the Barents Sea, snow crab is expected to increase to more than 290 million specimens. Estimated carrying capacity of the Barents Sea is 436 million, according to Jørgensen and Spiridonov (2013). Most snow crab has been recorded in waters with temperatures below 2 °C; that small specimens are found exclusively at Goose Bank in the eastern Barents Sea indicates a recruiting area. Warming may push the snow crab further north, to Svalbard and Franz Josef Land. Snow crab feed mainly on benthos and fish (Jørgensen and Spiridonov 2013).

Fertilization probably takes place in the Barents Sea in May–June. For almost a year the female carries the eggs, which hatch just before the next fertilization. The larvae have a pelagic stage of two to three months before settling at the bottom. Taxonomic and genetic confirmed findings of snow crab larvae in the Barents Sea were published by Hjelset et al. (2021). It remains to be seen how a large population of snow crab will affect the Barents Sea ecosystem.

Norwegian Sea case: Norwegian spring-spawning herring

The Norwegian spring-spawning herring stock is by far the largest herring stock in the Northeast Atlantic, and the largest herring stock in the world (Holst et al. 2004). It is characterized by its large size, up to 40 cm and 700 grams. There are records of individuals of up to 20 years of age (Holst et al. 2004). The juveniles and adults are an important part of the ecosystems along the Norwegian coast, in the Barents Sea, in the Norwegian Sea and in adjoining waters (Figure 6.7) – as regards predation on zooplankton by herring, and herring as a food resource for higher trophic levels (like cod, saithe, seabirds and marine mammals). The predation intensity of, and on, herring exhibits seasonal, spatial and temporal variation as a consequence of variations in migration pattern, prey density, stock size, size of year-classes and stock sizes of competing stocks for resources and predators (ICES 2019a, 2019b).

Herring spawning takes place along the middle part of the western coast of Norway in February/March, with main location around the Møre area. The eggs are deposited at the bottom, where they hatch after approximately three weeks. In the early summer, the larvae drift with the Norwegian coastal current into the southern Barents Sea, where the herring spend their first three to four years before migrating back to the Norwegian Sea.

Norwegian spring-spawning herring is a highly migratory stock, and its migrations cover large parts of the Norwegian Sea when stock levels are high (Holst et al. 2004). It is not clear what drives the variability in migration of the stock, but the biomass and production of zooplankton are probable factors, as well as feeding competition with other pelagic fish species (e.g. mackerel) and oceanographic conditions (e.g. limitations due to cold areas) (ICES 2019a). Beside environmental factors, the age distribution in the stock will also influence migration. Changes in the migration patterns of herring are often linked to large year-classes entering the stock, initiating a different migration pattern which subsequent year-classes will follow. No large year-classes have entered the stock since 2004, although the 2013 year-class was estimated to be above average (since 1988) and was in 2018 observed feeding in the northeastern part of the Norwegian Sea (ICES 2019a).

Estimated spawning-stock biomass (SSB) varied by a factor of 16 during the period 1981–2019 (ICES 2019a; Figure 6.11). It was lowest in the 1980s, peaked at 7 million tonnes in 2007–9, gradually declined to 4 million tonnes as of 2019. The average for the

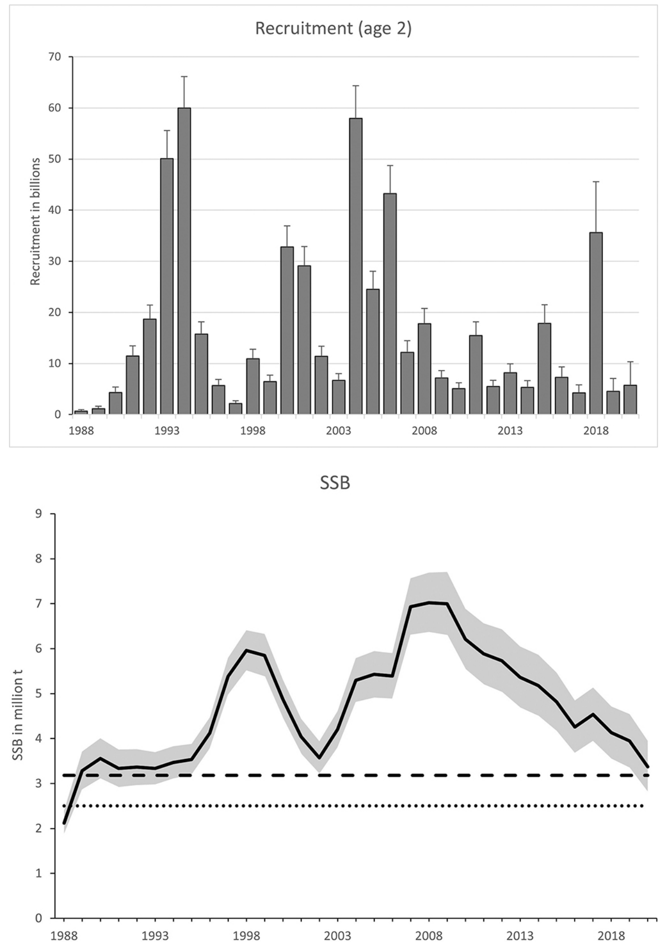


Figure 6.11 Recruitment and spawning-stock biomass of herring. Updated and redrawn from ICES (2020). Dashed line is Bpa and dotted line is Blim.

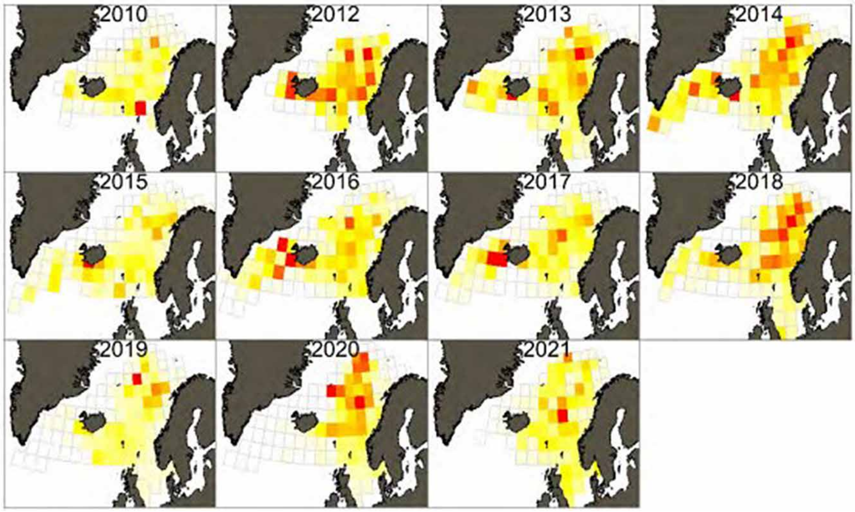


Figure 6.12 Distribution of mackerel during summer, 2010–2021.

period 1981–2019 was 3.9 million tonnes. The last year-class that with above-average recruitment was in 2004. Since 2004, only four year-classes have been average, whereas nine have been below average (ICES 2019b). This below-average estimated recruitment (age 2) over a decade is a major factor behind the gradual reduction of spawning-stock biomass (Figure 6.12).

Norwegian Sea case: Northeast Atlantic mackerel

Mackerel (*Scomber scombrus*) is widely distributed in the North Atlantic, with main spawning areas west of the British Isles and in the Bay of Biscay. After spawning, mackerel generally migrate into the southeastern Norwegian Sea. However, the distribution of mackerel in the area has varied considerably over the past 20 years, depending on sea temperatures, stock sizes and feeding conditions. Figure 6.12 shows the summertime distribution after 2010. The main reason for the expansion of feeding area is the increased size of the stock: there has been a succession of large year-classes since 2001, with all year-classes estimated to be above the long-term average (ICES 2019b) (Figure 6.13, upper panel).

The mackerel migration cycle is characterized by feeding in the northern part of its distribution, centred on the Norwegian Sea, during summer and autumn; it then spawns further south in January to July, southward from the Norwegian Sea (Utne et al. 2012; Brunel et al. 2017; Olafsdóttir et al. 2018).

From the 1990s to 2019, sizeable changes have been observed in summer-feeding distribution of mackerel, and on a smaller scale in the location of their spawning area. Further, the spawning-stock biomass (SSB) of mackerel is estimated to have increased since 2007, peaking in 2014, and declining since then (Figure 6.13).

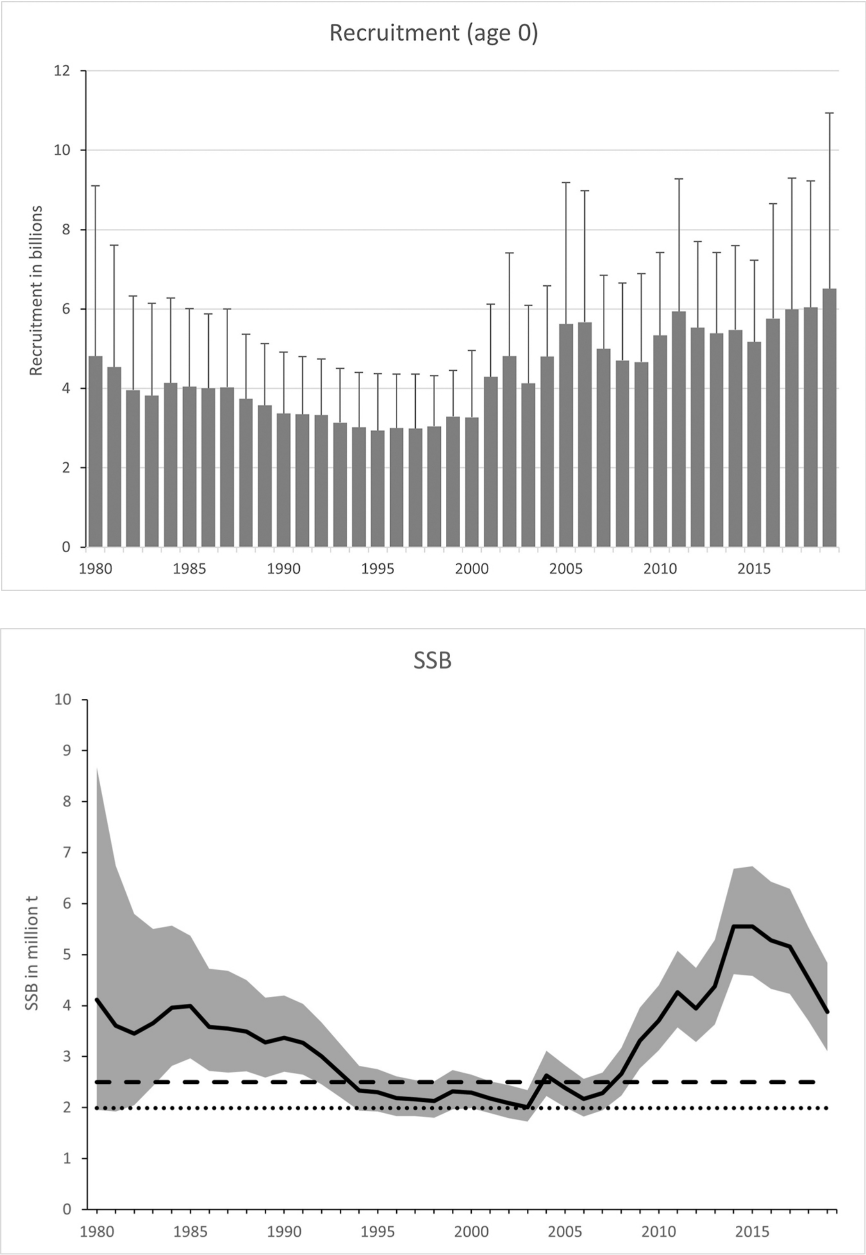


Figure 6.13 Recruitment and spawning-stock biomass of mackerel. Updated and redrawn from ICES (2020b). Dashed line is Bpa and dotted line is Blim.

Stomach analyses indicate that mackerel and herring have a similar diet, mainly calanoid copepods, especially *C. finmarchicus*. By contrast, blue whiting show lower diet overlap with these two species, broader diet composition and dominance of larger prey like euphausiids and amphipods (Langøy et al. 2012; Bachiller et al. 2016). Recent estimates (2005–10) based on bioenergetics show that these three species consume on average 135 million tonnes of zooplankton per year (Bachiller et al. 2016), which is higher than previous estimates such as those of Utne et al. (2012) and Skjoldal et al. (2004). Mackerel consumed 23–38 per cent, herring 38–51 per cent and blue whiting 14–39 per cent of the total zooplankton eaten by pelagic fish during the feeding season. Thus, in terms of consumption/biomass ratios, mackerel feeding rates may be as high as those of herring in some years (ICES 2019a).

Fisheries

Commercial fisheries in the Barents Sea ecoregion target only a few stocks. Demersal fish species dominate the catches, targeting cod, haddock and other gadoids. As fishing on capelin may disrupt the food chain between zooplankton and predators like cod, harp seals, minke whales and some birds, it is permitted only when the stock is sufficiently large to sustain the predation by cod and enable good recruitment. In addition, there is fishery on the benthic-living species deep-sea prawn, red king crab and snow crab. Harp seals and minke whales are also hunted in the region.

There are currently twelve nations with fisheries targeting the stocks in the Barents Sea ecoregion: Norway and Russia dominate, followed by the Faroe Islands and Iceland. Total landings peaked in the mid-1970s at over 4 million tonnes. In the past three decades, total landings have been between 1 and 2 million tonnes (ICES 2020a). The fisheries in the Norwegian Sea ecoregion are managed by Norway and by coastal states, with some fisheries managed by the North-East Atlantic Fisheries Commission (NEAFC).

Pelagic fishing by multinational fleets is the major activity in the ecoregion. The number of fishing vessels is declining whereas the sizes of the vessels are increasing. These fisheries are predominantly pelagic, targeting Norwegian spring-spawning herring, mackerel and blue whiting (ICES 2019d). The largest landings from the Norwegian Sea are by Norway, the Russian Federation, the Faroe Islands and Iceland. Annual catches in the ecoregion have varied between 700,000 tonnes to almost 1 million tonnes (ICES 2019d). Other stocks commercially harvested in the Norwegian Sea are Northeast Arctic saithe (*Pollachius virens*), redfish (*Sebastes* sp.), silver smelt (*Argentina silus*), Greenland halibut (*Reinhardtius hippoglossoides*), halibut (*Hippoglossus hippoglossus*), deep-water shrimps, the copepod *Calanus finmarchicus* and minke whale (*Balaenoptera acutorostrata*) (ICES 2019d).

Northeast Arctic cod

Catches of Northeast Arctic cod have varied between 0.3 and 1.3 million tonnes (Figure 6.14), with highest catches in the 1950s and the 1970s. The stock was heavily fished from the 1950s until the 1990s. Since around 2000 the stock has increased strongly; catches after 2010 have been above the long-term mean. In 2013, the maximum quota was set at 1 million tonnes. Catches have decreased since then but are still at a high level. The total quota set for 2022 was 708,480 million tonnes.

Snow crab

The first commercial catches were landed in 2012, by Norwegian vessels. Most catches have been in the central Barents Sea; after peaking at 18,000 tonnes in 2015, catches are now between 10,000 and 16,000 tonnes. Total quota in the Barents Sea for 2019 was 13,840 tonnes (Hjelset et al. 2019). Today only Norway and Russia are involved, but the EU had some catches in 2014–17. Model simulations indicate that annual catches may reach the 25,000–75,000-tonne range within the next ten years – probably even more if the stock continues to grow (Hvingel and Sundet 2014). The Norwegian quota for 2021 was set to 6,500 MT.

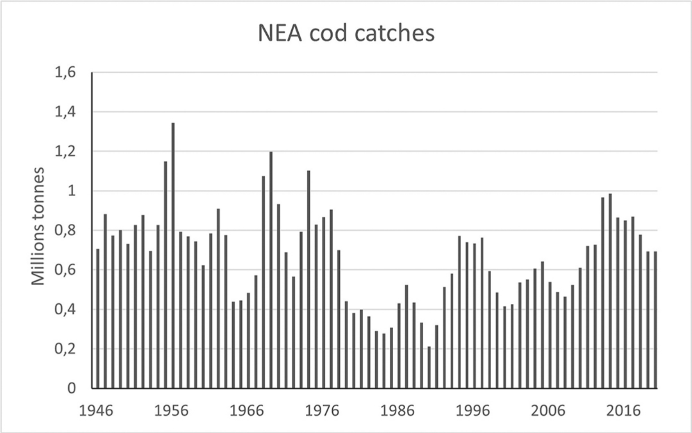
Norwegian spring-spawning herring

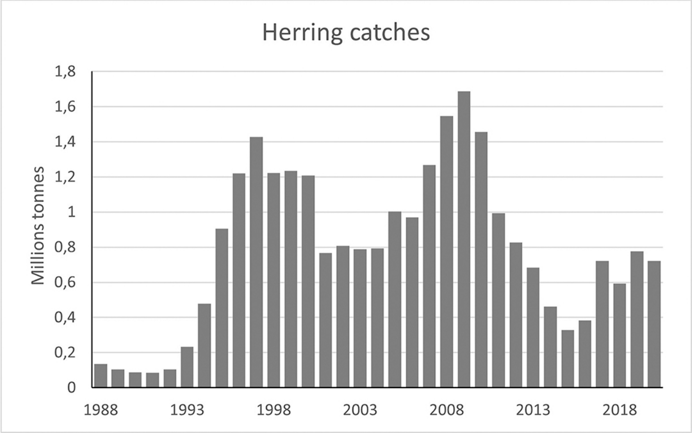
The fishery on Norwegian spring-spawning herring in the ecoregion has fluctuated greatly. After annual catches of 1–2 million tonnes in the 1950s and early 1960s, the stock collapsed and was almost depleted, until a strong year-class was spawned in 1983. Since then stocks have been rebuilding, peaking around 2010 with catches of 1–1.5 million tonnes (Figure 6.14), then steadily declining, and are now at medium-low levels of 400,000–600,000 tonnes. The quota set by ICES for 2022 was 598,585 tonnes. For 2021 ICES recommended a quota of 651,033 tonnes, but as the countries did not reach agreement, individual quotas were set at altogether 881,097 tonnes.

The main fishing actors here are Norway, followed by Iceland, the Faroe Islands, Russia and Denmark, with purse seine (51 per cent) and pelagic trawl (49 per cent) the most-used gear.

Northeast Atlantic mackerel

Landings of mackerel remained relatively stable at 600,000–800,000 tonnes in the 1980s, but in the 2010s catches have increased (Figure 6.14), in conjunction with the stock increase in abundance and distribution area, reaching a maximum of about 1.4 million tonnes in 2014. The quota recommended for 2022 was 794,920 tonnes by ICES, down by 125,000 since 2020. The major mackerel-fishing nations are Iceland, Russia, Greenland, the Faroe Islands and Norway, and the most-used gears are pelagic trawl (83 per cent) and purse seine (17 per cent).





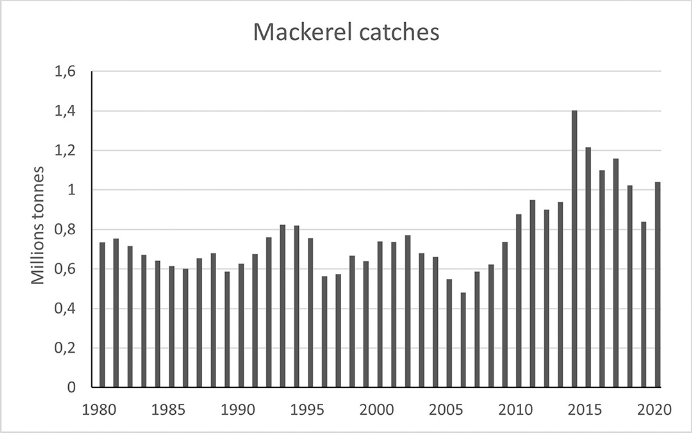


Figure 6.14 Catches of Northeast Arctic cod (*upper*), herring (*middle*) and mackerel (*lower*). Figures redrawn from ICES (2020c, 2020d, 2020e).

Climate development and climate impact

Already in the beginning of the last century Helland-Hansen and Nansen (1909) indicated that ocean temperature variations 'are the primary cause of the great and hitherto unaccountable fluctuations in the fisheries'. In his review of Norwegian cod and herring fisheries, Hjort (1914) reported fluctuations in fisheries dating back to the early 1700s, and added that attempts had been made to explain these fluctuations, but most theories were valueless, serving only 'as indicators of the state of general knowledge concerning marine biology at the time they arise'. Hjort was critical of the Helland-Hansen/Nansen hypothesis, but more recent investigations have shown that the physical conditions are important indicators for recruitment, distribution and growth of many commercially valuable species in the Barents Sea and Norwegian Sea (Ottersen and Loeng 2000; Ottersen et al. 2006; Loeng and Drinkwater 2007; Drinkwater et al. 2011; Årthun et al. 2018).

We now turn to the question of climate developments over the next fifty years, discussing what is known today about climate impact on fish stocks, and what may be expected in the years to come.

Future climate changes in physical conditions

The future development of the marine climate will depend heavily on future emissions of climate gases released to the atmosphere. The various Coupled Model Intercomparison Projects (e.g. CMIP5, Taylor et al. 2012) offer many global climate models, each delivering projections of the future climate according to differing greenhouse gas (GHG) concentration trajectories (RCPs) adopted by the IPCC for its Fifth Assessment Report (IPCC 2013). These climate models are global and run with relatively low horizontal resolution. To provide projections with more detailed and realistic circulation and hydrographic properties in the Nordic and Barents Seas, these climate models can be downscaled with regional models. For the results shown in Figures 6.15–6.17 here, we have used the Regional Ocean Modeling System (ROMS, Shchepetkin and McWilliams 2005) to downscale the Norwegian Earth System Model (NorESM, Bentsen et al. 2013) forced with the RCP4.5 scenario. In this scenario, emissions peak around 2040, whereas the resulting radiative forcing will stabilize towards the end of the twenty-first century at an increased level of 4.5 W m^2 relative to preindustrial times.

This downscaled projection covers the North Atlantic Ocean, the Nordic and Barents Seas, and the Arctic Ocean, and has been evaluated and applied in previous studies on effects of climate change on the marine ecosystem (Skogen et al. 2018; Sandø et al. 2020, Sandø et al. 2021). In addition to the warming due to anthropogenic emissions of GHGs there is also a considerable contribution from natural variability in the climate system. Such natural variability can dominate climate variability on inter-annual to decadal timescales; however, as the contributions from anthropogenic emissions are small but positive every year, these are expected to dominate on centennial timescales (Hawkins and Sutton 2009). Finally, it should be noted that years with extremes related

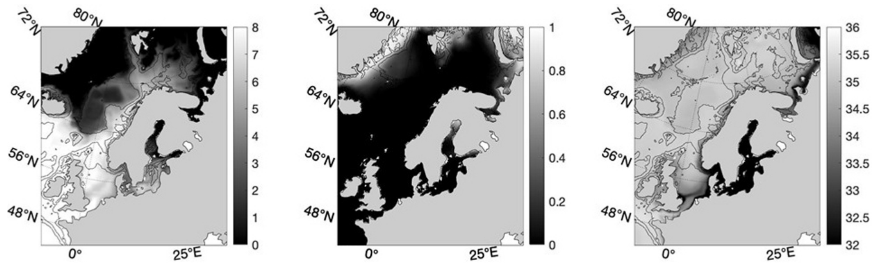


Figure 6.15 Present-day climate (average 2010–19) winter sea surface temperature (°C) (*left*), sea-ice concentration (*middle*) and sea surface salinity (*right*), from the RCP4.5 scenario.

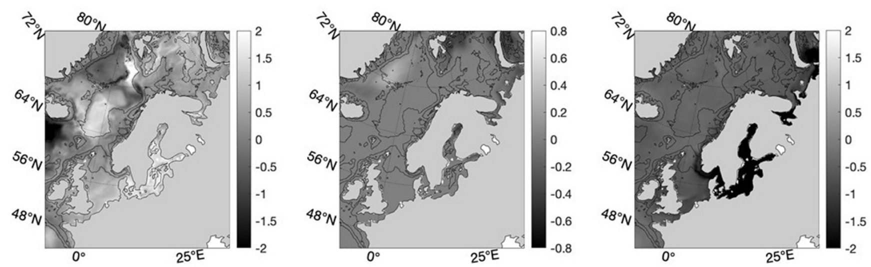


Figure 6.16 Future change, given as the difference between the projected future (average 2060–9) and present (average 2010–19). Winter sea surface temperature (°C) (*left*), sea-ice concentration (*middle*) and sea surface salinity (*right*). From the RCP4.5 scenario.

to natural variability occur randomly in climate projections, and that the extreme years in the ensemble member downscaled here are not intended as a prediction of *when* these will happen in the future – it is more to show that such extremes *will* occur on top of global warming.

Winter sea surface temperature (SST), sea-ice concentration (SIC) and sea surface salinity (SSS) for the first decade of the simulation (2010s) and possible changes fifty years from now (2060s minus 2010s) are shown in Figures 6.15 and 6.16, respectively. Figure 6.17 shows time-series of SST in polygons representing various regions in the Norwegian Sea and the Barents Sea.

The sea surface temperature time-series in Figure 6.17 show large inter-annual and decadal variability. Less clear are the long-term trends, which are relatively small but positive in all regions. The projected change for SST at the Barents Sea Opening is low, and less than the 1 °C projected for the same period by Ellingsen et al. (2008).

Figure 6.18 illustrates how the variation on different timescales superpositions to give the observed temperature. In the future, it will be very difficult to predict annual variation for any specific year. However, the range of variations around the longer multi-decadal signal overlaying climate-change scenario development is likely to be

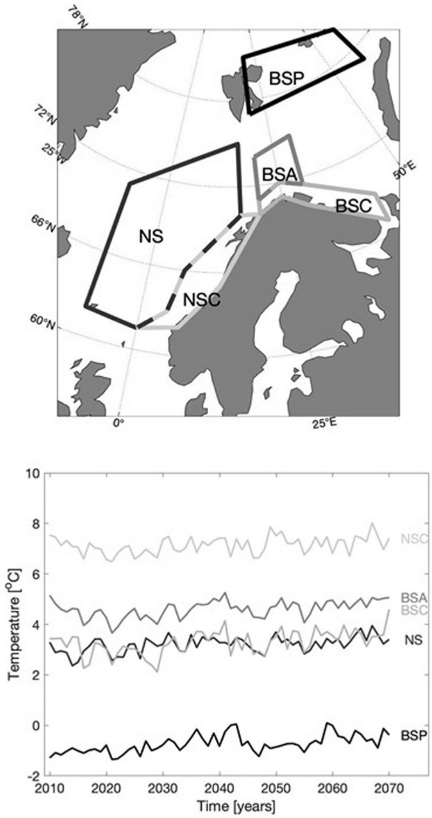


Figure 6.17 Map of polygons (*left*) from which time-series of sea surface temperature (°C) (*right*) in Norwegian Sea Coast, Norwegian Sea, Barents Sea Atlantic, Barents Sea Coast and Barents Sea Polar are calculated.

the same in the future as it was historically. This variation is illustrated by the vertical bars after 2010, showing that the temperature observed in any given year in the future will be somewhere along the blue vertical line. This figure is calculated for the time-series data from the Kola section in the southern Barents Sea, but the development should not differ in the Northern Barents Sea or in the Norwegian Sea.

Effects of climate change and variability

Climate variability and change are known to have many and diverse biological effects – directly on an organism, such as through inducing physiological changes, or indirectly, for example through their effect on predators and prey. In this section we summarize what is known about climate impact on *fish stocks* in the Norwegian and Barents Sea – not climate effects on plankton production, the major food source for fish larvae and pelagic fish.

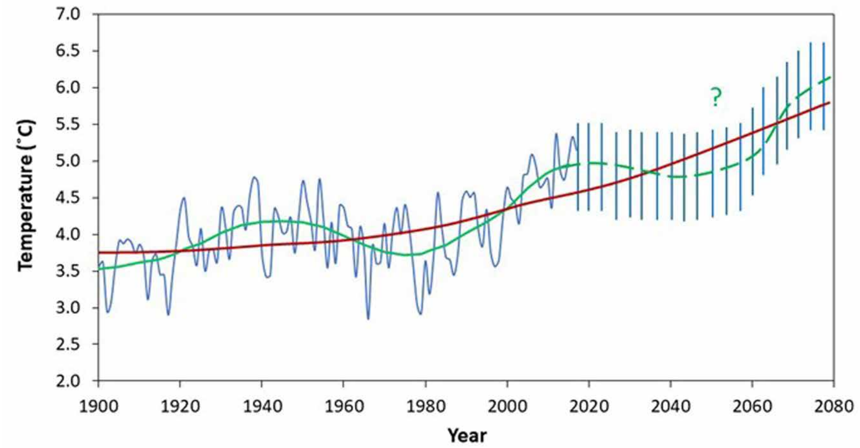


Figure 6.18 Observed and predicted ocean climate in the Northeast Atlantic represented by the Atlantic water masses in the Barents Sea. Thin line: annual mean temperature observations (stations 4–7, 0–200 m depth) of the Kola Section, Barents Sea (source: PINRO [now VNIRO Polar Branch], Murmansk, Russia). Thick, undulating line: 30-year low-pass filter of the annual mean temperature observations depicting the processes linked to Atlantic Multidecadal Oscillation (AMO). Thick, positive trend line: the long-term temperature trend including prediction on anthropogenic climate change for the Barents Sea (IPCC B2 Scenario, corresponding to an in-between RCP 2.6 and 4.5 Scenario). Stippled line: future multi-decadal climate signal under the assumption (note the interrogation mark) that amplitude and periodicity continue as during the past century. Bars: range of inter-annual variability as during the past century. (Figure from Gullestad et al. 2020.)

Impact on recruitment

Sætersdal and Loeng (1987) concluded that most of the year-classes of high and medium abundance for cod, haddock and herring were either associated directly with positive temperature anomalies in the early part of a warm period in the Barents Sea, when feeding areas are expanding, or occurred immediately prior to a shift to a warmer regime. Good year-classes never occur in cold years, but may be produced in warm years. The results indicate that high temperature is a necessary but not sufficient condition for the production of year-classes of high abundance (Ellertsen et al. 1989). Ottersen et al. (2006) showed that the statistical relationship between temperature and the recruitment of Barents Sea cod had increased during the final decades of the twentieth century. Several main reasons have been suggested for the linkage between temperature and recruitment: higher primary production because of larger ice-free area (Svendsen et al. 2007); a greater influx of zooplankton carried by the increased inflow of Atlantic water (Sundby 2000); and higher temperatures promoting higher biological activity at all trophic levels (Sakshaug 1997).

Impact on growth

Nakken and Raknes (1987) concluded that growth of cod increased significantly with increasing temperature. They also noted out that, in growth studies of cod, the coupling between environmental changes and population parameters, such as areas of distribution, abundance, growth and maturity, was probably far more complex than a simple length/ temperature relationship. Gjøsæter and Loeng (1987) came to the same conclusion in their study of the growth of capelin. It is apparent that temperature effects linked to the availability of food may be as important as these direct effects, but various underlying mechanisms are conceivable. A shift in climate could change the general physical conditions, thus altering the availability of nutrients for the primary producers. It could also affect the growth of organisms at different levels in the food web and influence the abundance of food competitors, predators – and so on. Loeng et al. (1995) concluded that, with the larvae of cod, haddock and herring, growth tended to increase with increasing temperatures. This was confirmed by Ottersen and Loeng (2000), who showed that variation in juvenile growth is driven primarily by temperature.

Impact on distribution

Several factors need to be considered in connection with fish distribution.

- Bottom topography: demersal species will have only short feeding migration into deep ocean areas, like the Norwegian Sea and the Arctic Ocean. For pelagic species, topography may not be directly important for migration, except perhaps for spawning.
- Climatic conditions: temperature developments determine which areas are available for the various fish stocks, as they have temperature preferences. Sea ice may also have an impact. Salinity influences the vertical layering of the water masses, and water-mass type.
- Food conditions: an important factor that influences the migration of all fish stocks.
- Stock abundance: as a large stock needs more food than a small one, the distribution area expands with a large stock; also important is fish density: someone will have to move if things get too crowded.

The 'potential for movement' assessment utilized the best available information regarding how different species have responded to environmental conditions in the past, and applied these relationships to infer the future distributions and abundance of commercial species. The assessment by Cheung et al. (2009) utilized the best available information on how different species have responded to environmental conditions in the past, and applied these relationships to infer future distributions and abundance of commercial species. Using this approach, these authors identified how bio-climatic envelopes would shift under climate change, employing a narrow suite of factors governing the responses to climate change. They also predicted that the polar regions would experience a high rate of invasions by new species. However, Hollowed et al. (2013b) included a broader suite of factors governing the potential for movement to the Arctic, and concluded that only a few species had a high probability of expanding or moving into the Arctic. This would indicate that bio-climatic envelope models alone are insufficient for making projections – species interactions, life history and behavioural responses must be included. For example, demersal species are unlikely to move far into the deep Arctic Ocean because of the depths, but are more likely to shift eastwards into the Kara Sea.

Pelagic species that exhibit long-distance feeding migrations may be capable of utilizing the Arctic Ocean as a summer feeding area if temperature and food conditions are suitable. However, examples of simulation studies indicate that pelagic foragers may predominantly track gradients in prey (Humston et al. 2004). Gradient-tracking foragers are likely to conserve energy and forage on local prey sources. Therefore, the emergence of foraging migrations into the Arctic is likely to take considerable time to evolve. There are many unknown factors that might have an impact on the future distribution of fish stock, and complex, nonlinear responses are likely to occur. For example, the indirect effect of climate through the food web may be as important as the direct effect of thermal habitat suitability. The framework shows that the potential impact of climate change is likely to differ by region and species.

Fossheim et al. (2015) found that the recent warming in the Barents Sea has led to a change in spatial distribution of fish communities, with boreal communities expanding northwards at a pace reflecting the rate of local climate change. Increased abundance and distribution areas of large, migratory fish predators can explain the observed community-wide distributional shifts, which in turn change the ecological interactions experienced by Arctic fish species. For instance, the Arctic shelf fish community retracted northwards to deeper areas bordering the deep polar basin. Depth is likely to limit the further retraction of some fish species in the Arctic shelf community. As a consequence of warming, many incoming species experience increasing abundances and expanding distribution ranges in the ocean. Eriksen (2017) concluded that the pelagic community has undergone major changes since 2000, going from a colder to a warmer temperature regime and from a low- to a high-productive pelagic community. Her results support general expectations as regards climate change: increased production in the northern marine systems, and contraction and decline of Arctic species whereas boreal species expand their distribution.

Such expansion in distribution is not necessarily related solely to the warming climate. The post-2010 expansion in mackerel summer distribution in the Norwegian Sea was facilitated by increasing stock size, and constrained by the availability of preferred ambient temperature range (9–13 °C) and mesozooplankton (Olafsdóttir et al. 2018). Distribution retraction in recent years has coincided with declining stock size, but has not been concurrent with changes in temperature or prey abundance (ICES 2019b). We do not know why mackerel distribution in the westward area has retracted drastically, compared to mackerel distribution in the Norwegian Sea. In 2019, temperatures in the westward area were within the range preferred by mackerel, and mesozooplankton abundance was similar to or higher than in the years when mackerel was abundant in the area (ICES 2019b). More research is needed to explain which factors influence the migration route taken by mackerel after spawning, whether northward into the Norwegian Sea or westward towards Iceland and Greenland.

Also, the rise and the fall of the blue whiting stock is likely to have been related to changing oceanographic conditions (Payne et al. 2012). The expansion of their feeding area into the Barents Sea in the first decade after 2000 was probably connected to the high abundance of the stock. When this stock collapsed again, the feeding area contracted to mainly the Norwegian Sea. However, the temperature habitat was suitable for such an expansion, due to the previous warming. Landa et al. (2014) concluded that, on a year-to-year basis, the distribution boundaries for cod are related more to abundance than to ecosystem temperature. However, long-term trends indicate an expansion in distribution boundaries for many commercial species, probably indirectly related to the increase in ecosystem temperature.

Effect of future climate change on distribution of fish stocks

From the observations described above, we expect future climate change to have impacts on recruitment, growth and distribution of most fish species. In addition, we expect new species to enter the Norwegian and the Barents Seas. On the other hand, fishing has made it more difficult to attribute changes in fish populations to climate. While many wish to attribute changes to either fishing or to climate, the two interact and their effects cannot often be separated. For example, Ottersen et al. (2006) found that the age at maturity of cod had decreased over recent decades from +13 years to 8–10 years. They attributed the increase in the correlation between temperature and recruitment over this period to heightened climate sensitivity caused by fishing. Future studies will need to focus not only on the mechanisms through which climate affects the structure and function of marine ecosystems but also on the interaction between fishing and climate. Only then we can tackle issues of ecosystem responses to future climate change.

Earlier studies have projected shifts in bio-climatic habitats of marine species, concluding that new species will colonize high-latitude ecosystems at an accelerated rate relative to other regions of the globe (see Cheung et al. 2009; Hollowed et at. 2018). However, closer examination of the processes governing fish distributions has shown that range expansions and successful colonization of new regions will hinge on a complex suite of factors (Walther 2010), including habitat suitability, habitat quality and population size (Auster and Link 2009). Arctic marine ecosystems include many specialist species that have gradually managed to adapt to the environment, but are challenged by the extreme inter-annual variations and the rapid pace of change now underway in the Arctic (ACIA 2005; Burrows et al. 2011; Duarte et al. 2012).

Another direct effect of increased ocean temperature is an increase in suitable feeding areas, which can offer release from food competition and cannibalism through extended overlap with prey (Årthun et al. 2018). Future expansion or movement of sub-Arctic commercial fish stocks from the Norwegian or Barents Seas into the Arctic appears increasingly likely, because the inflow of warm Atlantic water is stronger and the open-water connection with the Arctic Ocean provides greater access to the region. On the other hand, temperature is only one among several factors. For commercial fish stocks to expand their area, also important are food availability, depth conditions, stock size and distance to spawning area. Moreover, such areas must be upstream, so larvae can drift into the nursery area. Bottom-spawning species, like herring and capelin, require specific bottom conditions.

The northwards spatial distribution of the boreal fish noted by Fossheim et al. (2015) is likely to continue, due to the continuing warming with longer periods when the Barents Sea is ice-free. Increased abundance and distribution areas of large, migratory fish predators can explain the community-wide distributional shifts that have been observed. These shifts will change the ecological interactions experienced by fish species. The Arctic shelf fish community has retracted northwards to areas bordering the deep polar basin. However, depth will limit further retraction of some fish species in the Arctic shelf community, as Hollowed et al. (2013b) have pointed out. Fossheim et al. (2015) find that climate warming is inducing structural change over large spatial scales at high latitudes, leading to a borealization of fish communities in the Arctic. This in turn may lead to better food conditions for certain large demersal stocks like cod and haddock.

The success of invasive species like snow crab will depend on their habitat preference, which may entail a complex set of various factors, such as bottom substate, temperature variation range, availability of prey, the spawning or reproduction conditions, lack of predators, to mention only some. Under favourable conditions a species may expand, as seems to be the case for snow crab. Importantly, observations of young snow crab at several locations across the Barents Sea indicate a range of potential spawning sites: the snow crab may come to utilize the entire Barents Sea in much higher numbers than today.

Pelagic species such as Norwegian spring-spawning herring and capelin might expand and move into Arctic waters if prey resources and temperatures are sufficient to meet their metabolic demands. If the total biomass of pelagic fish in the Norwegian Sea does not exceed the present amount, however, major changes in distribution appear unlikely.

Drinkwater (2005) modelled the response of cod recruitment throughout the North Atlantic to future warming scenarios based on previous responses to climate variability. In the Barents Sea he found increases in cod recruitment from current values under temperature increases from 1 °C to 4 °C over present values. Coupled with expected higher growth rates, that would mean an increase in total biomass in the Barents Sea, in turn leading to increased fish catches (Drinkwater 2005; Stenevik and Sundby 2007). More cod is expected to spawn in the north and less in southern regions along the Norwegian coast (Sundby and Nakken 2008; Sandø et al. 2020) in the future. However, any increase in cod recruitment and distribution will hinge on changes in zooplankton production, *Calanus finmarchicus* in particular. The expected rise in abundance of the latter, an especially important food for juvenile cod, under future climate change (Ellingsen et al. 2008) supports the contention that cod recruitment is likely to increase. However, given suitable temperature and food conditions, Atlantic cod foraging might expand over the Arctic continental shelf areas. A few individuals of demersal fish stock like cod and haddock may well move into the deep Arctic Ocean for feeding – but not in large numbers, due to general population linkage to the bottom.

They are more likely to migrate eastwards along the shelf north of Novaya Zemlya. We assume that the northerly distribution observed in 2013 will be the northern border for the feeding migration of demersal stocks also in the future.

Sandø et al. (2020) used model results together with observations at current spawning sites to investigate how decadal variability in physical factors such as temperature, salinity and sea-ice extent may affect the spatial distribution of Northeast Arctic cod spawning sites along the Norwegian coast. Their study did not take into account any biological factors – which, as they acknowledged, may alter the result. They then concluded that, over the next fifty years, spawning sites may shift further northeastwards, with new locations along the Russian coast close to Murmansk, where low temperatures for many decades were a limiting factor on spawning during spring. The long-term latitudinal shifts in spawning habitats along the Norwegian coast may also be indirectly linked to temperature through the latitudinal shift of the sea-ice edge and the corresponding shift in available ice-free predation habitats, which control the average migration distance to spawning sites (Sandø et al. 2020).

That being said, however, models do not always yield correct results. Here we may recall the study by Wisz et al. (2015), showing that cod would not have suitable environmental conditions in the Barents Sea before 2050! Their article is an example of how mistaken a model result might be if the researcher does not check how the situation in the ocean is today – and, for the cod in the Barents Sea, has been for at least the past thousand years.

Conclusions

Climatic variations and change have always influenced the biology of the ocean. For humans, the impacts on fish stocks are most important. Climate affects individual fish species variously: through factors such as growth and metabolism, on population level through changes in environmental habitat and spawning-site characteristics and on ecosystem level through prey and predators. Changes in a commercial stock can also be caused by fisheries. It is not uncommon for a commercial stock for approximately 30 per cent of the fishable part of the population to be harvested annually. Hence, observed variations in a fish stock may be due to both climate and fishing.

There is a close link between the Norwegian and Barents Seas, in terms of physical oceanography and ecosystems. For example, both regions exhibit high inter-annual as well as multi-decadal hydrographic variability. Cold periods were recorded in the early twentieth century and in the 1970s, and warm periods after 1930 and after 2000. These multi-decadal variations in temperature both amplify and counteract the slower increase in temperature due to climate change in the Barents Sea and the Norwegian Sea. Thus, there may be a moderate increase over the next twenty years, and then a higher increase in the ensuing forty years, as both climate change and multi-decadal oscillation will have positive trends.

The general picture regarding fish stocks is that northwards shifts in temperature habitats are opening new potential feeding areas farther north and east. The Northeast

Arctic cod is a demersal species that is now filling the entire Barents Sea. However, expansion northwards into the deep Arctic Ocean is not likely. Any further expansion is expected to be in eastern or northeastern direction. The picture is different for the snow crab, a new species entering an area well suited for expansion. This stock is expected to increase in abundance and further expand west and northwards in the Barents Sea. Mackerel and Norwegian spring-spawning herring are pelagic stocks with large feeding migrations into the Nordic Seas. Their distribution pattern is therefore strongly linked to prey availability, and food competition may be a limiting factor. Mackerel has had a considerable expansion in the Nordic Seas; it is now found all the way to the Murman coast in the east, to Svalbard in the north, and to Greenland in the west. This is believed to be due to a combination of favourable environmental conditions and stock abundance increase. It is clear that a future increase in temperature will create new feeding areas. However, the fish stocks will use these new areas only if their abundance is high. As pelagic stocks, they have the potential to expand further northwards and into the Arctic Ocean, but they are also limited by the need for favourable environmental conditions, food availability and proximity to suitable spawning sites.

Future warming is expected to lead to a change in spatial distribution of fish communities, with boreal communities expanding northwards at a pace reflecting the rate of local climate change. Increased abundance and distribution areas of large, migratory fish predators can explain the observed community-wide distributional shifts. The Arctic shelf fish community may retract northwards to areas bordering the deep polar basin. However, depth will limit further retraction of some fish species in the Arctic shelf community.

References

ACIA (2005), *Arctic Climate Impact Assessment*, Cambridge: Cambridge University Press.

Alvsvåg J., A-L. Agnalt and K. E. Jørstad (2009), 'Evidence for a Permanent Establishment of the Snow Crab (*Chionoecetes opilio*) in the Barents Sea', *Biological Invasions*, 11(3): 587–95.

Anker-Nilssen, T. and H. Lorentsen (2004), 'Seabirds in the Norwegian Sea', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 435–46, Trondheim: Tapir Academic Press.

Anker-Nilssen, T., V. Bakken, H. Strøm, A. N. Golovkin, V. V. Bianki and I. P. Tatarinkova (2000), *The Status of Marine Birds Breeding in the Barents Sea Region*, Tromsø: Norsk Polarinstitutt Rapportserie 113.

Araya-Schmidt, T., L. Olsen, L. Rindahl, R. B. Larsen and P. D. Winger (2019), 'Alternative Bait Trials in the Barents Sea Snow Crab Fishery', *PeerJ*, 7: e6874. https://doi.org/10.7717/peerj.6874.

Auster P. J. and J. S. Link (2009), 'Compensation and Recovery of Feeding Guilds in a Northwest Atlantic Shelf Fish Community', *Marine Ecology Progress Series* 382: 163–72. https://doi.org/10.3354/meps07962.

Bachiller, E., G. Skaret, L. Nøttestad and A. Slotte (2016), 'Feeding Ecology of Northeast Atlantic Mackerel, Norwegian Spring-spawning Herring and Blue Whiting in the Norwegian Sea', *PLOS ONE*, 11: e0149238.

Bachiller E., K. R. Utne, T. Jansen and G. Huse (2018), 'Bioenergetics Modelling of the Annual Consumption of Zooplankton by Pelagic Fish Feeding in the Northeast Atlantic', *PLOS ONE*, 13(1): e0190345. https://doi.org/10.1371/journal.pone.0190345.

Barrett, R. T., T. Anker-Nilssen, G. W. Gabrielsen and G. Chapdelaine (2002), 'Food Consumption by Seabirds in Norwegian Waters', *ICES Journal of Marine Science*, 59: 43–57.

Bentsen, M., I. Bethke, J. B. Debernard, T. Iversen, A. Kirkevåg, Ø. Seland, H. Drange, C. Roelandt, I. A. Seierstad, C. Hoose and J. E Kristjánsson (2013), 'The Norwegian Earth System Model, NorESM1-M – Part 1: Description and Basic Evaluation of the Physical Climate', *Geoscientific Model Development*, 6: 687–720. https://doi.org/10.5194/gmd-6-687-2013.

Bjelland, O. and J. C. Holst (2004), 'Other Fish Species and Fish Communities', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 357–70, Trondheim: Tapir Academic Press.

Bjørke, H. and H. Gjøsæter (2004), 'Cephalopods in the Norwegian Sea', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 371–94, Trondheim: Tapir Academic Press.

Blindheim, J. (2004), 'Oceanography and Climate', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 65–96, Trondheim: Tapir Academic Press.

Brunel T. C. Damme, M. Samson and M. Dickey-Collas (2017), 'Quantifying the Influence of Geography and Environment on the Northeast Atlantic Mackerel Spawning Distribution', *Fisheries Oceanography*, 27. doi: 10.1111/fog.12242.

Burrows, M. T., D. S. Schoeman, L. B. Buckley, P. Moore, E. S. Poloczanska, K. M. Brander, C. Brown, J. F. Bruno, C. M. Duarte, B. S. Halpern, J. Holding, C. V. Kappel, W. Kiessling, M. I. O'Connor, J. M. Pandolfi, C. Parmesan,F. B. Schwing, W. J. Sydema and A. J. Richardson (2011), 'The Pace of Shifting Climate in Marine and Terrestrial Ecosystemsì', *Science*, 334: 652–5.

Cheung, W. W. L., V. W. Y. Lam, J. L. Sarmiento, K. Kearney, R. Watson and D. Pauly (2009), 'Projecting Global Marine Biodiversity Impacts under Climate Change Scenarios', *Fish and Fisheries*, 10(3): 235 – 51. doi: 10.1111/j.1467-2979.2008.00315.x.

Dolgov, A. V., E. L. Orlova, E. Johannesen and B. Bogstad (2011), 'Piscivorous Fish', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian cooperation*, 466–84, Trondheim: Tapir Academic Press.

Drinkwater, K. F. (2005), 'The Response of Atlantic Cod (*Gadus morhua*) to Future Climate Change', *ICES Journal of Marine Science*, 62, 1327–37.

Drinkwater, K., H. Loeng, O. Titov and V. Boitsov (2011), 'Climate Impacts on the Barents Sea Ecosystem', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian Cooperation*, 777–807, Trondheim: Tapir Academic Press.

Drobysheva, S. S. (1994), *Barents Sea Euphausiids and their Role in Formation of Commercially Valuable Biological Resources*, Murmansk: PINRO Press. (In Russian.)

Drobysheva, S. S., V. N. Nesterova, A. G. Nikiforov and N. G. Zhukova (2003), 'The Role of a Warm Water Component in Formation of Euphausiid Local Aggregations in the Southern Barents Sea', *Journal of Fisheries*, 4(2): 209–16. (In Russian.)

Duarte, C., S. Agustí, P. Wassmann, J. Arrieta, M. Alcaraz, A. Coello-Camba, N. Marba, I. Hendriks, J. Holding, I. García-Zarandona, E. Kritzberg and D. Vaqué (2012), 'Tipping Elements in the Arctic Marine Ecosystem', *Ambio*, 41: 44–55. doi: 10.1007/s13280-011-0224-7.

Ellertsen, B., P. Fossum, P. Solemdal and S. Sundby (1989), 'Relation between Temperature and Survival of Eggs and First-feeding Larvae of Northeast Arctic cod (*Gadus morhua* L.)', *Rapports et Procès-Verbaux des Réunions / Conseil Permanent International pour l'Exploration de la Mer*, 191: 209–19.

Ellingsen, I. H., P. Dalpadado, D. Slagstad and H. Loeng (2008), 'Impact of Climatic Change on the Biological Production in the Barents Sea', *Climatic Change*, 87: 155–75.

Eriksen, E. (2017), 'Dynamics of the Barents Sea Pelagic Compartment: Species Distribution, Interaction and Response to Climate Variability'. Thesis, University of Bergen, Norway.

Fauchald, P., S. V. Ziryanov, H. Strøm, H. and R. T. Barrett (2011), 'Seabirds', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea; Ecosystem, Resources and Management. Half a Century of Russian–Norwegian cooperation*, 373–94, Trondheim: Tapir Academic Press.

Fossheim, M., E. M. Nilssen and M. Aschan (2006), 'Fish Assemblages in the Barents Sea', *Marine Biology*, 2: 260–9.

Fossheim, M., R. Primicerio, E. Johannesen, R. Ingvaldsen, M. Aschan and A. Dolgov (2015), 'Recent Warming Leads to a Rapid Borealization of Fish Communities in the Arctic', *Nature Climate Change* 5: 673–7. https://doi.org/10.1038/nclimate2647.

Gjøsæter, H. and H. Loeng (1987), 'Growth of the Barents Sea Capelin, *Mallotus villosus*, in Relation to Climate', *Environmental Biology of Fishes*, 20: 293–300.

Gullestad, P., S. Sundby and O. S. Kjesbu (2020), 'Management of Transboundary and Straddling Fish Stocks in the Northeast Atlantic in View of Climate-induced Shifts in Spatial Distribution', *Fish and Fisheries*, 21: 1008–26. https://doi.org/10.1111/faf.12485.

Hansen, H. S. B. (2016), 'Three Major Challenges in Managing Non-native Sedentary Barents Sea Snow Crab (*Chionoecetes opilio*)', *Marine Policy*, 71: 38–43.

Haug, T., A. Bjørge, N. Øien, S. Y. Ziryanov and A. P. Golikov (2011), 'Marine Mammals', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian cooperation*, 395–430, Trondheim: Tapir Academic Press.

Haug, T., B. Bogstad, M. Chierici, H. Gjøsæter, E. H. Hallfredsson, Å. S. Høines, A. H. Hoel, R. B. Ingvaldsen, L. L. Jørgensen, T. Knutsen, H. Loeng, L.-J. Naustvoll, I. Røttingen, and K. Sunnanå (2017), 'Future Harvest of Living Resources in the Arctic Ocean North of the Nordic and Barents Seas: A Review of Possibilities and Constraints', *Fisheries Research*, 188: 38–57.

Hawkins, E. and R. Sutton (2009), 'The Potential to Narrow Uncertainty in Regional Climate Predictions', *Bulletin of the American Meteorological Society*, 90: 1095–108. doi: 10.1175/2009BAMS2607.1.

Helland-Hansen, B. and F. Nansen (1909), *The Norwegian Sea: Its Physical Oceanography based upon the Norwegian Researches 1900–1904*. Report on Norwegian Fishery and Marine Investigations 2(2).

Hjelset, A. M., H. E. H. Danielsen, J. I. Westgaard and A-L. Agnalt (2021), 'Taxonomic and Genetic Confirmed Findings of Snow Crab *(Chionoecetes opilio)* larvae in the Barents Sea', *Polar Biology* 44: 2107–15. https://doi.org/10.1007/s00300-021-02946-w.

Hjelset, A. M., C. Hvingel and J. H. Sundet (2019), 'Snøkrabbe på norsk sokkel i Barentshavet, Bestandsvurdering og kvoterådgivning 2019 Rapport', Havforskningsinstituttet. (In Norwegian.)

Hjort, J. (1914), 'Fluctuations in the Great Fisheries of Northern Europe', *Rapports et Procès-Verbaux de Réunions, Conseil Permanent International pour l'Exploration de la Mer*: 20. https://core.ac.uk/download/pdf/225949122.pdf.

Hollowed, A. B. and S. Sundby (2014), 'Change is coming to the northern oceans', *Science* 344: 1084. doi: 10.1126/science.1251166.
Hollowed, A. B., M. Barange, R. J. Beamish, K. Brander, K. Cochrane, K. Drinkwater, M. G. G. Foreman, J. A. Hare, J. Holt, S.-i. Ito, S. Kim, J. R. King, H. Loeng, B. R. MacKenzie, F. J. Mueter, T. A. Okey, M. A. Peck, V. I. Radchenko, J. C. Rice, M. J. Schirripa, A. Yatsu and Y. Yamanaka (2013a), 'Projected Impacts of Climate Change on Marine Fish and Fisheries', *ICES Journal of Marine Science*. doi: 10.1093/icesjms/fst081.
Hollowed, A. B., B. Planque and H. Loeng (2013b), 'Potential Movement of Fish and Shellfish Stocks from the sub-Arctic to the Arctic Ocean', *Fisheries Oceanography*, 22 (5): 355–70.
Hollowed, A. B., W. Cheung, H. Loeng, E. Logerwell and J. Reist (2018), 'Regional Assessment of Climate Change Impacts on Arctic Marine Ecosystems', in B. F. Phillips and M. Perez-Ramirez (eds), *Climate Change Impacts on Fisheries and Aquaculture*, 703–28, London: Wiley-Blackwell.
Holst, J. C., I. Røttingen and W. Melle (2004), 'The Herring', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 203–26, Trondheim: Tapir Academic Press.
Humston, R., D. B. Olson and J. S. Ault (2004), 'Behavioral Asumptions in Models of Fish Movement and their Influence on Population Dynamics', *Transactions of the American Fisheries Society*, 133: 1304–28.
Hvingel, C. and J. H. Sundet (2014), 'Snow Crab – A Valuable New Fishery Resource in the Barents Sea?' *Barents Observer*, 20 March.
ICES (2016), *Final Report of the Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR)*, 7–11 December 2015, Reykjavik. ICES CM 2015/SSGIEA: 10.
ICES (2018), *International Ecosystem Survey in the Nordic* Sea *(IESNS) in May to June 2018*. WD No. 01 to Working Group on International Pelagic Surveys (WGIPS 2019) and Working Group on Widely Distributed Stocks (WGWIDE), Tórshavn, 28 August–3 September 2018. ICES SCIENTIFIC REPORTS 1: 36
ICES (2019a), Working Group on Widely Distributed Stocks (WGWIDE). *ICES Scientific Reports*. 1: 36. doi: 10.17895/ices.pub.5574.
ICES (2019b), Report of the Working Group on Integrated Ecosystem Assessments for the Norwegian Sea (WGINOR). ICES WGINOR REPORT 2018 26–30 November 2018. Reykjavik, ICES CM 2018/IEASG: 10.
ICES (2019c), ICES Report on Ocean Climate 2018. *ICES Cooperative Research Report No. 349*. https://doi.org/10.17895/ices.pub.5461.
ICES (2019d), Norwegian Sea Ecoregion – Ecosystem Overview. *ICES Ecosystem Overviews Norwegian Sea Ecoregion*, 12 December 2019.
ICES (2020a), Working Group on the Integrated Assessments of the Barents Sea (WGIBAR). *ICES Scientific Reports*, 2: 30. http://doi.org/10.17895/ices.pub.5998.
ICES (2020b), Arctic Fisheries Working Group (AFWG). *ICES Scientific Reports*, 2: 52. http://doi.org/10.17895/ices.pub.6050.
ICES (2020c), 'Cod (*Gadus morhua*) in Subareas 1 and 2 (Northeast Atlantic)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/cod.27.1-2.pdf.
ICES (2020d), 'Herring *(Clupea harengus)* in Subareas 1, 2, and 5, and in Divisions 4.a and 14.a, Norwegian Spring-spawning Herring (the Northeast Atlantic and the Arctic Ocean)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/her.27.1-24a514a.pdf.

ICES (2020e), 'Mackerel *(Scomber scombrus)* in Subareas 1–8 and 14, and in Division 9.a (the Northeast Atlantic and Adjacent Waters)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/mac.27.nea.pdf.

ICES (2021), Working Group on Widely Distributed Stocks (WGWIDE). *ICES Scientific Reports*, 3: 95. http://doi.org/10.17895/ices.pub.8298.

IPCC (2013), *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press.

Jakobsen, T. and V. K. Ozhigin, eds (2011), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian Cooperation*, Trondheim: Tapir Academic Press.

Jørgensen, L. L. and V. Spiridonov (2013), 'Effect from the King- and Snow Crab on the Barents Sea Benthos: Results and Conclusions from the Norwegian–Russian Workshop in Tromsø 2010', *Fisken & Havet*, 8.

Keenlyside, N., M. Latif, J. Jungclaus, L. Kornblueh and E. Roeckner (2008), 'Advancing Decadal-scale Climate Prediction in the North Atlantic Sector', *Nature*, 453: 84–8.

Kerr, R. (2008), 'Mother Nature Cools the Greenhouse, but Hotter Times Still Lie Ahead', *Science*, 320: 595.

Knight, J. R., R. J. Allan, C. K. Folland, M. Vellinga and M. E. Mann (2005), 'A Signature of Persistent Natural Thermohaline Circulation Cycles in Observed Climate', *Geophysical Research Letter*, 32. doi: 10.1029/2005GL024233.

Kushnir, Y. (1994), 'Interdecadal Variations in North Atlantic Sea Surface Temperature and Associated Atmosphere Conditions', *Journal of Climate*, 7: 141–57.

Kuzmin S. A., S. M. Akhtarin and D. T. Menis (1999), 'The First Finding of Snow Crab *Chionoecetes opilio* (Decapoda, Majidae) in the Barents Sea', *Zoologichesky Zhurnal*, 77 (4): 489–91.

Landa, C. S., G. Ottersen, S. Sundby, G. E. Dingsør and J. E. Stiansen (2014), 'Recruitment, Distribution Boundary and Habitat Temperature of an Arcto – boreal Gadoid in a Climatically Changing Environment: A Case Study on Northeast Arctic Haddock (Melanogrammus aeglefinus)', *Fisheries Oceanography*, 23(6): 506–20

Langøy, H., L. Nøttestad, G. Skaret, C. Broms and A. Fernö (2012), 'Overlap in Distribution and Diets of Atlantic Mackerel (*Scomber scombrus*), Norwegian Spring-spawning Herring (*Clupea harengus*) and Blue Whiting (*Micromesistius poutassou*) in the Norwegian Sea during Late Summer', *Marine Biology Research*, 8: 442–60.

Loeng, H. (1991), 'Features of the Physical Oceanographic Conditions in the Barents Sea', *Polar Research*, 10 (1): 5–18

Loeng, H. and K. Drinkwater (2007), 'An Overview of the Ecosystems of the Barents and Norwegian Seas and their Response to Climate Variability', *Deep-Sea Research II*, 54: 2478–500.

Loeng, H., H. Bjørke and G. Ottersen (1995), 'Larval Fish Growth in the Barents Sea', in R. J. Beamish (ed.), *Climate Change and Northern Fish Populations*, Canadian Special Publication of Fisheries and Aquatic Sciences, 121: 691–8

Mauchline, J. (1998), 'The Biology of Calanoid Copepods', *Advances in Marine Biology*, 33, London: Academic Press.

Melle, W. and H. R. Skjoldal (1998), 'Reproduction and Development of *Calanus finmarchicus, C. glacialis* and *C. hyperboreus* in the Barents Sea', *Marine Ecology Progress Series*, 169: 211–28.

Melle, W., B. Ellertsen and H. R. Skjoldal (2004), 'Zooplankton: The link to higher trophic levels', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 209–34, Trondheim: Tapir Academic Press.

Mork, K. A., Ø. Skagseth and H. Søiland (2019), 'Recent Warming and Freshening of the Norwegian Sea Observed by Argo Data', *Journal of Climate*, 36: 3695–705. https://doi.org/10.1175/JCLI-D-18-0591.s1.

Nakken, O. and A. Raknes (1987), 'The Distribution and Growth of Northeast Arctic Cod in Relation to Bottom Temperatures in the Barents Sea, 1978–1984', *Fisheries Research*, 5 (2–3): 243–52. https://doi.org/10.1016/0165-7836(87)90044-0.

Nummelin, A., C. Li and P. J. Hezel (2017), 'Connecting Ocean Heat Transport Changes from the Midlatitudes to the Arctic Ocean', *Geophysical Research Letters*, 44: 1899–908. https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2016GL071333.

Nøttestad, L. and E. Olsen (2004), 'Whales and Seals: Top Predators in the Ecosystem', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 395–434, Trondheim: Tapir Academic Press.

Olafsdóttir, A. H., A. Slotte, J. A. Jacobsen, G. J. Óskarsson, K. R. Utne and L. Nøttestad (2016), 'Changes in Weight-at-Length and Size-at-Age of Mature Northeast Atlantic Mackerel (*Scomber scombrus*) from 1984 to 2013: Effects of Mackerel Stock Size and Herring (*Clupea harengus*) Stock Size', *ICES Journal of Marine Science*, 73 (4), 1255–65. https://doi:10.1093/icesjms/fsv142.

Olafsdóttir, A. H., K. R. Utne, J. A. Jacobsen, T. Jansen, G. J. Óskarsson, L. Nøttestad, B. Þ. Elvarsson, C. Broms and A. Slotte (2018), 'Geographical Expansion of Northeast Atlantic Mackerel (*Scomber scombrus*) in the Nordic Seas from 2007 to 2016 was Primarily Driven by Stock Size and Constrained by Low Temperatures', *Deep-Sea Research II*. https://doi.org/10.1016/j.dsr2.2018.05.023.

Ottersen, G. and H. Loeng (2000), 'Covariability in Early Growth and Year-class Strength of Barents Sea Cod, Haddock and Herring: The Environmental Link', *ICES Journal of Marine Science*, 57: 339–48.

Ottersen, G., D. O. Hjermann and N. C. Stenseth (2006), 'Changes in Spawning Stock Structure Strengthen the Link between Climate and Recruitment in a Heavily Fished Cod (Gadus morhua) Stock', *Fisheries Oceanography*, 15: 230–43.

Ottersen, G., S. Kim, G. Huse, J. Polovina and N. C. Stenseth (2010), 'Major Pathways by which Climate May Force Marine Fish Populations', *Journal of Marine Systems*, 79: 343–60.

Ozhigin, V., R. Ingvaldsen, H. Loeng, V. Boitsov and A. Karsakov (2011), 'Introduction to the Barents Sea', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian Cooperation*, 39–76, Trondheim: Tapir Academic Press.

Pavlov, V. A. and J. H. Sundet (2011), 'Snow Crab', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea Ecosystem: Resources and Management. Half a Century of Russian–Norwegian Cooperation*, 168–71, Trondheim: Tapir Academic Press.

Payne, M. R., A. Egan, S. M. M. Fässler, H. Hátún, J. C. Holst, J. A. Jacobsen, A. Slotte and H. Loeng (2012), 'The Rise and Fall of the NE Atlantic Blue Whiting (*Micromesistius poutassou*)', *Marine Biology Research*, 8: 475–87. doi: 10.1080/17451000.2011.639778.

Planque, B., J. M. Fromentin, P. Cury, K. Drinkwater, S. Jennings, I. Perry and S. Kifani (2010), 'How Does Fishing Alter Marine Populations and Ecosystem Sensitivity to Climate?' *Journal of Marine Systems*, 79: 403–17.

Rey, F. (1981), 'The Development of the Spring Phytoplankton Outburst at Selected Sites off the Norwegian coast', in R. Sætre and M. Mork (eds), *The Norwegian Coastal Current*, 649– 80, Bergen: University of Bergen.

Rey, F. (1993), 'Planteplanktonet og dets primærproduksjon i det nordlige Barentshavetì', *Fisken og havet*, 10.

Rey, F. (2004), 'Phytoplankton: The Grass of the Sea', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 97–136, Trondheim: Tapir Academic Press.

Sakshaug, E. (1997), 'Biomass and Productivity Distributions and their Variability in the Barents Sea', *ICES Journal of Marine Science*, 54: 341–50.

Sakshaug, E., G. Johnsen and K. Kovacs, eds (2009), *Ecosystem Barents Sea*, Trondheim: Tapir Academic Press.

Salvanes, A. G. V. (2004), 'Mesopelagic Fish', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 301–14, Trondheim: Tapir Academic Press.

Salvanes, A. G. V and J. B. Kristoffersen (2001), 'Mesopelagic Fish', in J. Steele, S. Thorpe and K. Turekian (eds), *Encyclopedia of Ocean Sciences*, 1711–17, London: Academic Press.

Sandø, A. B., G. O. Johansen, A. Aglen, J. E. Stiansen and A. H. Renner (2020), 'Climate Change and New Potential Spawning Sites for Northeast Arctic Cod', *Frontiers in Marine Science*, 7: 28. https://www.frontiersin.org/article/10.3389/fmars.2020.00028.

Sandø, A. B., E. A. Mousing, W. P. Budgell, S. S. Hjøllo, M. D. Skogen and B. Ådlandsvik (2021), 'Barents Sea Plankton Production and Controlling Factors in a Fluctuating Climate', *ICES Journal of Marine Science*. https://doi.org/10.1093/icesjms/fsab067.

Shchepetkin, A. F. and J. C. McWilliams (2005), 'The Regional Oceanic Modeling System (ROMS): A Split-explicit, Free-surface, Topography-following-coordinate Oceanic Model', *Ocean Modelling*, 9: 347–404.

Simpson, S., S. Jennings, M. Johnson, J. Blanchard, P. Schon, D. Sims and M. Genner (2011), 'Continental Shelf-wide Response of a Fish Assemblage to Rapid Warming of the Sea', *Current Biology*, 21: 1565–70.

Sirenko, B. I. (2001), 'List of Species of Free-living Invertebrates of Eurasian Arctic Seas and Adjacent Deep Waters', *Explorations of the Fauna of the Seas*, 51 (59): 1–131.

Skagseth, Ø., T. Furevik, H. Loeng, R. Ingvaldsen, K. Mork, K. Orvik and V. Ozhigin (2008), 'Volume and Heat Transports to the Arctic Ocean via the Norwegian and Barents Seas', in R. Dickson, J. Meincke and P. Rhines (eds), *Arctic-Subarctic Ocean Fluxes*, 45–64, Dordrecht: Springer Netherlands.

Skaret G., E. Bachiller, H. Langøy and E. K. Stenevik (2015), 'Mackerel Predation on Herring Larvae during Summer Feeding in the Norwegian Sea', *ICES Journal of Marine Science*. doi: 10.1093/icesjms/fsv087.

Skjoldal, H. R., ed. (2004), *The Norwegian Sea Ecosystem*, Trondheim: Tapir Academic Press.

Skjoldal, H. R., P. Dalpadado and A. Dommasnes (2004), 'Food Webs and Trophic Interactions', in H. R. Skjoldal (ed.), *The Norwegian Sea Ecosystem*, 263–88, Trondheim: Tapir Academic Press.

Skogen, M. D., S. S. Hjøllo, A. B. Sandø and J. Tjiputra (2018), 'Future Ecosystem Changes in the Northeast Atlantic: A Comparison between a Global and a Regional Model System', *ICES Journal of Marine Science*, 75 (7): 2355–70.

Stenevik, E. K. and S. Sundby (2007), 'Impacts of Climate Change on Commercial Fish Stocks in Norwegian Waters', *Marine Policy*, 31: 19–31.

Sundby, S. (2000), 'Recruitment of Atlantic Cod Stocks in Relation to Temperature and Advection of Copepod Populations', *Sarsia*, 85: 277–98.

Sundby, S. and O. Nakken (2008), 'Spatial Shifts in Spawning Habitats of Arcto-Norwegian Cod Related to Multidecadal Climate Oscillations and Climate Change', *ICES Journal of Marine Science*, 65: 953–96.

Svendsen, E., M. Skogen, P. Budgell, G. Huse, B. Ådlandsvik, F. Vikebø, J. E. Stiansen, L. Asplin and S. Sundby (2007), 'An Ecosystem Modelling Approach to Predicting Cod Recruitment', Deep-Sea Research, Part II, in *her og lengre oppe er ikke dette den fullstendige henvisn?>Topical Studies in Oceanography*, 54: 2810–21.

Sætersdal, G. and H. Loeng (1987), 'Ecological Adaptation of Reproduction in Northeast Arctic Cod', *Fishery Research*, 5: 253–70.

Taylor, K. E., R. J. Stouffer and G. A. Meehl (2012), 'An Overview of CMIP5 and the Experimental Design', *Bulletin of the American Meteorological Society*, 93: 485–98.

Utne, K. R., S. S. Hjøllo, G. Huse and M. D. Skogen (2012), 'Estimating the Consumption of *Calanus finmarchicus* by Planktivorous Fish in the Norwegian Sea Using a Fully Coupled 3D Model System', *Marine Biology Research*, 8: 527–47.

Walther, G.-R. (2010), 'Community and Ecosystem Responses to Recent Climate Change', *Philosophical Transactions of the Royal Society B*, 365: 2019–2024. http://doi.org/10.1098/rstb.2010.0021.

Wisz, M., O. Broennimann, P. Grønkjær, P. Moller, S. Olsen, D. Swingedouw, R. B. Hedeholm, E. E. Nielsen, A. Guisan and L. Pellissier (2015), 'Arctic Warming Will Promote Atlantic–Pacific Fish Interchange', *Nature Climate Change*, 5(3): 232–2. https://doi.org/10.1038/nclimate2500.

Wood, R. (2008), 'Natural Ups and Downs', *Nature*, 453: 43–5.

Yaragina, N. A., A. Aglen and K. M. Sokolov (2011), 'Cod', in T. Jakobsen and V. K. Ozhigin (eds), *The Barents Sea: Ecosystem, Resources and Management. Half a Century of Russian–Norwegian Cooperation*, 225–70, Trondheim: Tapir Academic Press.

Årthun, M., B. Bogstad, U. Daewel, N. S. Keenlyside, A. B. Sandø, C. Schrum and G. Ottersen (2018), 'Climate Based Multi-year Predictions of the Barents Sea Cod Stock', *PLOS ONE*, 13: e0206319.

7

The North-Atlantic Mackerel Dispute: Lessons for International Cooperation on Transboundary Fish Stocks

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Introduction

Scholars foresee an increase in the failure of global cooperation as the impacts of climate change on fish stocks become increasingly apparent (see Ch. 1; also Shearman and Smith 2007: 49–55; Cheung et al. 2016; Pinsky et al. 2018). An example of one case of this, in 2009, is when Iceland and the Faroe Islands unilaterally decided to increase their annual catch quotas of Northeast Atlantic mackerel (*Scomber scombrus*) by 6,500 per cent and 340 per cent, respectively (Cendrowicz 2010). Eventually Greenland also followed suit. This move was sharply criticized by the other coastal actors with an interest in the stock – the EU and Norway. The decision to set quotas unilaterally came after the mackerel stock had shifted its distribution in a northwesterly direction around 2006, thereby becoming more abundant in the Icelandic and Faroese EEZs. Whether that shift was due to natural stock fluctuations or warming sea temperatures became a point of contention (Jansen and Gislason 2013). Iceland and Greenland have remained outside the total quota-setting scheme, whereas the Faroe Islands reached an agreement with the EU and Norway in 2014.

The ensuing dispute over the Northeast Atlantic mackerel stock, which involves quotas as well as other management measures such as monitoring standards, shows how international cooperation can fail to adjust to changing biophysical conditions (Bomsdorf 2014).[1] Moreover, the ensuing dispute has had negative impacts on the sustainability of fish stocks. In late September 2018, the International Council for the Exploration of the Sea (ICES) reported that, for the first time since 2007, mackerel stock had fallen below a sustainable level, due to current fishing pressures (ICES 2018). In 2019, Northeast Atlantic mackerel lost its Marine Stewardship Council (MSC) certification (MSC 2019; see Ch. 5).

Why did the international regime set up to manage the Northeast Atlantic mackerel stock fail? And what lessons can be learned as to how international management regimes adapt, or collapse, when faced with external challenges?

In this chapter we focus on how the regime dealing with mackerel in the North Atlantic has responded to and sought to cope with changes in the preferences and interests of participating coastal states – changes which inherently derive from alterations in the geophysical environment. Further, we examine the dispute in the Northeast Atlantic from the perspective of literature on international regimes (particularly that of Young 2010a, 2010b; see also Ch. 3 in this volume) as a sub-field of international relations theory that draws attention to issue-specific areas of international cooperation between states. This case study links to the overarching questions number two and three in this volume, concerning challenges posed to management regimes and whether institutions succeed (institutional resilience; see Ch. 1).

It is impossible to ignore how state interests are formed, through domestic interest groups that in turn frame the scope of possible outcomes in international negotiations (Putnam 1988; Bernauer et al. 2010). We therefore complement the regime approach with a new analysis of interview data from Spijkers and Boonstra (2017). In addition, background interviews were conducted with relevant actors, including representatives from the Norwegian Ministry of Trade, Industry and Fisheries, the European Commission (specifically DG MARE), the Icelandic Ministry of Industry and Innovation, and the North-East Atlantic Fisheries Commission (NEAFC). Our data were compiled from interviews with twenty-six experts – politicians, civil servants, scientists and industry stakeholders. The interviews, which were semi-structured, were conducted with experts from the coastal states (Norway, Faroe Islands, Iceland and the EU) and the ICES (Spijkers and Boonstra 2017). These interviews are used sparingly in the section 'Why did cooperation fail?', to illustrate the findings from the literature analysis. Here we focus on Iceland as the primary newcomer that has set the highest unilateral quotas without being able to agree with the other parties, although we also recognize the role of the Faroe Islands and Greenland.

International cooperation and fisheries

Migrating fish stocks constitute a mobile and transnational resource of great value. Straddling fish stocks in the high seas constitute a 'global commons', an environmental object that cannot be appropriated by any individual group (Crowe 1969: 1103–4). When states exploit stocks independently of each other, seeking to maximize their own immediate short-term benefits, that can set in motion a 'tragedy of the commons', where the stocks may risk serious depletion.

Effective international cooperation is thus a necessity. Some studies of cooperation on fisheries management have focused on the economic and/or game-theoretical aspects of the issue (Hotvedt 2010; Gänsbauer et al. 2016; see also Ch. 8). A different set of problems requires different types of organization to manage the underlying dynamics between participating states. Given that they are aware of this fact, states will have strong incentives to cooperate with each other (sole preferred outcome) – but they will also worry that others might not act rationally (i.e. overexploit the stock for short-term gains), or might defect unilaterally (and again, overexploit the stock for short-term gains) for various political reasons. These dynamics resemble 'assurance problems' (Martin 1992: 769–82). The solution is to develop an organization of a limited nature that can assist by providing assurance – see Chapters 2 and 3 in this volume for more on these issues.

Increased collaboration between states through various mechanisms has created *international regimes*. Krasner's (1983: 2) definition has become the baseline for related research: 'a set of implicit or explicit principles, norms, rules and decision making procedures around which actor expectations converge in a given area of international relations'. However, this definition has been criticized for being both vague and difficult to disentangle. Levy et al. (1995: 274) proposed defining international regimes as 'social institutions consisting of agreed upon principles, norms, rules, procedures and programs that govern the interactions of actors in specific issue areas'. Young (2010b) has argued that a regime is an institution specialized regarding a certain issue or geographic area. Here, we employ the two latter definitions.

States remain the primary actors in international fishery management, and regimes develop as states seek to tackle issues that transcend borders and boundaries. How do regimes tackle change? Why and when do they collapse or fail? Young (2010a, 2010b) has explored how regimes set up to deal with environmental and resource issues handle rapid change and internal and external pressures. Crucial here is the concept of *regime vulnerability* to external or internal stresses: 'Simply put, vulnerability rises as stresses begin to overwhelm an institution's robustness (i.e. its capacity to cope with stress without adapting) and resilience (i.e. its capacity to deal with stress through adjustments that stop short of transformative change)' (Young 2010b: 379). Specifically, Young uses the case of fisheries regimes when exploring the resilience, vulnerability and adaptation of environmental regimes, pinpointing how 'long periods of institutional stasis are punctuated by shorter periods or bursts of far-reaching and dramatic change' (Young 2010b: 379).

Here we lean on Young's (1999) and Stokke's (2012) definitions (see also Ch. 3), on the assumption that effective governance under such changing circumstances requires institutional resilience – the ability to adapt national and international institutions to new circumstances. We focus on *institutional resilience*: the ability to respond to new challenges by adapting institutional boundaries, or cooperation across such boundaries, to an extent sufficient for maintaining or improving institutional performance and effectiveness. *Institutional effectiveness* refers to significant contributions to solving the problem addressed by the regime in question.

International cooperation within fisheries management has expanded as states collaborate with other states to solve border-transcending problems. As Molenaar describes in Chapter 2, an important component of institutionalizing cooperation between states on fishery issues was the establishment of Regional Fisheries Management Organizations (RFMOs), enshrined in the United Nations Convention on the Law of the Sea (UNCLOS) and the UN Fish Stocks Agreement (UNFSA) (UNCLOS 1982, UNFSA 1995). Their functioning and structures may differ (see Chs. 3 and 14), but most RFMOs have a Scientific Committee which provides relevant scientific advice on the biological status of the stock(s), indicating possible management actions (Polacheck 2012). The performance of RFMOs has varied widely, coming under scrutiny as international pressure for sustainable management of fish stocks and their marine ecosystems has mounted (Polacheck 2012).

With climate change leading to greater changes in the distribution of the stocks (Christiansen et al. 2014: 355–9), just how robust, resilient and vulnerable are current regimes developed to deal with straddling fish stocks? Here the concept of *adaptation* enters the picture, also noted in Chapter 3. For example, Young (2010a: 174–8) has warned that under conditions involving interactive internal and external stressors – as when fish stocks alter their geographic distribution – a regime's ability to adapt and manage the situation can deteriorate. Increasing stress may threaten the very existence of the regime, leading to a 'dramatic and sudden collapse' (Young 2010b: 384).

The mackerel dispute in the Northeast Atlantic

In 1982, Denmark (on behalf of Greenland and the Faroe Islands), Norway, Iceland, the Soviet Union (now Russia) and the EU signed the Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries. This led to the creation of a specific RFMO for the region, the NEAFC, tasked with recommending measures to ensure sustainable harvesting of fish stocks in the Northeast Atlantic. Although NEAFC has jurisdiction only in waters outside the 200-nautical mile EEZs, it also gives recommendations applicable to the national economic zones (NEAFC 2011). Consequently, a coastal-state regime has developed for the Northeast Atlantic.

NEAFC starts negotiations on management measures in waters outside national jurisdiction after the coastal-state agreement has been concluded (covering the setting of the overall total allowable catch (TAC) and management plan), making the coastal-state negotiations the core of the management process (Russell and VanderZwaag 2010). Both the coastal-state and high-seas quotas are agreed during these negotiations, They are informed by advice provided by ICES, which gives NEAFC limited scope for management within its regulatory area (Russell and VanderZwaag 2010). These mechanisms have been described as a success in managing national and international fisheries in a region that has historically struggled with overfishing and unsustainable practices (Kristiansen 2013).

Mackerel constitutes one of most profitable fish stocks in the North Atlantic, worth around £500 million annually (Findlay 2014). The coastal states convene annually to agree on quotas for the various fish stocks in the Northeast Atlantic, based on recommendations from ICES. Since 1999, when agreement was reached on quotas, the Northeast Atlantic mackerel stock has predominantly been divided among the EU, Norway and the Faroe Islands.

In 2006, the mackerel shifted northwards, in tandem with a rise in sea temperature in the North Sea (Werber 2015). Mackerel is found in waters between 6 °C and 15 °C; as the waters further to the northwest became warmer, Iceland gained a new fishery. More northernly areas, including the waters around Iceland, have become the mackerel's summer feeding ground in the course of the 2010s then they aggregate through autumn and early winter along the edge of the continental shelf (see Ch. 6 for more on these changes and the marine conditions that impact this fish stock in the Northeast Atlantic.)

Whereas the stock rarely entered Icelandic waters during summer, it is now present throughout the year. While in Icelandic waters, the weight-gain of the mackerel has been between 43 and 55 per cent, according to the Icelandic Ministry of Industries and Innovation (2012). Iceland grasped this economic opportunity and started expansive mackerel fisheries in 2007, unilaterally setting its quota and claiming that mackerel fisheries have historically been important for the country (Fontaine 2015).

From virtually no catches, Icelandic fishermen caught more than 100,000 tonnes in 2008–9 (ICES 2017). Total mackerel catches reported to ICES were 621,618 tonnes in 2008 and 737,969 tonnes in 2009 (ICES 2017). Iceland did not participate in the coastal-state negotiations of the TAC for mackerel until 2010, when the mackerel entered Icelandic waters in large numbers. Being deemed a coastal state entails that the country is recognized as a legitimate party to the quota negotiations, with a claim to a share of the TAC. Iceland had sought coastal-state status since 1999, but had been rejected by Norway and the EU until 2010, when it officially became a coastal state. However, Norway in particular refused to accept this, arguing that Iceland's 'history-based claim' was 'one of the most unfounded claims' ever seen (Hotvedt 2010: 47).

Iceland's zonal attachment was a contentious issue, as the Norwegian authorities considered it to be about 5 per cent, whereas Iceland demanded quotas equal to a 16 per cent zonal attachment in 2012. Norway and Iceland held widely differing views on how to calculate quotas. Iceland was given a quota of less than 2,000 tonnes by the annual negotiations (about 0.31 per cent of the TAC); the negotiations broke down as the countries disagreed on appropriate quota allocations. The dispute continued in subsequent years due to wide discrepancies in expectations and concessions.

In parallel, the unilateral quotas set by the Faroe Islands were met with indignation from the EU and Norway, with the dispute climaxing when the EU prohibited the import of both Atlanto-Scandian (Norwegian spring-spawning) herring and mackerel caught under the control of the Faroe Islands in 2013. In retaliation, the Faroe Islands involved the World Trade Organization (WTO), but the EU repealed the measures adopted against the Faroe Islands in August 2014. In March 2014, the EU, Norway and Faroe Islands managed to agree on a long-term management strategy for the stock. The quotas for 2015–17 were set without Iceland signing on, although it did participate in the negotiations (European Commission 2016). Although the demand for a greater share of the stock was initially rejected by the EU and Norway, the Faroe Islands were included as part of the new long-term management plan: their catch increase was deemed more legitimate because of their long-time cooperation within the coastal-state management regime. The share of the quota allocated to the Faroe Islands rose substantially, from 5 per cent of the TAC to an average of 15 per cent a year until 2018.[2]

Also Greenland emerged as a newcomer with a mackerel interest, as the stock continued to shift westwards even beyond Icelandic waters around the 2010s. From 2010, Greenland set its own quotas, relatively moderate ones. From 2016, the Greenlandic government announced that it would take part in the annual mackerel negotiations with the other coastal states, confident that the stock had permanently shifted to Greenlandic waters (McGwin 2016). However, as was the case with Iceland, Greenland was unable to agree with Norway, the EU and – eventually – the Faroe Islands over the size of a specific Greenlandic part, and was left with the quota set for 'third countries' (Iceland, Russia and Greenland).

Over time, the combined increase in fishing pressure by the coastal states resulted in steadily growing overfishing of the stock. From 1998 to 2013, the total mackerel quota recommendations issued by ICES had ranged from 300,000 to 700,000 tonnes. However, the coastal states had on average exceeded the quota by at least 100,000 annually, which prompted questions about the health and longevity of the stock itself (Cendrowicz 2010; Norwegian Ministry of Trade Industry and Fisheries 2014). In 2019, the fish stock lost its 'sustainable' certification through MSC (MSC 2019). As Hønneland notes in Chapter 5, the role of MSC certification should not be underestimated: it can serve as a strong driver for agreement between the parties. However, no management agreement involving all coastal states has been achieved at the time of this writing. Thus, the coastal state regime that had been created for sustainable management of a transboundary natural resource in the Northeast Atlantic failed to solve precisely the problem it was originally established to deal with. A central point here has been disagreement over how to interpret the shift of the mackerel stock as such. Two concerns in particular stand out: What were the drivers behind the change in geographical stock distribution, and how long would this change last? (Hannesson 2013: 3) Norway and the EU considered the fluctuations to be an irregularity, whereas Iceland held that they were part of a larger ongoing climatic shift (Gänsbauer, Bechtold and Wilfing 2016: 101). Further, there remains disagreement on how to calculate zonal attachment – a core concern when setting quotas for a transboundary fish stock (Pinsky and Fogarty 2012: 890; see also Ch. 8).

In addition to the science-based arguments, a central aspect is the role that the fishing industry has played in domestic politics, limiting the possible scope of agreement in the coastal-state negotiations. Grasping this dimension is, per Putnam's (1988) logic, pivotal to understanding why states have proved unwilling to relent on their quota positions. Two actors stand out here: Iceland and the Faroe Islands.

Iceland is a small island state heavily invested in fisheries, with a close relationship between interest groups and the government (Ásgeirsdóttir 2007). Approximately 40–45 per cent of Iceland's total export revenues come from fisheries product alone. Seafood industry as well as fishing itself employs about 6 per cent of the Icelandic workforce (Islandsbanki 2016: 20, 26). Statistics for the early 2000s show that the industry contributed between 10 and 15 per cent of Iceland's GDP – although the actual contribution may have been much higher, because the fishing industry is linked in with almost all facets of the Icelandic economy (Árnason and Agnarsson 2003: 14). From almost no catches prior to 2006, by 2016 the Icelandic mackerel fishery alone was worth 103 million USD and constituted 8 per cent of Iceland's total catch value (Win 2017).

Iceland's negotiations within the NEAFC framework are led by the Ministry of Industry and Innovation, which works closely with interest groups and spends much time drumming up support for the government's preferred outcome (Ásgeirsdóttir 2008: 91–2). The preferred outcome for the government in fisheries negotiations is very similar to the preferred alternative of the Federation of Icelandic Fishing Vessel

Owners (LÍÚ), the largest and most influential fisheries interest group (Ásgeirsdóttir 2008: 91–2). The views of interest organizations are therefore well represented also at the highest level of negotiations. In practice, when the government agrees on a quota-allocation figure, LÍÚ convinces its members to fall in line and support the government (Ásgeirsdóttir 2008: 91–2).

Like Iceland, the Faroe Islands is a small island entity; its population is approaching 50,000. Tourism and aquaculture are important industries, but fishing still predominates (Hovgaard and Ackrén 2017: 72), and the largest businesses are all fisheries-related. A full 16 per cent of the population in the Faroe Islands are fishers, as compared with 7 per cent for Iceland (Hotvedt 2010: 39–40).

Fisheries therefore loom large in the community and the economy of the Faroe Islands (Hegland and Hopkins 2014). The Faroese Minister of Fisheries leads the international negotiations, and the relationship between business and politics is close. Export is handled by just a few companies, and there is a close relationship between shipowners and fish-exporting businesses (Iversen, Svorken and Bendiksen 2014: 22). Faroese fishery interest groups send representatives to consult with the delegations participating in international negotiations. The two most important interest groups are the Faroese Shipowners Association and the Faroese Pelagic Fleet (Hotvedt 2010: 41). The Faroe Islands followed Iceland in setting fishing quotas unilaterally in 2009. During the dispute, the Faroe Islands made it clear that they expected to gain quotas larger than Iceland, if an agreement were to be reached (Iversen, Svorken and Bendiksen 2014: 2).

For Norway, seafood products constitute a considerable part of the national economy, second only to petroleum in export value, although 'fisheries' also include aquaculture. The total number of fishers in Norway in 2017 was only around 9,500, or 0.36 per cent of total Norwegian employment (Statistics Norway (SSB) 2018), but the economic importance of fisheries extends beyond the extractive industry to the processing factories – a driving factor for the Norwegian representatives during the negotiations (Spijkers and Boonstra 2017). Overall, the influence of the fisheries sector on the official position of the Norwegian delegation has been considerable, with mackerel as the second most valuable stock (after cod, or third after herring and cod, depending on the year) (Statistics Norway (SSB) 2018).

Finally, regarding the EU, its Common Fisheries Policy (CFP) sets out the rules for the conservation of fish stocks and the development of the structure and economics of fishing fleets (van Hoof and van Tatenhove 2009: 726). To enable member-states to continue fishing in areas beyond EU jurisdiction, the Community began negotiating on behalf of its member-states to join RFMOs or establish bilaterally negotiated fisheries agreements with third countries (see Ch. 4; also Popescu 2015: 6). Several EU states have been involved in mackerel fisheries, with the UK (predominantly Scotland) as clearly the biggest. During the mackerel dispute, the species was by far the most important for the Scottish fisheries industry: approximately 38 per cent of total Scottish landings in 2014 were attributed to the mackerel catch, with a value of £195 million (Scottish Government 2016). Mackerel represents approximately 35 per cent of the UK (mostly Scottish) fish catch. Nonetheless, some interviewees held that, probably because of the special workings within the EU CFP, the industry does not have the same influence as it might in other coastal states (see Spijkers and Boonstra 2017).

Why did cooperation fail?

Why and how did the issue of setting mackerel quotas manage to topple an agreement in the Northeast Atlantic? Iceland's, and eventually Greenland's, desire to join the coastal-state negotiations changed the balance between the other actors. Arguments concerning the increase in the stock's biomass in Icelandic waters, and references to historical fisheries of mackerel, were aimed at legitimizing Iceland's expectations of a share of the TAC. Replacing a common management regime with two different ones (one Icelandic and one Faroese/EU/Norwegian), which was deemed unsustainable in 2019 (MSC 2019), is clear evidence of the regime's inability to adapt to change.

These issues relate to the concept of regime effectiveness. How to judge whether an international regime is 'effective'? As Young and Stokke discuss in Chapter 3, some regimes do play an essential part in solving the problems that led to their formation. Effective regimes contribute significantly to reducing or solving the issue-specific problem they address (Stokke 2012; Breitmeier, Underdal and Young 2011). In case of diverging interests among the actors, when can we say that cooperation has in fact failed?

A central point here is that networks, institutions and norms in an international cooperative regime are hard to overcome, even as the coastal states started to disregard the regime itself when setting their independent quotas for mackerel. Albeit relatively informal and ad hoc, the continued dialogue on fish-stock management has become institutionalized. This has developed through a decades-long process of institution-building, predominantly at the practical level among officials. Iceland (and the Faroe Islands) never abandoned the fisheries regime. Iceland still participates in the annual quota-allocation meetings for other stocks, and continues to cooperate on enforcement and surveillance measures.

The dilemma in these fisheries negotiations is how to find a division of quotas acceptable to all parties. However, the dispute involves more than the coordination of interests and 'Pareto-optimal' outcomes. Pivotal here is the role played by the fishing industry in domestic politics. Domestic interests – related to the considerable position of the fishing industry in Iceland – actively pushed for this new opportunity, not least because other fisheries had declined at the same time as the financial crisis hit Reykjavik. Many Icelandic fishers gave priority to the new, abundant mackerel fisheries instead of the traditional herring fishery (Hotvedt 2010: 29). For Greenland, the mackerel has been a more recent phenomenon; it has even been questioned whether the shift was more temporary than in the case of Iceland – which would weaken the case for large Greenlandic quotas (McGwin 2020).

An additional central point concerns the use of, and dispute over, how to operationalize certain of the sharing principles set out in the UNFSA, such as 'zonal attachment'. The science that underpins common decisions on the TAC has been used to undermine some parties' claims to the mackerel stock (Spijkers and Boonstra 2017).

Moreover, there is still some uncertainty as to whether the northward shift change in the distribution of the mackerel stock is a passing natural variation, or an effect of global warming – i.e. a more permanent situation. This has led to opportunistic argumentation: the parties whose interests have been harmed by the shift emphasize the uncertainty, whereas those who have benefited from the shift tend to stress the global warming aspect.

In sum, we find that cooperation on mackerel in the Northeast Atlantic failed because the basis for cooperation – the distribution of a marine resource – underwent rapid changes, and the established joint management mechanism (coastal-state negotiations and NEAFC) proved unable to respond adequately to the challenge. Interest in fishing mackerel grew in Iceland and the Faroe Islands, as the abundance of mackerel became apparent. Norway in particular was unrelenting in its desire to maintain its relatively large share of the TAC, for reasons related to preserving its position within the regime and to domestic fishing interests (Spijkers and Boonstra 2017: 1844).

Lessons for the future?

From this specific case, what lessons can we draw that hold relevance for transboundary resource regimes more generally? To what extent would an alteration of scope and depth through further institutionalization – like the development of organizational capacities and majority voting – hamper or improve the ability of the Northeast Atlantic fisheries regime to handle rapid changes in the fish stocks? Could cooperation on mackerel (or other stocks) be further institutionalized, to avoid conflict? Or would such institutionalization hamper the flexibility of the collaborative regime, arguably making it harder to reach new agreements as stocks change their physical distribution?

NEAFC itself uses simple majority voting, and votes are considered binding, unless a member-state lodges a reservations within fifty days. In that case, the new regulation will not apply to the member-state in question. If, however, more than three parties object to the NEAFC Commission's decision, it becomes non-binding on all parties (NEAFC 1980). The expansion of new mechanisms and procedures is particularly sensitive to domestic interests, so state negotiators will be unlikely to accept proposals that go against their country's domestic interests. The current regime, based on NEAFC and coastal-state negotiations, still requires decisions by consensus; that does not enhance the autonomy of the regime, nor make it immune to future breakdowns. Moving away from a strict consensus-based model would have advantages for the decision-making structures. On the other hand, such a change would constitute a loss of sovereignty, which is often opposed by states (Kristiansen 2013: 55).

Some RFMOs have no power to make their members adhere to regulations and management regimes; some use qualified majority; and others apply a consensus-based system (Molenaar 2004). However, in nearly all RFMOs, change as regards cooperation and sustainable resource management comes about only if the states want this to happen (Hallwood 2016: 132). How, then, can decision-making procedures best adjust to rapid climate-induced shifts? Tying the member-states down to a more rigid structure might not be an adequate response to a situation in flux. An alternative could be to speak directly to the main rationale for member opposition to new policies: domestic interests in retaining or increasing their shares of the TAC. That, however, would be likely to lead to overfishing of the stock.

Further, the use of an assumedly neutral source of reliable information is crucial for trust in the relevant regime, especially with issues linked to climate change (Sarewitz 2004: 386). If there is too much uncertainty surrounding the reliability of information, actors may opt to ignore, select or hide relevant information (Polasky et al. 2011: 402). The complexity of the objective truth makes it possible for actors to form their own separate interpretations of the situation, depending on their own institutional and political context. If the science that supports effective cooperation on this marine resource is questioned, and the fundamental principles determining quota allocations are in dispute, then it might be that signs of the dissolution of the regime itself are emerging.

According to Young's (2010b) analysis, however, we could expect that all these stressors to the regime will eventually prompt a re-alignment or change in the regime – perhaps agreeing on a new or coherent framework for scientific advice, or a distribution key acceptable to all parties. A tipping point might be reached: but what might prompt it? Given the stasis of the dispute in the 2010s, it seems that what might spur the states into a renegotiation of the whole cooperative mechanism would be a rapid depletion of the stock. That could force the domestic fisheries organizations to yield – but efforts might be too limited, and too late. Thus, we would underscore what Stokke highlights in Chapter 14 as a key finding as to how institutional resilience is challenged – in this case study, the challenges have been emerging along both a cognitional strand (disagreement over science and data) and a regulatory one (how to allocate quotas and the size of the TAC).

Alternatively, one approach to settling the dispute might be to disband the whole regime. Including 'sunset provisions' in regime set-ups could allow states 'to start over with arrangements that may be better suited to biophysical or socioeconomic circumstances as they evolve over time' (Young 2010b: 380; 2010a). This would entail that all relevant states – including the UK post-Brexit – convene to reinvent their quota-setting through coastal-state negotiations. Given the dependence on as well as references to historic rights, as well as the advantageous positions held by both Norway and the EU, it is unlikely that this second option would allow for much additional leeway. The problem is thus not only the limited robustness or resilience of the *regime* (how the relevant institutions and/or decision-making procedures are adapting to the new situation), but the rigidity of the quota expectations and positions of the various parties referring to historic rights and domestic interest groups.

The mackerel dispute demonstrates how international regimes set up to manage transboundary resources find themselves challenged when the resources in question change. Central to the failure of cooperation here have been not only interstate considerations but also intrastate interests: domestic-level fishery interests, and how these make the negotiating positions of the coastal states inflexible. Under a relatively weak (fisheries) regime, domestic interests hold considerable sway over the behaviour of coastal states. The limited flexibility accorded to the various negotiating states – and thus the regime at large – can be ascribed to a combination of strong domestic industry influence on negotiating positions, and disagreement on how to measure stock biomass, together with unclear allocation principles that have led all actors to adopt a strategy of 'holding out' with expectations of achieving advantageous outcomes in the future.

Managing transboundary fish stocks in the context of a changing climate is thus arguably not only a problem of coordination or assurance. We need to be sensitive to how states use unilateral quota-setting as a final attempt to coerce other members of the regime, protecting their privileged position or forcing a more favourable outcome. This must be seen in tandem with the disruption of the principles on which cooperation is based – here, fisheries science – and the limited structure of the RFMO itself. Fisheries regimes are not 'too big to fail', as has been seen across several other maritime domains where even small changes in biophysical conditions have led to severe disruptions in management regimes (Young 2010b: 380). The loss of the MSC certification of mackerel in 2019 underscores this: the outcries from environmental organizations and policymakers alike that follow from such a loss in certification can help to sway the parties towards agreement. However, in this case we have not – yet – seen that effect, as the parties seem intent on playing a game of chicken: waiting to see who gives in first.

Strengthening the autonomy of the cooperative mechanisms between the coastal states is one obvious way to manage such disputes better in the future. However, states are wary of relinquishing decision-making powers. As Stokke highlights in Chapter 9 on Barents Sea fisheries, one central way to improve institutional resilience is by bringing additional actors into the compliance effort. Indeed, both Iceland and the Faroe Islands, and later Greenland, were brought into the mackerel regime. However, these efforts came too late – only when positions and expectations had hardened. Another lesson from this case study is thus the relevance of bringing in *all* relevant actors, as soon as possible, in order to avoid future disruption to stock management. States cannot ignore third parties that suddenly find themselves with EEZ access to the stock in question – that is in itself the essence of the problems emerging from shifting fish stocks.

Thus, as regards the dispute examined here, starting with agreement on the fundamentals – the scientific basis underpinning the diverging claims – may be a first step towards a long-term solution in the face of shifting stocks. As transboundary resources continue to change in response to climate change, understanding how regimes adapt and deal with shifting state interests is of central importance. This can help us to recognize international cooperation as a reflection of regimes, at a time when such cooperation is coming under mounting pressure.

Notes

1 Some even noted that the mackerel dispute was the primary reason for Iceland's decision to retract its EU membership bid on 12 March 2015 (Griswold 2015).

2 Agreed Record on a Fisheries Arrangement between the European Union, the Faroe Islands and Norway on the Management of Mackerel in the North-East Atlantic for 2014 to 2018.

References

Allison, E. H., A. L. Perry, M. C. Badjeck, W. N. Adger, K. Brown, D. Conway, A. S. Halls et al. (2009), 'Vulnerability of National Economies to the Impacts of Climate Change on Fisheries', *Fish and Fisheries*, 10 (2): 173–96.

Árnason, R. and S. Agnarsson (2003), 'The Role of the Fishing Industry in the Icelandic Economy: A Historical Examination', *Working Paper Series*, 03:08. https://rafhladan.is/handle/10802/7609.

Ásgeirsdóttir, Á. (2007), 'Oceans of Trouble: Domestic Influence on International Fisheries Cooperation in the North Atlantic and the Barents Sea', *Global Environmental Politics*. https://doi.org/10.1162/glep.2007.7.1.120.

Ásgeirsdóttir, Á. (2008), *Who Gets What? Domestic Influences on International Negotiations Allocating Shared Resources*, Albany, NY: State University of New York Press.

Bernauer, T., A. Kalbhenn, V. Koubi and G. Spilker (2010), 'A Comparison of International and Domestic Sources of Global Governance Dynamics', *British Journal of Political Science*, 40 (3): 509–38. https://doi.org/10.1017/s0007123410000098.

Bomsdorf, C. (2014), 'Iceland to Set Own Mackerel-Fishing Quota', *The Wall Street Journal*, 13 March. http://www.wsj.com/articles/SB10001424052702303546204579437291728713068.

Brander, K. (2010), 'Impacts of Climate Change on Fisheries', *Journal of Marine Systems*, 79 (3–4): 389–402.

Breitmeier, H., A. Underdal and O. R. Young (2011), 'The Effectiveness of International Environmental Regimes: Comparing and Contrasting Findings from Quantitative Research', *International Studies Review*, 13 (4): 579–605.

Cendrowicz, L. (2010), 'The Mackerel Wars: Europe's Fish Tiff with Iceland', *Time*, 27 August. http://content.time.com/time/world/article/0,8599,2014161,00.html.

Cheung, W. W. L., M. C. Jones, V. W. Y. Lam, D. D. Miller, Y. Ota, L. Teh and U. R. Sumaila (2016), 'Transform High Seas Management to Build Climate Resilience in Marine Seafood Supply', *Fish and Fisheries*, August, 1–10.

Christiansen, J. S., C. W. Mecklenburg and O. V. Karamushko (2014), 'Arctic Marine Fishes and their Fisheries in Light of Global Change', *Global Change Biology*, 20 (2): 352–9.

Crowe, B. L. (1969), 'The Tragedy of the Commons Revisited', *Science* 166 (3909): 1103–7.

European Commission (2016), 'Commission Negotiates Mackerel Quota Increases in North-East Atlantic for 2017'. Press Release. https://ec.europa.eu/newsroom/mare/items/35945/en

FAO (2016), 'The State of World Fisheries and Aquaculture: Contributing to Food Security and Nutrition for All'. http://www.fao.org/3/a-i5555e.pdf.

Findlay, K. (2014), 'Mackerel Stock is at its Healthiest Level in Years', *The Press and Journal*, 11 June. https://www.pressandjournal.co.uk/fp/business/scotland-business/252104/mackerel-stock-is-at-its-healthiest-level-in-years/.

Fontaine, P. (2015), 'Iceland Struggles to Settle the Fishing Quota Dispute', *The Reykjavik Grapevine*. http://grapevine.is/mag/articles/2015/06/22/iceland-struggles-to-settle-the-fishing-quota-dispute/.

Gänsbauer, A., U. Bechtold and H. Wilfing (2016), 'SoFISHticated Policy – Social Perspectives on the Fish Conflict in the Northeast Atlantic', *Marine Policy*, 66: 93–103. doi: 10.1016/j.marpol.2016.01.014.

Griswold, A. (2015), 'Holy Mackerel! Iceland Has a Fishy Reason for Abandoning Its EU Bid', Slate. http://www.slate.com/blogs/moneybox/2015/03/13/iceland_abandons_eu_bid_it_s_all_about_the_mackerel.html.

Hallwood, P. (2016), 'International Public Law and the Failure to Efficiently Manage Ocean Living Resources', *Marine Resource Economics* 31 (2): 131–9.

Hannesson, R. (2013), 'Sharing a Migrating Fish Stock', *Marine Resource Economics*, 28 (1): 1–17. https://doi.org/10.5950/0738-1360-28.1.1.

Hegland, T. J. and C. C. E. Hopkins (2014), 'Towards a New Fisheries Effort Management System for the Faroe Islands? Controversies around the Meaning of Fishing Sustainability', *Maritime Studies*, 13 (12). https://doi.org/10.1186/s40152-014-0012-7.

Hoof, L. van and J. van Tatenhove (2009), 'EU Marine Policy on the Move: The Tension between Fisheries and Maritime Policy', *Marine Policy*, 33 (4): 726–32.

Hotvedt, B. D. (2010), 'The Problem of Sharing a Common Stock: An Analysis of the Mackerel Conflict in the North East Atlantic'. Thesis, Norwegian College of Fisheries Science, University of Tromsø, Norway.

Hovgaard, G. and M. Ackrén (2017), 'Autonomy in Denmark: Greenland and the Faroe Islands', in D. Muro and E. Woertz (eds), *Secession and Counter-Secession: An International Relations Perspective*, 69–76, Barcelona: Barcelona Centre for International Affairs.

Icelandic Ministry of Industries and Innovation (2012), 'Iceland's Commitment to Sustainable Mackerel Fishing'.

ICES (2017), 'ICES Advice on Fishing Opportunities, Catch, and Effort – Northeast Atlantic'. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/mac.27.nea.pdf.

ICES (2018), 'Mackerel (Scomber Scombrus) in Subareas 1–8 and 14, and in Division 9a (the Northeast Atlantic and Adjacent Waters)'. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/2018/mac.27.nea.pdf.

Islandsbanki (2016), *Annual Report 2016*. Reykjavik. https://www.islandsbanki.is/library/Skrar/IR/Afkoma/AR16_ISB_final.pdf.

Iversen, A., M. Svorken and B. I. Bendiksen (2014), 'Makrellkonfliktens konsekvenser', Tromsø: Nofima. https://nofima.brage.unit.no/nofima-xmlui/handle/11250/283203?locale-attribute=en.

Jansen, T. and H. Gislason (2013), 'Population Structure of Atlantic Mackerel (*Scomber Scombrus*)', *PLOS ONE*, 8 (5): e64744.

Krasner, S. D., ed. (1983), *International Regimes*, Ithaca, NY: Cornell University Press.

Kristiansen, M. S. (2013), 'Forvaltning av felles ressurser: en casestudie av regimeeffektivitet i den nordvest-atlantiske fiskeriorganisasjonen (NAFO) og den nordøst-atlantiske fiskerikommisjonen (NEAFC) (Management of Joint Resources)'. Thesis, Sociology and Political Science, Norwegian University of Science and Technology.

Levy, M. A., O. R. Young and M. Zürn (1995), 'The Study of International Regimes', *European Journal of International Relations*, 1 (3): 267–330.

Martin, L. L. (1992), 'Interests, Power, and Multilateralism', *International Organization*, 46 (4): 765–92.

McGwin, K. (2016), 'Greenland Moves to Join North Atlantic Mackerel Fishing Agreement', *The Arctic Journal*, 14 November. https://www.arctictoday.com/greenland-moves-to-join-north-atlantic-mackerel-fishing-agreement/.

McGwin, K. (2020), 'No More Mackerel in Greenland's Seas, Biologists Conclude', *Arctic Today*, 31 August. https://www.arctictoday.com/no-more-mackerel-in-greenlands-seas-biologists-conclude/.

Molenaar, E. J. (2004), 'Regional Fisheries Management Organizations: Issues of Participation, Allocation and Unregulated Fishing', in A. G. O. Elferink and D. R. Rothwell (eds), *Oceans Management in the 21st Century: Institutional Frameworks and Responses*, 69–86, Leiden: Martinus Nijhoff.

MSC (2019), 'MSC Certificates Suspended for All North East Atlantic Mackerel Fisheries'. Press Release, 31 January. https://www.msc.org/media-centre/press-releases/press-release/msc-certificates-suspended-for-all-north-east-atlantic-mackerel-fisheries.

NEAFC (1980), *Convention on Future Multilateral Cooperation in North-East Atlantic Fisheries*. https://www.neafc.org/system/files/Text-of-NEAFC-Convention-04.pdf.

NEAFC (2011), 'FAQs about NEAFC'. http://www.neafc.org/neafcguide.

Norwegian Ministry of Trade Industry and Fisheries (2014), 'Enighet om trepartsavtale om makrell (Tri-party Agreement on Mackerel)'. Press Release, 12 March. https://www.regjeringen.no/no/aktuelt/Enighet-om-trepartsavtale-om-makrell/id752940/.

Pinsky, M. L. and M. Fogarty (2012), 'Lagged Social-ecological Responses to Climate and Range Shifts in Fisheries', *Climatic Change*, 115 (3–4): 883–91. https://doi.org/10.1007/s10584-012-0599-x.

Pinsky, M. L., G. Reygondeau, R. Caddell, J. Palacios-Abrantes, J. Spijkers and W. W. L. Cheung (2018), 'Preparing ocean governance for species on the move', *Science*, 360 (6394): 1189–91. https://doi.org/10.1126/science.aat2360.

Polacheck, T. (2012), 'Politics and Independent Scientific Advice in RFMO Processes: A Case Study of Crossing Boundaries', *Marine Policy*, 36 (1): 132–41. https://doi.org/10.1016/j.marpol.2011.04.006.

Polasky, S., S. R. Carpenter, C. Folke and B. Keeler (2011), 'Decision-making under Great Uncertainty: Environmental Management in an Era of Global Change', *Trends in Ecology and Evolution*. https://doi.org/10.1016/j.tree.2011.04.007.

Popescu, I. (2015), 'Beyond the European Seas: The External Dimension of the Common Fisheries Policy', in-depth analysis, European Parliament Research Service (EPRS). https://www.europarl.europa.eu/thinktank/en/document/EPRS_IDA(2015)571323.

Putnam, R. D. (1988), 'Diplomacy and Domestic Politics: The Logic of Two-Level Games', *International Organization*, 42 (3): 427–60.

Russell, D. A. and D. L. VanderZwaag (2010), 'Challenges and Future Directions in Transboundary Fisheries Management: Concluding Reflections', in *Recasting Transboundary Fisheries Management Arrangements in Light of Sustainability Principles: Canadian and International Perspectives*, 521–6, Leiden: Martinus Nijhoff.

Sarewitz, D. (2004), 'How Science Makes Environmental Controversies Worse', *Environmental Science and Policy*, 7 (5): 385–403. https://doi.org/10.1016/j.envsci.2004.06.001.

Scottish Government (2016), 'Scottish Sea Fisheries Statistics 2015'. https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2015-9781786524300/.

Shearman, D. J. C. and J. W. Smith (2007), *The Climate Change Challenge and the Failure of Democracy*, Westport, CT: Praeger.

Spijkers, J. and W. J. Boonstra (2017), 'Environmental Change and Social Conflict: The Northeast Atlantic Mackerel Dispute', *Regional Environmental Change*, 17 (6): 1835–51. https://doi.org/10.1007/s10113-017-1150-4.

Statistics Norway (SSB) (2018), 'Fisheries (terminated in Statistics Norway), 2018, Final Figures'. https://www.ssb.no/en/jord-skog-jakt-og-fiskeri/statistikker/fiskeri/aar-endelige/2019-11-08.

Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.

Werber, C. (2015), 'The One that Got Away: It's Us or the Fish, EU tells Iceland. Iceland Chooses the Fish', *Quartz*, 13 March. http://qz.com/362227/its-us-or-the-fish-eu-tells-iceland-iceland-chooses-the-fish/.

Win, T. L. (2017), 'Iceland Reaps Riches from Warming Oceans as Fish Swim North', *Arctic Now*, 21 September. https://news.trust.org/item/20170921004206-j96z7/.

Young, O. R. (1999), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, Cambridge, MA: MIT Press.

Young, O. R. (2010a), *Institutional Dynamics: Emergent Patterns in International Environmental Governance*, Cambridge, MA: MIT Press.

Young, O. R. (2010b), 'Institutional Dynamics: Resilience, Vulnerability and Adaptation in Environmental and Resource Regimes', *Global Environmental Change*, 20 (3): 378–85.

Young, O. R. (2011), 'Effectiveness of International Environmental Regimes: Existing Knowledge, Cutting-Edge Themes, and Research Strategies', *PNAS*, 13 December, 108 (50): 19853–60.

8

Stock-Shifts and Regime Resilience in the Barents Sea

Anne-Kristin Jørgensen

Introduction

Since the mid-1970s, Norway and the USSR/Russia have jointly managed the main commercial fish stocks in the Barents Sea. Of these, the most valuable by far is Northeast Arctic cod (*Gadus morhua*) – the largest cod stock in the world. In 2012, Norwegian media reported that this stock had set a new record in terms of northerly distribution, with the northernmost concentrations found in areas bordering the Polar Ocean. More ominously, from a Norwegian viewpoint, the stock had also expanded eastwards, more deeply into waters under Russian jurisdiction.

Some Norwegian commentators (e.g. Rønning 2013; NRK 2018) speculated that Russia might take the opportunity to claim a larger share of the cod quota, which has been split equally between Norway and the USSR/Russia since 1976. As these observers were aware, the management regimes for pelagic stocks in the Norwegian Sea had become basically dysfunctional when large-scale stock-shifts began to upset the existing system of quota allocation between the coastal states (ABPmer 2018; see also Ch. 7).

Thus far, however, the Barents Sea regime has escaped any stock shift-related upheavals. This calls for an explanation. After all, stock-distribution patterns in the Barents Sea are also changing. Moreover, as examined below, although Russia has not challenged the allocation key for cod under the regime, it has shown less reticence where other stocks are concerned. How, then, have Norway and Russia, despite their numerous differences in other areas, been able to handle these problems without falling out with each other, when similar arrangements in the Norwegian Sea, involving 'like-minded' Western European countries, have broken down?

In the following, I present and discuss the factors and features that have helped the Barents Sea regime to ward off, with relative ease, the shocks brought on by stock-shifts. Some of these 'resilience drivers' are regime- or context-specific and thus not transferable to other settings; others are more general in nature and may hold some promise of institutional learning across regimes.

Thus, although this chapter also addresses the second among the three overarching research questions posed in Chapter 1, by examining the nature of the challenges that climate-related stock-shifts have posed to the Barents Sea regime, the main emphasis is on research question three: on the adaptive capacity of the regime and its ability to cope with this specific stressor – as well as with stress in general. As stock-shifts tend to put most pressure on regimes' regulative capacity, I focus on the regulative dimension of resilience.

The chapter draws primarily on written sources, notably the protocols and scientific reports produced under the Joint Norwegian–Russian Fisheries Commission (JNRFC), as well as news articles on Barents Sea stock-shifts and scholarly works on the topic. Russian sources have proven particularly valuable, as the perceptions held by Russian fisheries scientists and analysts can help to explain Russian responses (or, in the case of cod, lack of response) to the recent stock shifts. In addition, I conducted four supplementary interviews with Norwegian fisheries scientists about the stock-shifts and their influence on the management regime.[1] Finally, to interpret and contextualize my findings, I have drawn on my own experience as a former participant in the JNRFC.[2]

The next section discusses the problems international fishery regimes typically face when stock-shifts force the parties to renegotiate existing allocation systems. Examples from the Norwegian Sea illustrate how easily such negotiations may become derailed, putting an otherwise solid regime on the path toward collapse (see also Ch. 7). Next, I show how a narrow focus on cod has obscured the fact that the Barents Sea regime has been far from immune to stock shift-related controversies. Specifically, I examine the bargaining processes that ensued after Russia began to signal displeasure with the existing distribution of Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes mentella*) and saithe (*Pollachius virens*) between the parties. Although there were parallels to the Norwegian Sea regarding the points of disagreement, the parties managed to solve their differences without harm to the regime. Then, in the main section of this chapter, I attempt to account for this outcome by exploring how certain 'resilience drivers' have served to make the Barents Sea regime resistant not only to the specific type of stress brought on by stock-shifts, but to stress in general. The final section draws these threads together.

Stock-shifts and regime resilience

The resilience of an institution – such as a resource management regime – can be defined as its capacity to adapt to new challenges without compromising institutional performance (see Chs. 1 and 14).

Young (2010: 382) discusses the merits of various mechanisms that may serve to make environmental and resource regimes more resilient. He notes that adaptive management, understood as adjustment of instruments that are already in place, will often prove insufficient for dealing with serious stressors. When stress increases, he argues, priority should be given to institutional learning: the adoption and implementation of new instruments.

As Young also points out, institutional resilience is not necessarily uniform across the full range of actual or potential stressors. A regime that stands out as generally resilient may have an Achilles heel that renders it vulnerable to specific stressors (Young 2010: 379–80). This seems to have been the case for the fisheries regimes in the Norwegian Sea. A serious weak point was the system of resource allocation, which proved inadequately rigged for adaptation to large-scale stock-shifts. New instruments were needed – in the form of more 'climate-resilient' allocation mechanisms. As shown in Chapter 7, the task of negotiating such a mechanism for the mackerel stock (and others) has thus far proven beyond the abilities of the coastal states in the region.

Indeed, international negotiations on the allocation of natural resources tend to be challenging. Although the parties to a fisheries management regime may struggle – and often do – to reach agreement on conservation issues, determining 'who gets what' is normally a much more difficult task. Quota allocation, viewed in isolation, is always a zero-sum game.

To prevent annual tugs-of-war over this issue, many fisheries management regimes lean on fixed allocation keys. Such stable arrangements have been the norm in the Northeast Atlantic – but, after the stock shift, many experts have called for keys that can be adjusted (or that adjust automatically) to changes in zonal attachment (Dankel et al. 2015; ABPmer 2018). Unfortunately, such flexible instruments have their own drawbacks; for instance, they may become overly complex (see Ch. 3).

The problems do not end there, however. Where quota allocation is concerned, the devil is not only in the details, but pretty much everywhere. Global legal instruments provide only limited guidance on allocation of shared stocks (Molenaar 2016; Spijkers and Boonstra 2017), so the coastal states are left to fight out this difficult question among themselves. Article 11 of the UN Fish Stocks Agreement lists some general principles relevant for allocation, but these are too numerous and too vague to function as practical guidance for states in need of independent advice.

In 2015, NEAFC set up a working group on allocation criteria, to address the issue of how to share the pelagic fish stocks in the Northeast Atlantic. The members of the group identified several criteria as particularly worthy of consideration: zonal attachment, fishing patterns, fisheries dependency and contributions to conservation, management and research. They also agreed that the main criterion should be zonal attachment – loosely defined as 'stock distribution during life cycle' (NEAFC 2016).

However, the participants failed to reach agreement on the precise definitions of these criteria, and the question of weighting among criteria proved equally contentious (NEAFC 2016). After only two meetings, it became clear that the prospects for consensus on these issues were dim; and in 2017, the group's activities were put on hold (NEAFC 2017). The crux of the matter is that the definition and weighting of criteria largely determine 'who gets what'.

Consider zonal attachment. Measuring the spatio-temporal distribution of a stock requires deciding whether the calculation is to be based on biomass (the standard approach), abundance (number of individuals) and/or production (growth minus mortality) (Dankel et al. 2015: 57). Multiple other issues also must be clarified, such as what weight to attach to different life-stages of the stock. Thus, although zonal attachment is often seen as a 'scientific', objective, criterion, actual allocation outcomes depend heavily on the definition of the concept – and that is a matter for political negotiation.

This applies to the other criteria as well. Historical fishing ('fishing patterns') refers to a state's catch record over time – but it is up to the parties to determine which reference period to use. Likewise, the parties must decide which parameters to apply in calculating the fisheries-dependency criterion.[3]

With such a broad range of alternatives available, opportunistic argumentation is only to be expected – and where the Norwegian Sea is concerned, that has been the case. Analyses of the protracted negotiations on mackerel have shown that each state argues for the criteria and the definitions that serve its own interests (Ørebech 2013; Spijkers and Boonstra 2017; Totland 2020).

A few examples: Norway and the EU want to maximize the weight attached to zonal attachment, whereas Iceland and the Faroe Islands, with their fisheries-dominated economies, stress the importance of fishery dependency. Norway disputes Iceland's claim to historical fishing rights. Iceland, for its part, disputes Norway's definition of zonal attachment, and argues that not only stock biomass but also weight gain ('production') in the EEZ should be taken into account (Spijkers and Boonstra 2017; see also Ch. 7).

This unproductive wrangling has been going on for more than a decade, with no end in sight. What can be done to avoid such situations – and how have Norway and Russia managed to avoid ending up in the same predicament?

Stock-shifts and differential regime adaptation in the Barents Sea

The Norwegian–Russian (until 1992: Norwegian–Soviet) fisheries management regime in the Barents Sea was set up in the mid-1970s; it has faced and handled a string of severe challenges since then. As this section shows, the regime's adaptation to recent stock-shifts has been more extensive than commonly recognized, but only with respect to Barents Sea stocks other than cod – notably Greenland halibut, redfish and saithe.

Early challenges

The Barents Sea regime emerged in response to the transformative legal processes that produced the EEZ principle. Realizing that they were about to become 'co-owners' of the Barents Sea fish stocks, Norway and the Soviet Union resolved to extend their existing cooperation within fisheries research to the regulative sphere.

In 1975, the two states established the Joint Norwegian–Soviet Fisheries Commission (henceforth: JNSFC), which has met every autumn since 1976 to set total allowable catch (TAC) and other regulations for the joint stocks. A supplementary agreement, adopted in 1976, granted each party rights to fish in the other party's waters. This was particularly important to the Soviet Union, which had feared losing access to the rich fishing grounds in the western parts of the Barents Sea. Also Norway benefited from the arrangement, as it served to shield the nursing grounds in the Soviet EEZ from excess fishing pressure.

Prior to the formal establishment of the regime, the parties agreed that the cod and haddock (*Melanogrammus aeglefinus*) stocks would be split 50/50. The allocation key for the third joint stock, capelin (*Mallotus villosus*), was subsequently set at 60/40, in Norway's favour.

Since the demise of the Soviet Union, this fisheries regime has expanded in depth as well as in scope, while retaining the core elements and principles on which it was founded. Its efficiency, in terms of stock conservation, has varied over time, but the long-term trend has been positive. Today, the Barents Sea fisheries regime is generally described as a success story. The shared stocks are, for the most part, in good condition, due largely to prudent, science-based management (Kjesbu et al. 2014).

The cooperation has not always run smoothly, however. The parties have had to grapple with several serious challenges, most of them of an internal and recurring nature.

For one thing, Norway and the Soviet Union disagreed on how to draw the delimitation line between their EEZs. However, in 1978 they found a temporary solution for the fisheries in the disputed area: the 'Grey Zone', where each party would be responsible for the regulation and control of its own vessels. This arrangement worked well, remaining in place until Norway and Russia agreed on a permanent delimitation line in 2010.

A more malign legal dispute concerns the Fisheries Protection Zone (FPZ) around Svalbard, established by Norway in 1977 amid strong protests from the Soviet Union (see also Ch. 10). Russia has continued to challenge Norway's right to set and enforce fishery regulations in this area, which is of great importance to the Russian fishing fleet. The 'Svalbard question' remains a sore point in Norwegian–Russian relations and a complicating factor in the day-to-day workings of the regime (Jørgensen and Østhagen 2020; Østhagen, Jørgensen and Moe 2020; see also Ch. 10).

Concerning regulation, the two parties had conflicting preferences from the start. The Soviet fishing fleet consisted primarily of trawlers, whereas Norway had a large coastal fleet and relatively few trawlers. Throughout the 1980s, there was an annual tug-of-war over regulative measures. Norway called for stricter mesh-size and minimum-size regulations in the trawl fishery to protect juvenile fish, whereas the Soviet Union advocated lowering TACs and restricting the traditional Norwegian fishery for spawning cod. In the post-Soviet period, the pattern was partly reversed. Disagreements over TAC have been frequent, but now with Norway calling for moderation.

Finally, and as discussed in Chapter 9, Norway and Russia have periodically differed strongly in their views on the nature and extent of IUU fishing in the Barents Sea. This put an additional strain on their relations, particularly in the years around the turn of the millennium.

Thus, it cannot be because of the absence of stressors that the Norwegian–Russian fisheries regime has managed to remain operational after all these years. At times, tensions have run so high as to bring it to the verge of collapse. However, the annual negotiations in the Joint Commission have always produced an agreement, signed – albeit sometimes with a heavy heart – by both parties. Regime disruption of the kind seen in the Norwegian Sea has thus far been avoided.

Stock-shifts in the 2000s

In the course of the decades preceding the stock-shifts, the parties to the regime had become very apt at managing conflicting views – and at downplaying any conflicts that arose. This helps to explain why the impacts of stock-shifts on the regime have been overlooked by most external observers. There has been some public speculation on the *potential* implications for the allocation of cod, but the *actual* effects on the allocation of other stocks have passed largely unnoticed. What we need to find out is not only why Russia has made no claims to a larger share in the cod quota. We must also explain why Russia did, in fact, put forward such claims with respect to three other stocks, and how the regime managed to cope with this potentially conflictual situation.

In the Barents Sea, the link between ocean temperature and the spatial distribution of fish stocks is well documented. In warm periods, the stocks tend to grow and expand toward the north and east, whereas in colder periods they tend to decrease and shrink back to their core areas in the south and west (Matishov and Zhichkin 2013; Zhichkin 2014).

The most recent multi-decadal warming, peaking in 2015 (see Ch. 6) has led to an unprecedented increase in ocean temperatures in the Barents Sea (Matishov and Zhichkin 2013; Zhichkin 2014; Lind 2018). The associated stock-shifts have likewise been extreme. Fossheim et al. (2015) show that fish communities in the Barents Sea have been shifting up to four times faster than the global average. For ground-fish like cod and haddock, the deep Arctic Ocean constitutes a natural barrier, so any further expansion is likely to proceed eastwards (Haug et al. 2017).

The potential implications for the allocation of cod between Norway and Russia have received some attention in Norwegian media in recent years. Somewhat surprisingly, there has been no similar debate in Russia. Even in the northern fishing regions, where fishers, local politicians and expert commentators regularly speak of the need to take a firm line with Norway in the JNRFC, no one seems to find fault with how the cod quota is split between the parties.

In fact, the 50/50 allocation key is apparently seen as an unalterable feature of the regime itself. When the director of the Murmansk Marine Biological Institute, Academician Gennadyy Matishov, was asked to comment on Norway's concerns, he firmly dismissed the idea that the eastward shift of the cod stock might affect the quota distribution between the parties: '[T]his *cannot* influence [Russia's share of] the catches', he explained [emphasis added]. '[E]ach country has its quota, independently of where the fish is located at any given time' (RIA Novosti 2013).

Several Russian analysts have held that pre-agreed allocation keys serve as a stabilizing element in the cooperation (see e.g. Zilanov 2016). However, on at least two occasions, the Russian party to the JNRFC has used zonal attachment to argue that also capelin should be shared on a 50/50 basis (Hønneland 2006). In other words, the firm Russian commitment to a fixed allocation pattern seems to apply only to cod and haddock.

Russia's swift response to the eastward shift of the Northeast Arctic saithe, Greenland halibut and regional redfish stocks makes this abundantly clear. From the early 2000s, the Russian negotiators set about building a case for changing the status of these stocks from exclusively Norwegian to shared. They succeeded in the case of Greenland halibut and redfish, which became de facto joint stocks in 2008 and 2017 – but not in the case of saithe, which has retained its exclusive status. However, between 2001 and 2013, the share in the saithe quota set aside for Russian fishers increased markedly.

The processes that led up to these outcomes extended over several years. Where saithe is concerned, they are still underway. Since 2006, every protocol of the JNRFC[4] has contained a phrase referring to Russian data on the distribution of saithe 'in the whole Barents Sea', reflecting Russia's desire to highlight the occurrence of the stock beyond the Norwegian zone. For Greenland halibut, the Commission established a joint research programme in 2001 to explore the scientific basis of Russia's claim. In addition, two joint working groups were set up to map the zonal distribution of the stock, and to consider the merits of different quota allocation criteria. Later, the same strategy was used to clarify the status of the redfish stock.

Handling stock-shifts of Greenland halibut, redfish and saithe

In the JNRFC protocols there is little to indicate any conflict over any of these stock-shifts. However, the reports from the working groups on Greenland halibut, published as attachments to the protocols from the years 2006–9, show that the parties might well have ended up in a quagmire similar to that in the Norwegian Sea case.

The research data published in these reports confirmed that the centre of gravity of the Greenland halibut stock was moving east and north. The attachment of the stock to the Russian EEZ increased significantly in the period from 2004 to 2008 – but so did its attachment to the (disputed) FPZ around Svalbard. Separate calculations were made of biomass and abundance in each zone. In biomass, the Norwegian EEZ emerged as the clear 'winner' over the period as a whole – but, in 2008, the biomass was nearly equally distributed among the three zones. Abundance was highest in the Russian EEZ, with the FPZ a close second, while in the Norwegian EEZ, it was relatively low, and decreasing over the period (Attachment 11 to the protocol from the 38th session of the JNRFC, 2009).[5]

Unsurprisingly, the Norwegian and the Russian members of the working group on allocation criteria were unable to agree on a joint proposal. Nor is it surprising that the main points of contention were the definition of zonal attachment and the question of how to use the data from the FPZ. The Norwegians, naturally enough, preferred the biomass approach, whereas the Russians wanted to use the average of biomass and number of individuals. As to the FPZ, the Russians proposed that the data from this zone should be disregarded in the calculations, whereas the Norwegian negotiators simply noted that Norway would grant fishing opportunities to other countries in the FPZ on the basis of zonal attachment and historical catches (Attachment 11 to the Protocol from the 37th session of the JNRFC, 2008).

The members of the group agreed that zonal attachment, catch history and contribution to research and conservation were all relevant criteria. However, they refrained from expressing any views on how these criteria should be weighed against each other (Attachment 11 to the Protocol from the 37th session of the JNRFC, 2008).

And the rest is silence. Nothing is known of how this input was used (if at all) by the JNRFC when the allocation key for Greenland halibut was adopted. The working group on allocation criteria was to have delivered its final report in 2010, but this was pre-empted by the Commission, which set a TAC for Greenland halibut at its session in 2009. The protocol for that year made no mention of any changes in the status of Greenland halibut, but the action spoke for itself: henceforth, the stock would be managed jointly. The final decision on allocation was apparently made by the two delegation heads *in camera* (Interviews 1 and 2, Bergen, 6 February 2018).

The outcome was 51/45 in Norway's favour, with 4 per cent set aside for third countries. However, this piece of information went unmentioned in the protocol itself, although the formula was presented in an attachment to the protocol – in a footnote.

The contrast with the processes in the Norwegian Sea is striking. In both cases, stock-shifts have led to claims for reallocation of resources, but in the Barents Sea these developments seem to have passed under the radar. When Greenland halibut became a shared stock, Norwegian mainstream media largely ignored the matter. The press release from the 2009 session stated that a TAC and an allocation key had been agreed upon, without mentioning that an exclusive Norwegian stock had thereby become a joint stock. Norwegian fishers, however, were shocked to learn that Russia would henceforth receive 45 per cent of the quota.[6]

The parties certainly seem to have done what they could to downplay any conflict issues. Although the Russian side instigated the investigation of the Greenland halibut stock (Drevetnyak et al. 2016), the research programme was formally a joint initiative, presented as such in the protocol from the JNRFC's 2001 session. In protocols from subsequent sessions, the references made to the progress of the research and the processes in the working groups give the same impression: the focus is on consensus.

The Joint Commission used the same general approach for redfish as for Greenland halibut, but in the case of redfish, there is much less documentation of the process. Norwegian fishers feared that the negotiations on redfish would be prejudiced by the outcome for Greenland halibut, resulting in a similarly unsatisfactory (from their viewpoint) sharing arrangement (Fiskebåtredernes forbund/Norwegian Fishing Vessel Owners' Association 2013). In 2017, the stock was split 72/18 in Norway's favour, with the remaining 10 per cent set aside for third countries – an outcome apparently deemed acceptable in Norwegian fisheries circles (Interview 2, Bergen, 6 February 2018).

Where saithe is concerned, the tug-of-war over this stock seems to have taken the form of an annual ritual, with Russian researchers presenting their findings and arguments, and the Norwegian delegates politely listening. As Hønneland has observed,

> [R]ussian researchers lecture at length on the saithe, but the level of conflict over allocation remains low. While the Norwegian party presumably does not want saithe to be defined as a shared stock, it is willing to grant Russian fishers a share in the [surplus associated with] the positive development of the stock.
>
> (Hønneland 2006: 141–2; my translation)

I would argue that the way in which the JNRFC handled these issues reflects a general feature of the regime – what Hønneland (2012: 132) refers to as a 'drive towards agreement, or towards compromise'. Other analysts have made similar observations (Stokke and Hoel 1991; Stokke 2012). I believe this characteristic goes a long way towards explaining the resilience of the regime. In following I explore why and how the 'drive towards compromise' came into being, and discuss other 'resilience drivers' which help to explain the regime's ability to handle stock-shifts and other stressors without compromising on effectiveness in problem solving.

Drivers of resilience in Barents Sea fisheries management

As I draw many parallels between the Norwegian Sea and the Barents Sea, a reminder is in place that the stock-shifts in the Northeast Atlantic did *not* expose the regimes in these two areas to identical levels of stress. In the Barents Sea, the stocks did not shift beyond the jurisdictions of the parties to the regime. In the Norwegian Sea they did, subjecting the regimes not only to internal tension but also to the more serious problem of new entrants. Thus, the situations were not analogous. Still, the difference in the level of conflict between existing regime members in these two cases remains to be explained.

Conducive circumstances

The Barents Sea regime differs from the regimes in the Norwegian Sea in several important ways that are relevant to regime resilience. First, the Barents Sea regime has only two members. It makes intuitive sense that this will make it easier to reach agreement; and, indeed, cross-case comparisons and game theory simulations indicate that cooperative arrangements with fewer parties are generally more stable (ABPmer 2018).

Second, both parties to the Barents Sea regime are majority players with high stakes in the continued productivity of the stocks involved. This makes defection costly. By contrast, if a regime involves a mixture of majority and minority players, the latter may be tempted to defect and free-ride on the conservation efforts of the former (Hannesson 2013).

Third, the Barents Sea regime has been in operation for a long time, as have the allocation keys for the most important stocks. Longstanding regimes will have gained experience in stress-management, and longstanding allocative arrangements may be less exposed to demands for renegotiation (see Chs. 3 and 14).[7]

Fourth, due to the distributive pattern of stocks in the Barents Sea, the bilateral regime encompasses a high – and increasing – number of shared stocks. Multi-stock governance systems are more flexible than single-stock arrangements, as they allow for trade-offs and quota swapping (ABPmer 2018). Indeed, quota-swapping arrangements, underpinned by mutual access rules, have played an important role in the Barents Sea. The Soviet Union routinely exchanged part of its cod quota for quotas on the (then) exclusive Norwegian stocks – including redfish, Greenland halibut and saithe (Stokke and Hoel 1991; Hønneland 2006; Stokke 2012). This made it possible for the Soviet fleet to preserve its traditional fishing patterns from the pre-EEZ era. Incidentally, it also played into Russia's hand in the post-stock shift negotiations, as both parties considered catch history a relevant allocation criterion.

We may ask whether some form of informal (perhaps implicit) horse-trading may have played a part in the recent negotiation of allocation keys for these stocks. Did Norway, perhaps, consent to the new allocative arrangements for Greenland halibut and redfish on the condition (or implicit understanding) that Russia would refrain from challenging the allocation key for cod and haddock? This is, of course, purely speculative – but informal trading of that kind would not have been completely alien to the parties. When Russia, on a former occasion, proposed adjusting the allocation key for capelin to match the spatial distribution of the stock, the Norwegian party countered that, in such case, also the allocation key for cod would have to be adjusted. At the time when this dialogue took place, both parties were well aware that cod was more abundant in Norwegian waters, and the discussion ended there (Hønneland 2006: 142).

However, there is another, probably more powerful, explanation why it may be in Russia's perceived interest to keep the 50/50 key 'sacred': uncertainty regarding future ocean temperatures and stock distribution patterns in the Barents Sea.

The veil of uncertainty

Scientific uncertainty often complicates cooperation on fisheries management. Sometimes, however, a lack of certain knowledge may be a good thing. Young (1989) argues that parties engaged in institutional bargaining act under a 'veil of uncertainty' regarding their own future positions and interests, which makes it easier for them to come to agreement. In the case of the Barents Sea, uncertainty as to the future distribution of the cod and haddock stocks may well have made Russia think twice about challenging the allocative status quo.

In the Barents Sea, warm and cold cycles alter. The present warm cycle has probably been reinforced by climate change, leading to extreme temperature increases and stock-shifts on an unprecedented scale. Similarly, the next cold cycle may prove to be warmer than earlier ones. The stocks are therefore not likely to revert fully to their normal cold-cycle distribution pattern – but it is possible that we will see a partial reversion of the stock shift. Given the recent downward trend in ocean temperatures in the Barents Sea (see Ch. 6), it may be that a cycle change is already underway.

For this reason, it might prove very risky for Russia to request a renegotiation of the 50/50 allocation key. A new allocation arrangement based on zonal attachment as per today would establish this criterion as a valid basis for stock distribution between the parties. In that case, what would keep Norway from 'retaliating' by demanding a re-renegotiation if the stocks were to shift back again tomorrow?[8]

Greenland halibut, redfish and saithe are altogether different stories in this respect. These stocks were previously managed by Norway alone, and in principle (though not in practice), Norway could have reserved the entire quota on each of these stocks for itself. Consequently, Russia had nothing to lose and much to win by using zonal attachment to argue for a change of status.

Further, the question of whether the cod stock is more Russian than Norwegian, or the other way around, would almost certainly hinge on the definition of zonal attachment, and on the weight (if any) attached to the FPZ (Interviews 1 and 2, Bergen, 6 February 2018). The outcome of the Greenland halibut 'exercise' serves as a useful illustration, and perhaps a useful warning: full knowledge of the scientific facts would not help the parties to reach agreement on the 'actual' zonal attachment of the cod stock. All in all, the parties might deem it best to leave well alone and maintain the 'veil of uncertainty' regarding stock distribution.

'Urge to agree' vs 'culture of compromise'

We now turn to the 'drive towards compromise'. Many observers have noticed this feature of the regime – but they describe and account for it in different ways, depending on their underlying assumptions and the conceptual lenses they employ. This is reflected in the terms they use in referring to the phenomenon: An 'urge to agree' (Stokke and Hoel 1991: 60) is not quite the same thing as a 'culture of compromise' (Hønneland and Jørgensen 2015). The word 'culture' points toward the existence of social practices that may give rise to compromise solutions, whereas 'drive' and 'urge' indicate a situation with goal-oriented rational actors who find such solutions (or agreement at any cost) to be in their own best interest.

The art of compromise has been a salient feature of the regime since its inception. In the beginning, a 'logic of consequence' (March and Olsen 1989: 160–2) must have been involved, as shared norms, practices and identities ('culture') do not arise overnight. Gradually, however, agreement through compromise may have evolved into a shared norm. I propose that this is exactly what happened, and that, today, the parties' inclination towards compromise solutions rests in part on a 'logic of appropriateness' (March and Olsen 1989: 160–2).

In the early days, Norway and the Soviet Union, on opposite sides in the Cold War, had every reason to downplay conflicts and seek consensus wherever possible. Both parties wanted to avoid political tensions in the Barents Sea. The area was a highly sensitive one, not only due to its strategic importance but also because of the jurisdictional conflicts that had arisen along with the regime (Stokke et al. 1999).

In addition, the parties had to consider how failure to reach agreement in the annual negotiations would affect the fisheries and – ultimately – the stocks. Such concerns lie at the heart of all international fisheries regimes, but in the Barents Sea, the spatial distribution of the key commercial stocks gave rise to an idiosyncratic 'balance of terror': a situation with no agreement would spell disaster for the Soviet fishing fleet, given its dependence on access to the rich fishing grounds in Norwegian waters. Norway, for its part, had reason to fear that the Soviet fleet, if confined to its own EEZ, would proceed to wreak havoc on the nursery grounds in the east.

The upshot was that the parties embarked on what Stokke and Hoel (1991: 51) describe as a policy of 'mutual conflict avoidance'. Contentious issues were either settled or laid aside, disputes were managed through reciprocal concessions, and measures were adopted to minimize the risk of deadlock in the annual negotiations (Stokke and Hoel 1991: 52–3).

The Cold War has long since ended, but it is likely that the fear of political conflict and the 'balance of terror' continue to shape regime dynamics even today. Tensions between Russia and the West show no signs of abating; the Barents Sea has retained its strategic importance; and the value of the Barents Sea fisheries has increased steadily.

What, then, of the social-practice perspective? How does 'culture' enter into the equation? Consider the following statement by a former head of the Norwegian delegation to the JNSFC: 'Politically and *socially*, a bargaining technique evolved that made it easier to reach agreement' (Hønneland 2006: 41; my emphasis). Bargaining is not only a game in which self-interested agents strive to maximize their own utility – it is also a social process.

The practices that evolved in the Joint Commission helped to facilitate mutual concessions. Difficult issues, like the size of TACs for the next fishing year, were discussed in an 'inner circle' of a few, key members of each delegation. Often, the final decision was made by the two heads of delegation alone (Hønneland 2006, 2012). This veiled the issue of who had conceded what, which arguments had been put forward, etc. – but it also led to criticism from observers who worried about the lack of transparency around outcomes.

This bargaining style, which had arisen from the need to avoid conflicts, gradually came to be seen as standard operating procedure in the Joint Commission. The idea is neatly captured in the title of Hønneland's (2011) article 'Kompromiss als Routine' ('compromise as routine').

A somewhat different way to account for this development is to say that compromise gradually turned into a norm – not only in the sense of what is 'normal' or expected but also in the sense of what is 'right'. The parties to the regime seem to share the idea that seeking compromise is the right thing to do, and the members of the JNRFC 'take pride in their ability to reach agreement' (Hønneland 2012: 132).

The regular, and increasingly frequent, contacts between the parties have made the social aspects of the negotiations more important. Although self-interest may motivate actors to enter into a cooperation, the cooperative process itself may change that motivation as the participants 'get habitualized to cooperation, and, as a result, develop more collective identities' (Hasenclever et al. 1996: 215; see also Wendt 1994).

That is not to say that the bilateral fisheries regime has fostered anything like a collective identity between Norway and Russia. However, that may well be the case for the direct participants in the cooperation. Indeed, the regime as such seems to have taken on a distinct identity of its own, founded, in part, in the idea of 'our common Barents Sea'.

Where does this idea come from? Possibly, the fact that the regime is so explicitly associated with a defined geographic area helped to nurture this notion – but deliberate construction may also be part of the story. In general, actors tend to espouse ideas that happen to be in line with their own interests (Adler 1992: 124). In the present case, there is good evidence that the Soviet side actively promoted the idea of the Barents Sea as a kind of common property of the parties – for reasons that had everything to do with self-interest.

First and foremost, the Soviet Union viewed closer, bilateral cooperation with Norway in the Barents Sea as a way of curbing NATO influence in the region. [9]However, concerns for the fisheries probably also played a role: The more 'common' the sea and its fish stocks, the less would it matter that the bulk of the fishable resources were concentrated in the West.

This was not only about securing access. As the Soviet fishing fleet conducted such a large share of its operations in areas under Norwegian jurisdiction, the Soviet side (like the Russian side today) was keen to ensure that the same 'rules of the game' should apply in all zones. The Soviet/Russian party also repeatedly pushed for standardized inspection routines, joint inspections and even standardized sanctions (Jørgensen and Østhagen 2020).

Norway, for its part, consistently warded off all such overtures. Whereas the Soviet Union stressed the idea of joint management, Norway emphasized the right of each party to set its own rules in its own waters (Stokke et al. 1999: 100). For Norway, this was a matter of principle. As a small country, it was suspicious of anything that might smack of 'bilateralization' of its relations with a powerful neighbour (Holtsmark 1995; Hønneland and Jørgensen 2015).

Nevertheless, the idea of a 'common' Barents Sea has gradually become more pervasive, in the sense that Norway has to some extent bought into it – at least where the fisheries resources are concerned. Phrases like 'our common sea' and 'our common food larder' come up regularly when Norwegian politicians and officials comment on the cooperation (see e.g. Pedersen 2006; Jentoft 2015), and the regime itself has evolved in a direction that has given concrete content to these expressions.

There may be several reasons for Norway's increasing willingness to refer to the Barents Sea as a common ground. The demise of the Soviet Union served to diminish the power distance as well as the ideological distance between the parties. In addition, the idea of the regime as a joint project for protecting the resources in a 'common Barents Sea' may have been useful to Norway when, in the 1990s, it sought to engage Russia in a joint process towards a more ambitious and sustainable management policy.

Moreover, the political winds of change prevailing in the early years of that decade were conducive to projects stressing the friendship between East and West. In 1993, Norway initiated the Barents Euro-Arctic Region (BEAR) cooperation, explicitly aimed at creating an 'identity region' across the former Iron Curtain (Stokke and Tunander 1994; Hønneland 1998). The Barents Sea fisheries management 'project' has probably been more successful in this regard than the much wider BEAR initiative. The bilateral fisheries regime is based on a genuinely common interest – conservation of joint fish stocks – and has produced outcomes that give rise to a shared sense of pride in the achievement.

The 'construction' of the Barents Sea regime as a common project also drew on other ideas and narratives that highlighted the commonalities between the parties: among them the idea of a shared historical 'Pomor' identity in the North, the longstanding contacts in the realm of fisheries research, the narrative of the 'seafaring community' in the Barents Sea (Hønneland 2012: 130) and others. Gradually, the regime as a joint endeavour of two partners with a shared history – as opposed to a practical framework that would allow two opponents to realize a narrowly defined common interest – was spoken, written and acted into existence.

As the fish stocks and the harvestable surplus increased, so did the regime's prestige in the eyes of the outside world. This, in turn, enhanced the political significance of the cooperation. During the Cold War, the regime stood out as something of a political wonder by force of its sheer existence. Its political value today stems largely from the fact that it is a rare example of truly successful cooperation between Norway and Russia. Even the fishers, always ready to criticize research findings and management decisions they do not agree with, are largely favourable in their verdicts (see e.g. Norges Fiskarlag 2021).

The political authorities in both countries have learned from experience that they can trust their representatives to the JNRFC to make decisions that serve the nation's interests in the long run. In practice, the direct participants in the cooperation enjoy considerable autonomy to manage the resources as they see fit.[10] A regime which, like the one in the Barents Sea, is both successful and relatively independent is more likely to 'produce collections of actors who identify themselves – at least in part – as members of the relevant institutional arrangements' (Young 1999: 205; see also Østhagen 2016).

In 2019, the JNRFC became the first recipient of the Thorvald Stoltenberg Prize, established in memory of the 'father' of the BEAR cooperation. In its statement, the jury emphasized the compromise-oriented nature of the bilateral fisheries regime, noting how trust and perseverance 'over decades' had produced 'the finest cooperation we have in the North' (Karlsbakk 2019). Excerpts from the statement were cited in a White Paper on Norway's external fisheries relations (Government of Norway 2019).

In short, it may be argued that the parties' long-term involvement in a shared, successful, and highly valued project gradually gave rise to 'an evolution of community … in which [the] actors at least partially identif[ied] with and respect[ed] the legitimate interests of each other' (Wendt 1994: 390; Hasenclever et al. 1996: 214). This is precisely the kind of setting where a 'culture of compromise' could be expected to evolve.

In the mackerel conflict, it took years for Norway to accept that Iceland had any legitimate interests at all, and the Norwegian side used economic sanctions to bend Iceland and the Faroe Islands to its will – a strategy that seems to have backfired rather badly (see Ch. 7). By contrast, in the Barents Sea the Norwegian side seems to have accepted Russia's claim for a larger share in the Greenland halibut, redfish and saithe stocks as genuinely legitimate.[11] It may also be that the idea of a 'common Barents Sea' helps to legitimize a process whereby an increasing number of stocks are accorded shared status.

And the cod stock? Here, the status quo can hardly be improved upon! From the 'common Barents Sea' perspective, equal sharing is the natural and most legitimate solution.

Institutional learning through differentiation

As argued above, when stock-shifts hit the Northeast Atlantic with full force around the turn of the millennium, the two partners in the Barents Sea had been perfecting the art of compromise for a quarter of a century already. This helps to explain why the zero-sum negotiations over allocation did not end in stalemate and regime collapse, as was the case in the Norwegian Sea.

However, resilience is not only about avoiding the collapse of cooperation: it also involves preserving – or improving – regime performance and effectiveness. For this purpose, a 'culture of compromise' will not suffice. Indeed, compromise can be a double-edged sword: a solution that saves a regime from breakdown may undermine its effectiveness. For instance, RFMOs sometimes increase TACs to unsustainable levels in order to accommodate new entrants while keeping existing members happy (Lodge et al. 2007: 35–6).

I hold that institutional learning, generating institutional differentiation and placing technical experts centrally in the preparatory work of the JNRFC has been important for avoiding compromises that might reduce the stringency of regulative measures.

In the Soviet period, the JNSFC leaned primarily on adaptive management to cope with external stressors, such as stock fluctuations, that put pressure on the regime's problem-solving capacity. However, due to the parties' divergent preferences regarding the main management instruments, the Joint Commission often struggled to make the necessary adjustment of these instruments when the stocks were in decline.

Throughout the 1980s, the Barents Sea cod stock was in a depressed state (Zhichkin 2014; see also Ch. 6). Both parties saw the need for stricter measures, but their different priorities hampered progress here. The Soviet side stressed the need to reduce TACs – a measure that would disproportionately affect the Norwegian coastal fleet[12] – whereas the Norwegians pushed for more stringent technical regulations in the (predominantly Soviet) trawl fishery. As a result, the measures adopted by the JNSFC proved insufficient to prevent further deterioration of the stock (Stokke and Hoel 1991; Hønneland 2006).

This is not to say that the regime's conservation efforts were of no consequence: the situation would almost certainly have been worse in the absence of the regime (Stokke 2012). When the crisis in the cod fishery peaked in the late 1980s, the Joint Commission finally got its act together, and the cod TAC was cut to the bone.[13]

In the Soviet Union, a different type of crisis was unfolding: the Union was coming apart at the seams. Its final demise proved to be a game-changer for the bilateral fisheries regime. In early post-Soviet Russia, everything was in flux. This, along with the transformation of East–West relations, opened a window of opportunity for the JNRFC. The Russian side became more open to learning from its smaller partner, and Norway became less fearful of 'common' arrangements – at least up to a point. Basically, conditions now favoured institutional learning.

Developments in Russia that posed a threat to the regime in the short run, such as institutional disruption and unbridled IUU fishing, set off a process of institutional innovation that served to strengthen the regime's long-term resilience. For instance, the magnitude of the IUU problem gave the parties no alternative but to join forces, thus giving rise to a new area of cooperation: that of control and enforcement.[14]

Regular contacts were established between Norwegian and Russian control bodies to facilitate exchange of information. Joint seminars and mutual exchange of inspectors soon followed, enabling the rank-and-file members of these organs to meet, share experiences and learn from each other (Hønneland 2006; Østhagen 2016). Moreover, the expert group initially set up to address the IUU problem evolved into a new collaborative body, the Permanent Committee for Management and Enforcement

Cooperation, that came to function as a kind of secretariat to the JNRFC (Hønneland 2006; see also Ch. 9).

The emergence of these and other new arenas of cooperation made for greater efficiency and promoted bottom-up initiatives, which in turn increased the regime's capacity for innovation. Leaning on inputs from below and inspired by other regional fisheries regimes, the Commission adopted and implemented a series of new management instruments, principles and approaches.[15]

As Russia was in transformation as well as deep crisis during much of the 1990s, it was perhaps not unnatural that Norway assumed a leading role in these processes. However, around the turn of the millennium, Russian observers and stakeholders had taken to an increasingly sinister interpretation of this dynamic. They argued that the Norwegian side was deliberately exploiting Russia's weakness to push through decisions that were primarily in Norway's interest. This reasoning fed into a general narrative of the West taking advantage of its defeated opponent's inability to defend its interests (Hønneland and Jørgensen 2015).

Towards the end of the decade, these perceptions grew stronger, culminating at the annual session of the JNRFC in 1999, when negotiations remained deadlocked for several days. Fearing the consequences of a 'zero agreement', the Norwegians, on the eve of the last day, accepted a TAC far above the primary advice from the ICES.[16]

After the turn of the millennium, the bilateral cooperation came to be characterized by pragmatism, with more balanced relations between the parties and steady improvement of the regulative framework. The JNRFC adopted long-term management plans and harvest-control rules for each shared stock. By tying themselves to the mast in this fashion, the managers made the regime more resistant to stakeholder pressure for higher quotas.

Summing up: the regime's problem-solving capacity has gradually improved since the early 1990s, when the joint impacts of the 'cod crisis' and the end of the Cold War paved the way for institutional learning. Notably, the success in delegating certain specific tasks to the Permanent Committee alerted the parties to the advantage of bottom-up approaches. Since then, numerous problems, large and small, have been attacked – and often solved – at the lower level, in working groups and other expert bodies. These forums serve not only as arenas of knowledge-production and problem-solving but also as venues where Norwegian and Russian researchers and civil servants can get to know each other and gain insights into the views, experiences and attitudes of the other party.

Moreover, as Hønneland (2012: 133) has pointed out, once the experts have reached agreement on a difficult issue, the JNRFC will often adopt their propositions without further ado. That mode of cooperation reduces the risk of direct conflict in the JNRFC itself – and if the experts cannot find an acceptable solution to a given problem, at least they can identify points of agreement and disagreement.

A case in point is the way in which the Greenland halibut stock-shifts were handled. The establishment of a joint research programme ensured that there would be a modicum of agreement on the 'facts on the ground'. By leaving it to the experts to grapple with the most sensitive issues – the definition of zonal attachment and the FPZ question – the parties ensured that there was no need for the JNRFC to enter this minefield. When the experts had concluded that agreement on these issues was impossible (which had been evident from the outset), the two heads of delegation could settle the matter in the customary, discreet fashion – and subsequently announce that the allocation key had been based on scientific data. The wording in the press release, as well as in the protocol, bears witness to a shared understanding. Any disagreement was safely hidden away in the attachments.

Thus, the process of institutional differentiation underway from the early 1990s vastly strengthened the regime's capacity for learning, as well as giving rise to a form of 'bottom–up' bargaining that facilitated agreement at the level of the JNRFC. This further enhanced the regime's ability to manage conflicts and to cope with various types of stress.

While new approaches and management instruments adopted by the JNRFC have served to strengthen regime resilience along all three dimensions, external actors and institutions have also played an important role – particularly as regards the behavioural dimension. Ultimately, involvement of the wider institutional complex in which JNRFC is situated proved necessary to adequately address the IUU issue (see Ch. 9). Moreover, external actors' increasing concern with sustainability has sparked initiatives like the MSC certification process, which in some areas sets stricter conditions than the JNRFC. As discussed in Ch. 5, MSC has induced Russian fishing companies operating in the Barents Sea to take steps to protect bottom habitats – and thus filled a gap in the Norwegian–Russian management system.

Conclusions and implications

Returning to our point of departure: Why did the Barents Sea regime prove so resilient to stock-shifts relative to other regional management regimes, including those for various pelagic species in the Norwegian Sea?

Many factors combined to produce this distinctive outcome. Some were purely circumstantial, linked to the geographic location of the Barents Sea and the migration patterns of the main commercial stocks. The regime has faced few and relatively modest stock-shift-related claims from new entrants (see Ch. 9), and it has been fortunate in having several features that have facilitated efforts to cope with changes – notably, a low number of members and a high (and rising) number of shared stocks.

Another resilience factor is the veil of scientific uncertainty regarding future stock-shifts, which is likely to have affected Russia's preparedness to let the cod stock-shifts pass uncommented in terms of the allocation key. Linking that key firmly to zonal attachment would be a risky strategy for Russia – because a 50/50 division might well compare favourably with future zonal-attachment estimations. In the Norwegian Sea, no such worries about foregoing an attractive existing arrangement were relevant to Iceland when it claimed a substantial amount of the mackerel stock: no downside risk could offset the upside potential. Russia was similarly situated only in the case of Greenland halibut, redfish and saithe, none of which were remotely comparable to either cod or mackerel in terms of value or conflict potential. Thus, uncertainty about the duration of the stock-shifts is likely to have lessened the impact of this stressor on the Barents Sea regime. In the Norwegian Sea, heated debates over the temporary vs permanent nature of these shifts have only served to escalate the conflicts between the parties.

In this chapter I have placed considerable emphasis on another resilience driver that has shaped the dynamics in the Barents Sea from the start: the very high value the parties seem to have placed on achieving agreement, consensus and compromise. I have argued that this characteristic arose initially because what was at stake was not only the future productivity of several large and valuable fish stocks but also stability and peace in a strategically sensitive region. Over time, compromise has evolved into a norm that is viewed as fundamental by both parties and that gives the regime much of its identity. This may well be why the ' … drive towards agreement … in the Joint Commission – visible since its establishment in the mid-1970s [has been] accelerating with time' (Hønneland 2012: 132).

Moreover, I have argued that the concerns that originally pushed the parties towards agreement remain operational today. The 'balance of terror' is upheld by the spatial distribution of the stocks; and fears that a conflict over fisheries might spill over into other areas are very much alive (Jørgensen and Østhagen 2020). In the case of the Barents Sea regime, there are many reasons why the arc of negotiations bends towards compromise.

The final driver of resilience identified here is institutional learning. In the early 1990s, the regime embarked on a phase characterized by increasing trust between the parties and the ambition to put management on a more sustainable footing. A chain reaction of innovation was set off, with one step leading to the next. Most striking, perhaps, was the institutional transformation that gave rise to a new, multi-layered structure with numerous lower-level bodies. Complicated tasks could henceforth be delegated to the experts. As a result, new, sophisticated management instruments were elaborated and implemented, and some conflicts could be solved without the direct involvement of the JNRFC. When the climate between the parties began to deteriorate again towards the turn of the millennium, this way of doing things had become the modus operandi of the regime. The culture of compromise had been supplemented by a culture of learning.

By 2021, relations between Norway and Russia are again at low ebb. In the bilateral fisheries cooperation, points of conflict keep arising – as they have always done. Some controversies – like those over the size of TAC and the regulation of fisheries in the FPZ – have resurfaced again and again throughout the history of the regime and will probably continue to do so in future. External stressors must also be expected to arise from time to time, as borne out by the EU Commission's recent attempts to challenge the rights of Norway and Russia as coastal states to manage the Barents Sea cod stock bilaterally (European Commission 2021; see also Chs. 10 and 14).

Still, the regime's long history of success in stress-management gives reason for optimism. Minor disagreements are handled as a matter of routine, and when more serious conflicts arise and lead to temporary setbacks, creative changes for the better have generally followed. Although the parties have a distaste for open conflict, the regime itself seems to thrive on controversy – the term 'anti-fragile' (Taleb 2012) comes to mind.

Given the many idiosyncratic features of the Barents Sea regime, we must ask: is there any potential here for institutional learning across cases? Again, comparison with the regimes in the Norwegian Sea may prove instructive.

Although the (political) geography and the biology of the fish stocks in the two areas are given *a priori*, the single-stock arrangements in the Norwegian Sea could, in principle, be replaced by a multi-stock regime akin to that in the Barents Sea. Some analysts have suggested that such a solution might prove more resilient than the current set-up (ABPmer 2018). However, Hannesson (2013) doubts that a multi-stock approach would make much difference: as the constellation of major and minor players is the same for all stocks in the region, the opportunities for mutually beneficial trade-offs will always be limited.

As this analysis of the Barents Sea regime makes clear, however, a broad, multi-stock arrangement may have other advantages besides those linked to trade-offs – if the regime is institutionally differentiated and allows for frequent interactions between participants at different levels.

A multi-stock regime in the Norwegian Sea would not be a copy of the Barents Sea regime. Still, it is at least thinkable that a broader and more institutionalized arrangement with closer interaction between the parties could promote the kind of institutional features that allegedly eat strategy for breakfast and structure for lunch – such as a shared culture and a sense of community. Possibly, an arrangement along these lines would be better able to withstand external pressure from powerful stakeholder groups (see Ch. 7).

Finally, although the parties to the regimes in the Norwegian Sea largely relate to the same 'cognitive setting' (Young and Stokke 2020) – characterized, inter alia, by a shared belief in resource economic models and sophisticated research data as tools for determining the most 'fair' and 'objective' allocative solutions – they have nevertheless ended up resorting to opportunistic argumentation, politicization of science and strong-arm tactics.

Norway and Russia, share only some beliefs, and disagree on many principles, as well as on specific issues. This has fostered pragmatism in their relations. In the Barents Sea, there are no objective or mathematically correct solutions – only negotiated ones. The optimal is always out of reach, so 'good enough' will have to do. And sometimes, a 'veil of ignorance' is preferable to full knowledge – even in cases where that veil might be removed by (costly and time-consuming) research.

The Barents Sea approach may not be transferable to the Norwegian Sea, but a dash of pragmatism might prove very cost-effective and prevent institutional overload (see Ch. 3).

As one interviewee put it,

> [i]n the Norwegian Sea, they have five sessions every autumn before they can even start talking to each other. In the Barents Sea it is very different. Simplicity is a good thing.
>
> (Interview 1, Bergen, 6 February 2018)

Notes

1. Two of my interviewees had been directly involved in the bilateral fisheries cooperation with Russia for many years.
2. In the 1990s, I was a fisheries inspector and Russian interpreter in the Norwegian Coast Guard and took part in many joint activities with Russian colleagues. From 2002 to 2005, as Fisheries Counsellor at the Norwegian Embassy in Moscow, I was involved in the day-to-day cooperation of the parties and attended the annual sessions of the Joint Norwegian–Russian Fisheries Commission.
3. National fishery dependency is often defined as the fishery sector's share in GDP. However, calculating the economic contribution of a specific, shared stock may be complicated (see e.g. Dankel et al. 2015: 47).
4. Protocols of the Joint Commission are available at Joint Fish, https://www.jointfish.com/OM-FISKERIKOMMISJONEN/PROTOKOLLER.html.
5. The reports emphasized that there is considerable uncertainty in the material.
6. In a letter to the Norwegian Ministry of Fisheries and Coastal Affairs (Fiskebåtredernes forbund, 13 September 2013), the Norwegian Fishing Vessel Owners' Association demanded that the allocation key be re-negotiated, arguing that 'according to all normal criteria for allocation of [fish] stocks', Norway's share in the Greenland halibut stock ought to have been much higher than 51 per cent. In a recent interview, a spokesman for the association characterized the sharing agreement for Greenland halibut as 'catastrophically bad' for Norway (Vermes 2020).
7. Of course, this reasoning may be turned on its head: a long history may be a symptom, rather than a driver, of regime resilience. Perhaps it makes better sense to view this as a question of mutual reinforcement: regimes designed to cope well with stress tend to last longer, and the longer they last, the more proficient they may become in stress-management.
8. In such a case, the outcome for Russia might prove very negative indeed. The 50/50 key has probably never reflected the actual distribution of the stocks – at least, not in biomass terms. When the key was negotiated, Norway initially demanded a 70 per cent share (Zilanov 2016: 465), arguing that the fish was more prevalent in Norwegian waters. The 50/50 solution was identical to the Soviet position – an outcome that has been ascribed to 'politics' and the asymmetric power relations between the parties (Engesæter 1993; Hønneland and Jørgensen 2015). However, no attempts were made to map the zonal attachment of the stocks, so the parties could at best make educated guesses about the actual state of affairs. Precisely this 'veil of uncertainty' may have facilitated agreement, by making it easier for Norway to accept equal sharing.
9. To this end, the Soviet Union repeatedly proposed, and attempted to gain Norway's acceptance for, various forms of joint governance in the Barents Sea, and on Svalbard in particular (Holtsmark 1995).
10. This does not apply to the rare cases where a decision by the Joint Commission is seen as prejudicing Norway's or Russia's official positions on issues concerning sovereignty and jurisdiction.
11. The parties differed in their views on *how much more* Russia was entitled to, and on the implications for the status of the saithe stock. However, the Norwegian party acknowledged that the stock-shifts might affect quota allocation, and that this was a matter for negotiation between the parties (see e.g. Hønneland 2006).

12 The Norwegian coastal fleet was wholly dependent on the Barents Sea fisheries, whereas the Soviet trawler fleet operated both in the Barents Sea and in more distant fishing areas.

13 By then, Norway no longer allowed the coastal fleet to continue fishing with passive gear after TAC had been taken – a practice the Soviet Union had criticized heavily, but grudgingly accepted until the mid-1980s. According to Vyacheslav Zilanov, head of the Soviet delegation for a period in the 1980s, the Soviet political leadership stressed the need to avoid provoking 'ordinary Norwegian fishers', as many of them were members of left-leaning political parties and were generally sympathetic to their 'socialist neighbour' (Zilanov 2018: 24).

14 Only a few years earlier, cooperating with the Soviet Union on issues seen as falling within the realm of national sovereignty would have been anathema to Norway.

15 For instance, bypassing the controversial issue of mesh size in the trawl fishery, the Commission let scientists from both sides explore alternative methods to increase selectivity in trawls. Various types of grid technology were presented to the Permanent Committee, which considered the merits of each type and drafted regulations for their use. The parties then agreed to make selection grids mandatory in several fisheries.

16 With hindsight, this was probably a wise decision. There were indications that the Russian delegation had been 'captured' by the fishing industry, and the latter was clearly not ready to back down. By opting for a suboptimal agreement rather than no agreement at all, the Norwegians ensured that managers and scientists on both sides could continue their work on developing a framework for long-term sustainable management.

References

ABPmer (ABP Marine Environmental Research Ltd) (2018), *Building Resilience of Fisheries Governance in the North East Atlantic*. Final Report, ABPmer Report No, R2924, A report produced by ABPmer for Environmental Defence Fund, January. https://www.edf.org/sites/default/files/documents/building-resilience-fisheries-governance.pdf.

Adler, E. (1992), 'The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control', *International Organization*, 46: 101–46.

Dankel, G., G. Haraldsson, J. Heldbo, K. Høydal, H. Lassen, H. Siegstad, M. Schou, S. Sverdrup-Jensen, S. Waldo and P. Ørebech (2015), *Allocation of Fishing Rights in the NEA*, Discussion paper, Nordic Council of Ministers. http://norden.diva-portal.org/smash/record.jsf?faces-redirect=true&aq2=%5B%5B%5D%5D&af=%5B%5D&searchType=LIST_LATEST&language=no&pid=diva2%3A815984&aq=%5B%5B%5D%5D&sf=all&aqe=%5B%5D&sortOrder=author_sort_asc&onlyFullText=false&noOfRows=50&dswid=-9933.

Drevetnyak, K. V., A. A. Grekov, Y. A. Kovalev, E. A. Shamray and N. A. Yaragina (2016), 'Istoriya resheniya voprosa po opredeleniyu klyuchey raspredeleniya obshego dopustimogo ulova chernogo paltusa Barentseva Morya' (The story of how the quota allocation key for Greenland halibut in the Barents Sea was determined), *Voprosy rybolovstva*, 17 (4): 502–12. https://cyberleninka.ru/article/n/istoriya-resheniya-voprosa-po-opredeleniyu-klyuchey-raspredeleniya-obschego-dopustimogo-ulova-chernogo-paltusa-barentseva-morya/viewer.

Engesæter, S. (1993), 'Scientific Input to International Fishery Agreements', *The Fridtjof Nansen Institute Journal*, 13: 85–106.

European Commission (2021), 'EU Expresses Concern over Unsustainable Decisions on Arctic Cod by Norway and Russia'. News announcement, 23 August. Available online: EU expresses concern over unsustainable decisions on Arctic cod by Norway and Russia (europa.eu). https://ec.europa.eu/oceans-and-fisheries/news/eu-expresses-concern-over-unsustainable-decisions-arctic-cod-norway-and-russia-2021-08-23_en.

Fiskebåtredernes forbund (2013), 'Kvoteforhandlingene med Russland for kvoteåret 2014' (Quota negotiations with Russia for the quota year 2014). Letter from the Norwegian fishing vessel owners' association to the Ministry of Fisheries and Coastal Affairs and the Norwegian Fishermen's Association, 13 September.

Fossheim, M., R. Primicerio, E. Johannesen, R. B. Ingvaldsen, M. M. Aschan and A. V. Dolgov (2015), 'Recent Warming Leads to a Rapid Borealization of Fish Communities in the Arctic', *Nature Climate Change*, 5, 673–77. https://doi.org/10.1038/nclimate2647.

Government of Norway (2019), *Meld. St. 15 (2018–2019): Noregs fiskeriavtalar for 2019 og fisket etter avtalane i 2017 og 2018* (White Paper on Norway's fisheries agreements for 2019 and the fishery under the agreements from 2017 and 2018). https://www.regjeringen.no/no/dokumenter/meld.-st.-15-20182019/id2632380/?ch=4.

Hannesson, R. (2013), 'Zonal Attachment of Fish Stocks and Management Cooperation', *Fisheries Research*, 140: 149–54.

Hasenclever, A., P. Mayer and V. Rittberger (1996), 'Interests, Power, Knowledge: The Study of International Regimes', *Mershon International Studies Review*, 40 (2): 177–228. https://www.jstor.org/stable/pdf/222775.pdf?refreqid=excelsior%3A8a788faa88c8b07e9e2dc1831fe0f882.

Haug, T., B. Bogstad, M. Chierici, H. Gjøsæter, E. H. Hallfredsson, Å. S. Høines, A. H. Hoel, R. B. Ingvaldsen, L. L. Jørgensen, T. Knutsen, H. Loeng, L. J. Naustvoll, I. Røttingen and K. Sunnanå (2017), 'Future Harvest of Living Resources in the Arctic Ocean North of the Nordic and Barents Seas: A Review of Possibilities and Constraints', *Fisheries Research*, 188: 38–57.

Holtsmark, S. G. (1995), '"Bilateralisering" og "Fellesstyre": Et perspektiv på russisk politikk i Nord' ('Bilateralization' and 'Condominium': A perspective on Russian policies in the North), *Norsk Militært Tidsskrift*, 165 (4): 1–8.

Hønneland, G. (1998), 'Identity Formation in the Barents Euro-Arctic Region', *Cooperation and Conflict*, 33 (3): 277–97.

Hønneland, G. (2006), *Kvotekamp og kyststatssolidaritet: Norsk–russisk fiskeriforvaltning gjennom 30 år* (Battles over quotas and coastal state solidarity: Thirty years of Norwegian–Russian fisheries management), Oslo: Fagbokforlaget.

Hønneland, G. (2011), 'Kompromiss als Routine' (Compromise as routine), *Osteuropa*, 61 (2–3): 257–69.

Hønneland, G. (2012), *Making International Fisheries Agreements Work: Post-Agreement Bargaining in the Barents Sea*, Cheltenham: Edward Elgar.

Hønneland, G. and A. K. Jørgensen (2015), 'Kompromisskulturen i Barentshavet' (The culture of compromise in the Barents Sea), in T. Heier and A. Kjølberg (eds), *Norge og Russland: Sikkerhetspolitiske utfordringer i nordområdene* (Norway and Russia: Security policy in the High North), 57–68, Oslo: Universitetsforlaget.

Jentoft, M. (2015), 'Miljøsamarbeid med Russland trass isfront' (Environmental cooperation with Russia, despite icy relations), *NRK*, 2 December. https://www.nrk.no/urix/miljosamarbeid-med-russland-trass-isfront-1.12683161.

Jørgensen, A. K. and A. Østhagen (2020), 'Norges vern av suverene rettigheter rundt Svalbard: Russiske persepsjoner og reaksjoner' (Safeguarding Norwegian rights around Svalbard: Russian perceptions and reactions), *Internasjonal politikk*, 78 (2): 176–92. https://doi.org/10.23865/intpol.v78.1838.

Karlsbakk, J. (2019), 'Fiskerisamarbeid vant Thorvaldprisen' (Fisheries cooperation wins Thorvald Prize). *The Norwegian Barents Secretariat*, 27 February. https://barents.no/nb/nyheter/2019/fiskerisamarbeid-vant-thorvaldprisen

Kjesbu, O. S., B. Bogstad, J. A. Devine, H. Gjøsæter, D. Howell, R. B. Ingvaldsen, R. D. M. Nash and J. E. Skjæraasen (2014), 'Synergies between Climate and Management for Atlantic Cod Fisheries at High Latitudes', *Proceedings of the National Academy of Sciences of the USA*, 111 (9): 3478–83. https://doi.org/10.1073/pnas.1316342111.

Lind, S. (2018), *The Northern Barents Sea During 1970–2016: From Seabed to Surface in the Arctic Warming Hotspot*, PhD diss., University of Bergen.

Lodge, M., D. Anderson, T. Løback, G. Munro, K. Sainsbury and A. Willock (2007), *Recommended Best Practices for Regional Fisheries Management Organizations*. Report of an independent panel to develop a model for improved governance by Regional Fisheries Management Organizations, Chatham House, London: The Royal Institute of International Affairs. https://www.oecd.org/sd-roundtable/papersandpublications/39374297.pdf.

March, J. G. and J. P. Olsen (1989), *Rediscovering Institutions: The Organizational Basis of Politics*, New York, NY: Free Press

Matishov, G. G. and A. P. Zhichkin (2013), 'Vliyanie klimaticheskikh fluktuatsiy na promyslovuyu ikhtiofauny ekosistemy Barentsego morya' (The influence of climatic fluctuations on the commercial ichtyofauna of the Barents Sea), *Vestnik Yuzhnogo Nauchnogo Tsentra*, 9 (1), 61–70. http://www.ssc-ras.ru/files/files/61-70_Matishov.pdf.

Molenaar, E. (2016), *Multilateral Fisheries Allocation: An Overview of Global Instruments* [PowerPoint slides]. NEAFC Seminar on Allocation Criteria and Associated Issues, London, 22 February. https://en.uit.no/Content/454597/Molenaar-Multilateral-Fisheries-Allocation-Overview-Global-Instruments.pdf.

NEAFC (2016), *Interim Outcome of the Working Group on Allocation Criteria, September 2016*, WG-AC 2016- 03-03Report – Annex 1. http://neafc.org/system/files/WG-AC_2016-03-Report-Annex-1.pdf.

NEAFC (2017), *Report, 36th Annual Meeting of the North-East Atlantic Fisheries Commission, 13–17 November 2017*. http://chil.me/download-file/2c7e6df4-c3bf-474a-a916-90cf69ebe8dd/neafc-36-annual-meeting-final-report

Norges Fiskarlag (2021), 'Forhandler denne uka' (Negotiations this week), 11 October. https://www.fiskarlaget.no/nyheter/details/5/2627-forhandler-denne-uka.

NRK Troms og Finnmark (2018), 'Torsken flytter på seg' (The cod is on the move) [radio news report], 18 June. https://www.nrk.no/tromsogfinnmark/torsken-flytter-pa-seg-1.14075158

Pedersen, H. (2006), 'Norsk–russisk fiskerisamarbeid – dialog og tillit' (Norwegian–Russian fisheries cooperation – dialogue and trust), *Nordlys*, 28 October. https://www.nordlys.no/kronikk/norsk-russisk-fiskerisamarbeid-dialog-og-tillit/s/1-79-2376632.

RIA Novosti (2013), 'Treska migriruet v rossiyskie vody iz-za potepleniya Barentseva morya' (Cod is migrating into Russian waters due to the warming of the Barents Sea), 22 January. https://ria.ru/20130122/919128808.html.

Rønning, A. (2013), 'Torsken stikker til Russland' (The cod is escaping to Russia). *Forskning. no*, 23 December. https://forskning.no/havforskning-fangst/torsken-stikker-til-russland/589289.

Spijkers, J. and W. J. Boonstra (2017), 'Environmental Change and Social Conflict: The Northeast Atlantic Mackerel Dispute', *Regional Environmental Change*, 17 (6): 1835–51.

Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.

Stokke, O. S. and A. H. Hoel (1991), 'Splitting the Gains: Political Economy of the Barents Sea Fisheries', *Cooperation and Conflict*, 26: 49–65.

Stokke, O. S. and O. Tunander, eds (1994), *The Barents Region: Cooperation in Arctic Europe*. London: Sage.

Stokke, O. S., L. G. Anderson and N. Mirovitskaya (1999), 'The Barents Sea Fisheries', in O. R. Young (ed.), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, 91–154, Cambridge, MA: MIT Press.

Taleb, N. (2012), *Antifragile: Things that Gain from Disorder*, New York, NY: Random House.

Totland, O. A. (2020), 'Makrellkonflikten og strategisk klimafornekting' (The mackerel conflict and strategic climate denial), *Internasjonal politikk*, 78 (2): 142–66. https://doi.org/10.23865/intpol.v78.1453.

Vermes, T. (2020), 'Fiskebåtrederne ber Norge ta striden om Svalbardsonen til domstolen i Haag' (Fishing vessel owners call on Norway to take the dispute over the Svalbard zone to the [International] Court [of Justice] in The Hague). *ABC Nyheter*, 20 February. https://www.abcnyheter.no/nyheter/politikk/2020/02/12/195648526/fiskebatrederne-ber-norge-ta-striden-om-svalbardsonen-til-domstolen-i-haag.

Wendt, A. (1994), 'Collective Identity Formation and the International State', *American Political Science Review*, 88: 384–96.

Young O. R. (1989), 'The Politics of International Regime Formation: Managing Natural Resources and the Environment', *International Organization*, 43 (3): 349–75.

Young, O. R. (1999), *Governance in World Affairs*, Ithaca NY: Cornell University Press.

Young, O. R. (2010), 'Institutional Dynamics: Resilience, Vulnerability and Adaptation in Environmental and Resource Regimes', *Global Environmental Change*, 20 (3): 378–85.

Young, O. R. and O. S. Stokke (2020) 'Why is it Hard to Solve Environmental Problems? The Perils of Institutional Reductionism and Institutional Overload', *International Environmental Agreements*, 20: 5–19. https://doi.org/10.1007/s10784-020-09468-6.

Zhichkin, A. P. (2014), 'Prostranstvenno-vremennaya izmenchivost' promyslovoy znachimosti razlichnykh rayonov rybnogo lova v Barentsevom more' (Spatio-temporal variation in fish catches from different fishing regions in the Barents Sea), *Vestnik MGTU*, 17 (3), 465–73. https://cyberleninka.ru/article/v/prostranstvenno-vremennaya-izmenchivost-promyslovoy-znachimosti-razlichnyh-rayonov-rybnogo-lova-v-barentsevom-more.

Zilanov, V. K. (2016), 'Smeshannaya sovetsko/rossijsko-norvezhskaya komissiya po rybolovstvu: ot istokov cherez doveriya k budushego (lichnyy vsglyad uchastnika sobytiy)' (The Joint Soviet/Russian–Norwegian fisheries commission: from the origins through trust in the future (personal view of a participant in the events), *Voprosy rybolovstva*, 17 (4): 460–83.

Zilanov, V. K. (2018), *Mister Russland Arktis?* (Will Russia Lose the Arctic?), Oslo: Vidarforlaget. Originally published in Russian in 2013 as 'Rossija terjaet Arktiku?'.

Ørebech, P. (2013), 'The "Lost Mackerel" of the North East Atlantic – The Flawed System of Trilateral and Bilateral Decision Making', *International Journal of Marine and Coastal Law*, 28 (2): 343–73.

Østhagen, A. (2016), 'High North, Low Politics–Maritime Cooperation with Russia in the Arctic', *Arctic Review*, 7 (1). https://doi.org/10.17585/arctic.v7.255.

Østhagen, A., A. K. Jørgensen and A. Moe (2020), 'Rybookhrannaya zona Shpitsbergena: Kak Rossiya i Norvegiya rasreshayut arkticheskie raznoglasiya' (The Svalbard fisheries protection zone: How Russia and Norway manage an Arctic dispute), *Arktika i Sever* (Arctic and North), 40: 183–205. http://www.arcticandnorth.ru/article_index_years.php?ELEMENT_ID=348131.

9

External Shocks, Resilience and Barents Sea Fisher Compliance

Olav Schram Stokke

Introduction

What can two periods of drastically declining conditions for managing fisheries in the Barents Sea tell us about the conditions that promote or impede institutional resilience?[1] As explained in Chapter 1, 'institutional resilience' denotes the capacity of a governance system to adapt to rapidly changing circumstances, such as extensive shifts in the spatial distribution of fish stocks, in order to retain high levels of performance. Extensive and rapid spatial stock-shifts may affect fisheries management regimes, by altering underlying factors like the stock's zonal attachment and the availability of fish in high-seas areas.

In the Barents Sea, the most important commercial stock is Northeast Arctic cod (*Gadus morhua*), currently the world's biggest cod stock. Trawlers from Norway and Russia, the two coastal states that dominate the international regime for managing these fisheries, and from a few other European nations, take some two-thirds of the annual harvest, the remainder being caught by numerous relatively small but effective Norwegian coastal vessels using passive gears.

In the two time periods examined here, quota overfishing of this valuable stock reached very high levels, in some years accounting for nearly one-quarter of the total catch. Overfishing on this scale jeopardized not only stock replenishment but also the legitimacy of regional management measures, redistributing wealth from legal fishers to cheaters, and the repercussions through the seafood value chain promoted corrupt practices in fish production and distribution in Europe and beyond (Stokke 2009).

This chapter identifies the changes that triggered such illegal, unreported and unregulated (IUU) fishing in the Barents Sea and examines the institutional adaptations undertaken in order to regain previous levels of regime performance. Focusing on the behavioural or compliance task of management, it thereby contributes to addressing the second and the third of the overarching research questions developed in Chapter 1, on the challenges posed by stock-shifts and the institutional remedies available to those who operate international management regimes.

I first outline the complex of institutions that are most important for managing these fisheries, then review the two external shocks that triggered large-scale quota overfishing: a *stock shift* induced by changes in environmental conditions, making more cod available in a high-seas part of the Barents Sea known as the Loophole; and a *value-chain shift* induced by a change in industrial strategies by the Russian fishing industry that entailed more landings in foreign ports. Then I describe the set of unilateral, bilateral and ultimately multilateral measures that the coastal states and other actors (including private industries, transnational environmental organizations and international organizations) developed in response, involving more and more institutions, with careful attention to the interplay among them. Such deliberate interplay management, I hold, has been central in making this particular governance system resilient to the external perturbations incurred by shifts in stock distribution and value-chain strategies.

Institutional complex

By 'institutional complexes' is meant two or more institutions that are distinct in terms of membership and decision-making but deal with the same issue in potentially problematic and usually non-hierarchical ways (Oberthür and Stokke 2011; Orsini et al. 2013). Central in the complex of institutions involved in the management of Barents Sea fisheries is the Joint Norwegian–Russian Fisheries Commission (JNRFC), which meets annually to adopt and allocate total quotas and other regulations for stocks shared by Norway and Russia, including Northeast Arctic cod and regional stocks of haddock, capelin and halibut (see Chs. 1 and 8; also Stokke et al. 1999, 2012; Hønneland 2012). JNRFC decision-making builds on scientific recommendations from the Advisory Committee under the International Council for the Exploration of the Sea (ICES). Also non-coastal states agree to be bound by the quotas and technical restrictions established by the JNRFC, in return for gaining access to coastal-state waters.

As the Barents Sea fisheries regime is nested within the global fisheries regime, important parameters are set forth in general international customary and treaty law. In the law of the sea, flag-state jurisdiction is central, significantly circumscribed only when harvesters operate in internal waters, the territorial sea or an exclusive economic zone (EEZ) (see Ch. 2 by Molenaar). As codified in the 1982 UN Convention on the Law of the Sea (UNCLOS), a coastal state enjoys, within its 200-nautical mile EEZ, 'sovereign rights for the purpose of exploring and exploiting, conserving and managing' the fish stocks (Art. 56), permitting the full range of enforcement activities, including 'boarding, inspection, arrest and judicial proceedings' (Art. 73). This provides a strong legal basis for effective fisheries management within 200 nautical miles of the baselines.

Beyond the EEZs, in contrast, vessels enjoy the high-seas freedom of fishing (Art. 116), so that states other than the vessels' flag states have scarce basis for constraining their activities. Even flag-state duties were initially vague: such states 'have the duty to take, or to co-operate with other States in taking, such measures … as may be necessary for the conservation of the living resources of the high seas' (Art. 117) and 'shall, as appropriate, co-operate to establish sub regional or regional fisheries organizations to this end' (Art. 118).

Gradually, however, those seeking more stringent management measures in waters beyond national jurisdiction have succeeded in getting flag-state obligations strengthened with respect to vessels operating on the high seas, mostly through the UN Fish Stocks Agreement (UNFSA 1995). This treaty, which is binding on all states in the Barents Sea region, augments the duty to cooperate on high-seas fisheries by specifying that only states that are members of a regional fisheries regime, or that agree to apply the conservation and management measures taken under such a regime, shall have access to the fishery (Art. 8). With respect to enforcement measures, the UNFSA confirms stronger flag-state responsibilities, notably that of preventing a flag state's own vessels from engaging in high-seas fishing without a permit, and specifies procedures allowing non-flag states, under certain conditions, to inspect and detain fishing vessels on the high seas (Art. 21). The Agreement also encourages port states to conduct inspections of vessels that are voluntarily in port, and to prohibit landings and transhipment whenever inspections have 'established that the catch has been taken in a manner which undermines the effectiveness of […] conservation and management measures on the high seas' (Art. 23).

An important source of inspiration for flag-state elements of the Fish Stocks Agreement was the 1993 Compliance Agreement, negotiated under the auspices of the UN Food and Agriculture Organization (FAO). The FAO has also been important for implementation of the UNFSA: under this agency, states have developed a series of national and international plans of action for combating IUU fishing (FAO 2001).

In short, numerous fisheries institutions at the regional as well as global levels have gradually sharpened the tools available for research, regulation and enforcement action in the Barents Sea. Unfortunately, as elaborated in the next section, this dynamism has failed to prevent the emergence of very substantial IUU fishing of the region's most valuable fish stock. Responding to those challenges has required further expansion of the institutional complex, notably by involving the North-East Atlantic Fisheries Commission (NEAFC) as well as provisions under the global trade regime.

Two shocks and their impacts on IUU fishing

As the acronym indicates, IUU fishing is a three-pronged phenomenon – and the two external shocks to the governance system examined here triggered all three varieties. As defined by the FAO (2001), *illegal* fishing violates relevant 'national laws or international obligations', whereas *unreported* fishing is that which 'has not been reported, or has been misreported' to the relevant national authority or international fisheries organization, 'in contravention of' national or international procedures. *Unregulated* fishing, finally, refers to harvesting by vessels without nationality or flying the flag of a non-party in 'the area of application of a relevant regional fisheries management organization' or outside such areas if 'conducted in a manner inconsistent with State responsibilities … under international law'.

The shock deriving from the value-chain shift in Russian fisheries in the early 1990s and again the early 2000s led to very substantial illegal and unreported fishing and involved numerous players, including Russian harvesting vessels, Norwegian processors, transport vessels flying various flags, as well as fish importers in numerous European states. But let us first examine the shock that derived from a spatial shift of Northeast Arctic cod, increasing its availability in the high-seas part of the Barents Sea and involving unregulated fishing by mostly Icelandic vessels – with the full political backing of the Icelandic authorities.

Stock shift and unregulated fishing in the Loophole

Towards the end of the 1980s, changes in water temperature and salinity generated a marked increase in the availability of cod in the high-seas 'Loophole', located between the Norwegian and Russian EEZs (Stokke 2001). With this shift in distribution, Northeast Arctic cod became a straddling stock; and, although the presence of ice made for a short season, this new fishing opportunity attracted numerous distant-water vessel operators. In 1991 the cod fishery began cautiously, with vessels from the European Community, Greenland and the Faroe Islands; two years later, it accelerated when also Iceland became interested in this fishery. By 1995, as many as eighty Icelandic trawlers were operating in the Loophole, and the Icelandic media reported excellent catches (Stokke 2001). Keen to establish a 'real interest' in this stock, Iceland carefully recorded and published these catches, which were additional to those taken under annual quotas allocated under the JNRFC.[2]

These Icelandic activities in the Loophole have been qualitatively different from the clearly illegal quota overfishing conducted by many Russian vessels during the same period. Icelandic activities were 'unregulated' in FAO terms – but the lack of regulation in this case derived from open controversy among the governments involved. Indeed, when the FAO agreed on the formal definition of the 'unregulated' part of the IUU concept cited above, it inserted a caveat differentiating among two variants of unregulated fishing: 'Notwithstanding paragraph 3.3 [on unregulated fishing], certain unregulated fishing may take place in a manner which is not in violation of applicable international law, and may not require the application of measures envisaged under the International Plan of Action' (FAO 2001: para. 3.4).

The coastal states, Norway and Russia, argued in vain that newcomer activities in the Loophole lacked legitimacy and should be halted, as the stock was fully utilized. Many of the foreign fishing vessels that operated in the area were flying flags of convenience, which rendered traditional, diplomatic channels less effective for dealing with the problem.

The two coastal states agreed among themselves to step up their presence in the area by control vessels but refrained from stretching international law regarding unilateral enforcement measures beyond their EEZs. Despite pressure from industry organizations that called for emergency measures and greater activism, at no time did the coastal states use patrol vessels for non-courtesy boarding or detention of foreign vessels (Stokke 2001).[3] Such measures would most likely have met with opposition from the flag state: unilateral coastal-state enforcement on the high seas would be clearly incompatible with customary international law unless bona fide attempts to reach agreement with other users had failed and the stock was unequivocally in jeopardy due to the activity in question (Burke 1989). Even at the peak, unregulated catches of Northeast Arctic cod represented no more than a third of the *increase* in the total quota from the preceding year (Stokke 2001). Such additional harvesting pressure was more of a nuisance than a threat to sustainability; moreover, Iceland repeatedly declared its willingness to negotiate with the coastal states.

In short, traditional law-of-the-sea-based management measures proved insufficient for dealing with the rising unregulated fishing in the Barents Sea Loophole during the 1990s. That situation generated interest in exploring other compliance measures – notably measures involving port-state restrictions that potentially impinged on international trade rules.

Value-chain shifts and Russian landings

The shift in value-chain strategies within the Russian fishing industry in the early 2000s generated even greater illegal and unreported fishing, typically conducted by vessels that held quotas to fish but that exceeded them considerably. The ICES (2019) estimated that, at peak, unreported catches of this stock in the early 1990s made up more than one-third of that year's total cod quota.[4]

Overfishing of such magnitude was possible due to the incorporation of the Northwest Russian fishing industry into the global market economy, following the radical reordering of Soviet society that Gorbachev launched in the late 1980s. *Perestroika* triggered a rapid rise in Russian landings in Western ports, which in turn undermined the traditional Soviet monitoring system based on juxtaposition of catch reports from the vessels and delivery reports from the processing units. With Russian landings being made abroad, domestic fisheries-enforcement agencies no longer had access to port-delivery data – and that greatly increased the leeway for contravening quota and reporting requirements. As long as Russian landings abroad were limited to Norway, countermeasures could be developed within the existing institutional complex. However, when Russian vessels shifted the thrust of their direct landings from Norwegian to various British, German, Dutch, Spanish and other EU ports, an expansion of the complex was necessary, as elaborated below. Adding to the difficulties of monitoring landings abroad was the growing involvement of at-sea transhipment from Russian trawlers to transport vessels, spurring attempts to disguise the amount of actual catches.

Consequences

Of the two external shocks, the value-chain shifts posed the greatest challenges to sustainable management. Even during the peak years of Loophole fishing, unregulated catches were less than 60,000 tonnes, accounting for no more than 7 per cent of the total, and they soon dropped to negligible levels. In comparison, the ICES has estimated that illegal and unreported catches during the same period were as high as 130,000 tonnes in 1992 during the first wave of quota overfishing, and even higher than that when the second wave peaked in 2005 (ICES 2021). An important basis for these ICES estimates has been satellite tracking data of fishing and transport-vessel movements to main ports, combined with assessments of vessel storage capacity that enforcement agencies derive from inspections and vessel registers (Norway 2007).

The extremely high IUU catches were not the only threats to sustainable management of Northeast Arctic during those two periods. Also the coastal states contributed to the problem by setting legal quotas considerably higher than those recommended by ICES. These deviations from scientific advice were particularly noteworthy during a string of years from 1998 to 2004, reflecting reluctance on the part of the JNRFC to accept the implications of ICES implementation of the precautionary approach to fisheries research. That approach requires greater safety margins for stocks that drop below certain pre-defined precautionary reference points – as they did around the turn of the millennium (Stokke and Coffey 2004). Combating IUU fishing is an important task for fisheries management, but the harvesting pressure deriving from legal, reported and regulated fisheries also needs continuous and critical attention.

The damage incurred by these various categories of IUU fishing was multifaceted. As regards sustainability, they added to the quota-based fishing pressure which, according to the best available knowledge, was already too high. In economic terms, such large quota overfishing implied a substantial redistribution from those fishers who abided by the rules to those who cheated. Scientists have estimated that, without illegal fishing, the 2007 quota advice for Northeast Arctic cod would have been 85 per cent higher than the actual case.[5] Politically, awareness of large-scale IUU activities might undermine the willingness among fishers and managers to keep quotas and catches within scientific advice, in part on the expectation that the overfishers are those most likely to gain from such restraint. The fact that quota overfishers must cover their tracks also implies that such activities underpin corrupt practices in the production and distribution chains for Northeast Arctic cod and beyond. Evidence links large-scale overfishing in the region to other unlawful activities such as illegal trade in drugs or weapons and human trafficking.[6]

Hence, the IUU challenges facing coastal states in the Barents Sea concern not only the state of fish stocks but also the distribution of wealth, the role of science-based advice in precautionary fisheries management, and the broader struggle against corruption and crime in the region. These severe consequences of IUU fishing activities in the Northeast Atlantic, and the failure of the leading regional fisheries management body to combat them, can explain the growing interest in ways of adapting the institutional complex, notably by deepening the compliance cooperation within the JNRFC and mobilizing new bodies in order to make port-state measures more effective. To that we now turn.

Widening the institutional complex

Efforts to adapt the governance system to the external shocks posed by the stock- and value-chain shifts outlined above produced a stepwise expansion of the institutional complex. Frustrated with the ineffectiveness of traditional law-of-the-sea measures to combat IUU fishing, the coastal states developed new measures and extended the use of earlier measures, capitalizing on their legal competence further down the value chain of seafood production and distribution. That value chain involves shipbuilders, classification societies, insurance agents, brokers of various kinds, freighters, port-service or transhipment providers, processors, wholesalers, retailers and restaurants – and many more. Each of these links can provide potential means for enhancing compliance; and states and others have made increasing use of this possibility (Stokke 2019).

In the Barents Sea case, efforts to adapt institutions in order to deal more effectively with IUU fishing first concerned measures available within the existing bilateral fisheries commission. Soon they spread out to institutions with wider membership, mobilizing a steadily wider set of state- and non-state actors with complementary capabilities for furthering fisher compliance.

Differentiating the existing institution

Institutional differentiation was an important first response to the challenge posed by steeply rising Russian landings abroad, which initially occurred only in Norwegian ports. As noted, landings outside Russia implied that domestic fisheries-enforcement agencies were no longer able to cross-check fisher reports with port-delivery data. At-sea inspection of Russian vessels occurred only in waters under Norwegian jurisdiction; moreover, as Norwegian patrol vessels lacked information on how much fish each individual Russian vessel was allowed to take, they could only check whether logbooks corresponded with the amount of fish found on board. Russian enforcement agencies were not much better placed: as vessels landing their catch abroad did not present those logbooks to the Russian port authorities, monitoring of aggregate catches relative to the national quota had to rely on largely unverifiable radio-transmitted fisher reports (Hønneland 2012: 60). For quite some time, therefore, the value-chain shift towards foreign landings practically removed the risk that under-reporting of catches would be discovered.

One step towards responding effectively to this gap in the compliance system was taken when Norwegian enforcement agencies began to monitor the radio band used for Russian reporting, and alerted Moscow to discrepancies between reports and logbook data deriving from inspections (Hønneland 2012: 60).

To institutionalize such closer communication among the enforcement agencies, a Permanent Committee for Regulation and Control was established in 1993 under the JNRFC, facilitating regular sharing of data on Russian landings in Norwegian ports and vessel activities in waters under Norwegian jurisdiction. Soon the Permanent Committee became an arena for elaborating a much wider range of joint measures for improving the implementation of regional regime rules. Notable examples are regular exchanges of information about national fisheries legislation, annual seminars involving enforcement personnel of the two states, exchanges of observers on each other's control vessels, common conversion factors between whole fish and the processed products that enforcement personnel usually find onboard, and the coordination of satellite tracking systems (Stokke 2012).

In short, the two coastal states responded to the value-chain shift by strengthening the compliance component of their core institution. That meant better use of available information and broader involvement of actors capable of collecting and using such information.

Mobilizing other bilateral institutions

In the period when the JNRFC was struggling to reduce the compliance deficit associated with Russian landings abroad, it also had to face the arrival of numerous new entrants to the Barents Sea cod fishery, flagged by European Community states, Greenland, the Faroe Islands and Iceland and operating in the high-seas Loophole.

Norway and Russia soon had to acknowledge that efforts to shame the flag states, by characterizing Loophole fisheries as irresponsible and illegitimate, failed to make a strong impression. They therefore turned to a set of bilateral arrangements each of them had entered into with non-littoral states that received quotas of Northeast Arctic cod in exchange for quota shares in other stocks (Stokke 2001). The purpose of such mobilization of agreements with 'third parties' to the JNRFC regime was partly to play the 'quota card' available to coastal states with lucrative stocks inside their EEZs, and partly to widen the application of various port-state denial measures that the coastal states had already taken unilaterally in order to make Loophole activities more costly.

The annual bilateral protocols of the JNRFC provide for coordinated allocation of parts of the total quota to third parties. After bilateral negotiations with Norway in 1991–2, both Greenland and the European Community agreed to limit the Loophole activities of vessels under their jurisdiction, and pledged to keep total harvests in the Barents Sea within the overall quotas allotted under reciprocal-access agreements.

Trade measures, in the form of port-state denial of landing, were first applied unilaterally but soon found their way into the bilateral agreements with third parties. Since 1993, Norway had prohibited landing in its own ports of fish from stocks subject to Norwegian regulation unless there were taken pursuant to a fisheries agreement between Norway and the flag state (Stokke 2001). That ban, later extended to transhipment as well as provision of bunkering and other port services, also applied to fish caught in contravention of a relevant regional fisheries management regime, or by non-members of such a regime. This forced Loophole fishers to land their catches in ports further away from the fishing grounds – which often entailed higher operational costs, making IUU activities less profitable.

Realizing that broader participation would strengthen the clout of the port-denial measure, Norway soon agreed with Russia in the JNRFC to insert, in the respective quota agreements with other regional states, a new requirement: that these join the ban on landing and transhipment of catches originating from unregulated fishing.

In summary, then, the stock shift that occurred in the Northeast Atlantic from the late 1980s triggered an expansion of the institutional complex for managing the regional fisheries. Whereas the creation of a Permanent Committee for Control and Enforcement under the JNRFC proved helpful for coping with compliance issues within the ambit of the bilateral regime, the subsequent mobilization of third-party agreements with other quota-holders in the Barents Sea induced non-littoral states to close their ports to vessels operating in high-seas waters without coastal-state endorsement.

Mobilizing multilateral institutions

For coastal states troubled by unregulated fishing in adjacent high-seas waters and illegal and unreported fishing conducted inside their own EEZs but landed in ports beyond their jurisdiction, multilateral institutions offer several attractive features. Among the institutional edges of the NEAFC for compliance purposes is its broad membership, comprising the European Union member-states, including Denmark on behalf of Greenland and the Faroe Islands, and Norway – as well as Iceland and Russia, the two states that flagged most of the vessels engaged in IUU fishing activities for Northeast Arctic cod. Gradually, as explained here, this organization evolved into a vital instrument for combating IUU fishing of Northeast Arctic cod in the Barents Sea by considerably expanding the scope of the regional port-denial measures, including blacklisting of vessels.

In 1999, the NEAFC had implemented a Scheme of Control and Enforcement, which obliged members to adopt more stringent reporting procedures, satellite-based vessel-monitoring, reciprocal acceptance of high-seas inspections, as well as stricter flag-state commitments to investigate and prosecute infringements (Stokke 2009). The complementary Scheme to Promote Compliance by non-Contracting Party Vessels obliged NEAFC members to prohibit landing or transhipment by a non-member-state vessel that has been sighted engaging in harvesting in the regulatory area, unless a subsequent inspection could establish that the harvesting was not in contravention of NEAFC rules (NEAFC 1998: item 8).

Unfortunately for Norway and Russia, the stock of greatest concern to them fell outside the area of applicability for these potent compliance measures: Northeast Arctic cod is not among the 'regulated resources' under the NEAFC, and for many years the compliance schemes applied only to the latter. That situation changed in 2007, however, when the NEAFC agreed to a consolidated and more stringent Scheme of Control and Enforcement applicable not only to regulated resources on the high seas but to all 'frozen catch of fisheries resources caught in the Convention Area' (NEAFC 2007: Art. 20);[7] the latter includes the regional EEZs as well. Under the 2007 scheme, members shall prohibit a foreign vessel from landing or transhipping frozen fish in their ports unless the flag state of the vessel that caught the fish can confirm that the vessel is authorized to fish in the area, has sufficient quota, has reported the catch – and that NEAFC-collected satellite tracking information corresponds with vessel reports (NEAFC 2007: Arts 22–23).

This innovative flag-state confirmation procedure entails recurrent external checks on the flag state's implementation of authorization, data recording and vessel-monitoring commitments under global and NEAFC rules. Core elements of the NEAFC procedure were emulated in the global FAO Agreement on Port State Measures (FAO 2009).

The greater potency of multilateral measures as compared to unilateral or bilateral ones is also evident in the case of vessel blacklisting, a practice that Norway had begun already in 1997. Whereas documentation schemes target landings and transhipment on a cargo-by-cargo basis, blacklisting focuses on the vessel and its history. Under Norwegian law, no vessel with a history of unregulated harvesting for cod in the Barents Sea could obtain a licence to fish in the Norwegian EEZ – even if it should change ownership (Stokke 2001). Such denial was later extended to port calls, and now applies to fishing vessels as well as transport vessels that have taken on board fish in violation of regional transhipment rules.

Norwegian blacklisting of vessels with a history of Loophole fishing implied that vessel owners would have to balance the gains they hoped to obtain from unregulated harvesting in the Loophole against the cost of being unable to use the vessel legally in Norway's zone in the future. A further cost was the reduction in the second-hand value of vessels with a history of contravening conservation measures under the JNRFC. Non-coastal states inside and outside the EU obtain around 15 per cent of the total quotas of Northeast Arctic cod each year, and waters under Norwegian jurisdiction are the most attractive areas in which to take those quotas.

Some evidence indicates that the unilateral Norwegian blacklisting practice contributed to Iceland's decision to accept coastal-state restrictions on the harvesting of Northeast Arctic cod. However, the main reason was probably that the 1999 Loophole Agreement gave Iceland a permanent share of the overall quota – particularly attractive because Loophole catches had declined in the preceding years (Stokke 2001). Norway had declared that listing of a vessel was permanent, but the authorities nevertheless removed Icelandic vessels from the list following that country's adoption of the Loophole Agreement – which indicates that such removal had high priority among Icelandic negotiators.

As with the requirement that vessels must document that their catch derives from regulated fishing, the potency of the blacklisting instrument was reinforced by the expansion of the institutional complex for managing Barents Sea resources – here by the mobilization of the two NEAFC vessel lists. On this regime's Observation List are vessels flying the flag of a non-participant in the NEAFC Scheme of Control and Enforcement that have been sighted fishing in the NEAFC Convention Area without responding to calls and without substantiating that their harvesting complies with NEAFC rules. Such preliminary listing entails denial of landing, transhipment and access to services in member-state ports or by vessels flying a NEAFC-member flag. A Permanent Committee for Control and Enforcement meets annually to review the Observation List in light of any flag-state explanation or other relevant information, and to recommend to the Commission whether a vessel be removed from the list or transferred to the Confirmed List of IUU vessels. Contracting parties to the NEAFC are to deny port entry, fishing rights and the granting of their flag to vessels on the Confirmed List; their companies and nationals shall not be allowed to charter such vessels or import fish from them, and are encouraged to avoid their produce also at later stages in the distribution chain (NEAFC 2007: Arts 44–46). Further strengthening this instrument, the geographically adjacent Northwest Atlantic Fisheries Organization (NAFO) automatically adds vessels on the NEAFC list to its corresponding list, and vice versa.

In summary, port-state denial supported by catch documentation schemes or vessel blacklisting can discourage IUU activities even when conducted unilaterally by a coastal state or by several states under bilateral agreements – but these instruments become even more forceful if implemented under broader institutions.

Discussion

The dynamism that has characterized the institutional complex for managing Barents Sea fisheries since the early 1990s and the attention paid by the coastal states to the interplay among the component regimes have been decisive for resilience. In this section, I first examine whether and how the efforts to expand the institutional complex succeeded in mitigating the IUU problem, then elaborate on the relationship between institutional resilience and interplay management, i.e. deliberate efforts to improve the interplay of the institutions involved (Stokke 2020).

Institutional adaptation and regime performance

The creation of a Permanent Committee for Regulation and Control under the JNRFC and the subsequent mobilization of numerous bilateral and multilateral institutions helped to close the Loophole fisheries and the compliance gap ensuing from the value-chain shift in Russia's fishing. The main mechanism triggered by these institutional adaptations involved mobilizing new actors to join in fisheries compliance efforts, enhancing the flow of information necessary for exposing IUU activities and expanding the use of measures designed to curb them.

The operations of the Permanent Committee ensured that Russian fisheries authorities regained the ability to estimate catches independently of Russian fisher reports, temporarily lost when their vessels shifted their landings from domestic to foreign ports. The Committee's dynamic agenda on practical means for improving enforcement had the broader effect of gradually expanding the fisheries compliance constituency. Representatives of the police, judicial, customs and tax authorities became involved in meetings under the JNRFC, which in the Russian delegation served to reduce the influence of the fishing industry and regional authorities in Northwest Russia (Stokke 2010; Hønneland 2012: 55).

Similar comments apply to the mobilization of bilateral and multilateral arrangements for linking side-payments in the form of EEZ quotas to pledges to deny port access to vessels unable to document that their catch derives from legal, reported and regulating harvesting. The number of bilateral reciprocal-access agreements that included such provisions rose quickly during the 1990s, as neighbouring states were induced to join the coastal-state struggle to combat IUU fishing (Stokke 2010). The NEAFC Scheme of Control and Enforcement provided means for further expansion of the compliance constituency. Its satellite-based vessel-monitoring system greatly facilitated the identification of non-NEAFC vessels active in the region; and the subsequent introduction of NEAFC vessel lists induced several flag states to de-register certain vessels and to apply for status as cooperating states. By 2007, six out of twenty vessels on the NEAFC Confirmed List were in the process of being scrapped, nine were held back in NEAFC ports and the remaining five were operating outside the Northeast Atlantic (Stokke 2009: 348). Coordinated port-state denial among all states bordering on the NEAFC areas clearly succeeded in adding significant costs to IUU harvesting in the regions, thus helping to mitigate the problem.

Further evidence that the mobilization of a multilateral institution helped to improve the effectiveness of fisheries management is found in the steeply rising number of voyages by Russian vessels to Murmansk or Archangelsk after the strengthening of the NEAFC Scheme of Control and Enforcement, facilitating the tracking by Russian authorities of total catches (Stokke 2009: 348). While this change probably reflected other developments as well, including the rise in purchasing power in Northwest Russia, NEAFC-induced transparency concerning Russian deliveries in European ports contributed by reducing the profitability of landing in Europe. Indeed, ICES estimates of total overfishing of Northeast Arctic cod indicate a dramatic decline following the introduction of the new measures, from around 70,000 tonnes in 2006 to around 15,000 tonnes in 2008, with negligible levels thereafter (ICES 2021).

In summary, the institutional responses to widespread IUU fishing in the Barents Sea during the 1990s and the early 2000s brought new, powerful actors into regional fisheries compliance work. The performance of these institutions rose as a result, providing evidence of a resilient institutional complex.

Institutional interplay

Among the institutional interactions within the complex for managing Barents Sea fisheries, those involving international trade rules deserve particular attention because they cross the boundary between fisheries and other sectors. Whereas the dyads of institutional interplay involving the JNRFC and several bilateral or trilateral reciprocal fisheries arrangements with third parties were directly conducive to solving the IUU problem, interactions with global trade rules proved more complicated. Landing or transhipment of fish in a foreign port is covered by the non-discrimination principle of the World Trade Organization (WTO), which makes discrimination among vessels flagged by WTO members potentially objectionable. Mobilizing the multilateral NEAFC for port-denial purposes, as this section shows, served to reduce such tension between the resource-management and the trade regimes.

Compatibility of a trade restriction with WTO rules requires that it fits the WTO 'environmental window' – a set of exceptions defined first in GATT Article XX and reproduced in subsequent agreements (GATT 1994). Subject to the chapeau requirement that trade restrictions 'are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination … or a disguised restriction on international trade', such measures may be deemed compatible with the global trade regime if they are 'necessary to protect human, animal or plant life or health' or 'relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production and consumption'. A series of decisions by dispute settlement bodies have clarified the WTO compatibility criteria laid down in GATT Article XX in ways relevant to fisheries compliance (Stokke 2009).

A first compatibility test is that the state wishing to apply sanctions must have exhausted less restrictive measures – passed in the case of the NEAFC, due to the many non-trade measures in the compliance portfolio as well as the absence of more trade-restrictive measures applied by other international fisheries commissions, especially in the tuna trade. Such more restrictive measures include 'white lists', whereby only explicitly named vessels are allowed to land or tranship their catches; and import bans on states whose vessels have been found to be in non-compliance (Palmer et al. 2006).

The second and third WTO compatibility tests are that any discrimination has been minimized, and that requirements for avoiding the trade restriction do not excessively interfere with the sovereignty of the target state. Those tests too have been passed in the case of the NEAFC, as non-parties can avoid trade measures by applying for 'co-operating non-Contracting Party' status, which is available to those who agree to play by the same rules as NEAFC parties do, and because the system incorporates key features of a globally endorsed FAO Model Scheme on Port State Measures (Stokke 2009).

Accordingly, the multilateralization of port-state control enabled a design of this compliance measure that fits the WTO 'environmental window' much better than do unilateral or bilateral variants.

Interplay management

None of the institutional adaptations recorded above occurred without substantial efforts on the part of certain actors, especially the coastal states but non-state actors as well, who initiated or encouraged the differentiation as well as the expansion of the institutional complex. Those actors engaged in 'interplay management': deliberate efforts to shape the effects that one institution may have on the contents, operation or consequences of another (Stokke 2020). Some of this interplay management was facilitated by certain features of the institutional complex – notably, the political weight of the two coastal states in the institutions mobilized, and the fact that arrangements involving port-state denial had already emerged as high-profiled instruments for combating IUU fishing.

In both cases of institutional adaptation examined here, Norway took the lead and succeeded in recruiting Russia among the champions for greater transparency and more severe responses to IUU fishing. The creation of the Permanent Committee on Regulation and Control was the result of long-term efforts by Norway's Fisheries Directorate and Coast Guard to triangulate various types of evidence on quota overfishing, which finally convinced their Russian counterparts to partner up and accept more intrusive cooperative monitoring arrangements (Hønneland 2012: 60). Norwegian leadership similarly played a role in developing and diffusing port-state denial measures in the region – first unilaterally and then by using the JNRFC to coordinate with Russia on the insertion of relevant provisions in their respective third-party agreements and in their Loophole agreement with Iceland.

Leadership on the part of coastal states with significant power capabilities was also important for mobilizing the high-seas NEAFC regime for solving the EEZ problem of managing Northeast Arctic cod, reinforced by transnational environmental organizations that maintained pressure on other NEAFC states to accept the necessary amendments (Stokke 2009). After several years of encouragement, Russia co-sponsored the Norwegian proposal to amend the NEAFC Scheme of Control and Enforcement to incorporate also fish taken in the EEZs of the Convention area. Several other port-state members of the NEAFC, whose cooperation was necessary for closing the transparency gap created by Russian landings in Europe, had been laggards as regards compliance, but that was criticized by transnational ENGOs participating as observers at NEAFC meetings, among them Seas at Risk, PEW Environment and the WWF (Stokke 2014). Hence, the openness of this regional regime to non-governmental observer organizations facilitated coastal-state efforts to expand the institutional complex to achieve more effective management.

Interplay management also played a role in ensuring that trade-restrictive compliance measures would be compatible with international trade rules, albeit indirectly so. The NEAFC Scheme was modelled in part on corresponding measures under the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR) and NAFO. Before introducing the CCAMLR catch documentation scheme, its secretariat had consulted with the WTO Committee on Trade and the Environment, and the scheme was deliberately tailored to fit the environmental window of the global trade regime (Agnew 2000). Also in the Northwest Atlantic, specific WTO provisions guided the development and design of measures involving port-state denial.

Accordingly, although WTO provisions appear to have been peripheral in NEAFC debates on the Scheme of Control and Enforcement, the models that provided inspiration for the scheme's trade-restrictive measures had emerged with keen attention paid to minimizing tension with international trade rules (Stokke 2009: 346).

A basic requirement for such conducive interplay within an institutional complex is that those operating regional and global institutions within issue-areas such as high-seas fisheries follow each other's moves with considerable interest.

Conclusions

The shocks to the fisheries governance system stemming from shifts in the spatial distribution of cod in the Barents Sea and in the value-chain strategies of Russian fishing companies, and the institutional responses championed by the coastal states, tell us three important things about institutional resilience.

A first finding is that institutional resilience is best observed at the aggregate or macro-level of institutional complexes, rather than by focusing on individual regimes. As shown in the Barents Sea cases, adequate responses to changing circumstances may involve not only differentiation of existing institutions but also changes in relations among them – as well as the involvement of institutions that have not previously addressed the problem in question. Thus, whereas the creation and subsequent dynamism of the Permanent Committee on Regulation and Control under the JNRFC would have been showcased also in a regime-centred analysis, the more potent expansion of the institutional complex by the involvement of numerous third-party bilateral agreements and of the NEAFC would have passed under the radar.

That said, understanding the mechanisms that drive the expansion of an institutional complex usually requires keen attention to processes of change and resistance in key component regimes – as shown clearly in the decisive step of activating the NEAFC Scheme of Control and Enforcement for purposes of Northeast Arctic cod management. That particular widening of the institutional complex could not have occurred had the coastal states not succeeded in their effort to amend the scheme – and their ability to persuade other members to accept that amendment derived from institutional as well as power-related conditions specific to the NEAFC. Whereas institutional resilience is best observed at the level of complexes, analysing it requires understanding of change in the component institutions.

A second finding from this study is that the adaptations which helped to restore or even improve levels of regime performance did so by bringing new actors into the compliance effort. Those actors possessed information or regulatory competence that had not been needed prior to the challenges triggered by the stock- and value-chain shifts. The stepwise introduction of port-state measures to combat IUU fishing in the Northeast Atlantic complemented traditional fisheries-enforcement work by exploiting the need of fishing vessels for landing or transhipping their cargo. Compared to monitoring and inspection at sea, such measures are more cost-effective and far more powerful in combating high-seas fisheries. Each step in that institutional adaptation served to restore the good fit between the boundaries of the institutional complex and the spatial scope of the activities that generated the management problem.

Finally, this chapter has brought out the close link existing between institutional resilience and interplay management – deliberate efforts by those operating or participating in international institutions to improve the interaction with other institutions relevant to problem solving. The coastal states, and Norway in particular, have provided leadership by pressuring other states to join in combating IUU fishing in the Barents Sea; however, also non-governmental environmental organizations based outside the region have contributed to this outcome. Russia's preparedness to place its political weight behind requests for multilateral port-state denial derived partly from coastal-state dynamics within the JNRFC and partly from the consequent mobilization of domestic players previously not engaged in fisheries compliance.

Interplay management is a *political* activity because the interacting institutions typically differ in their emphasis among objectives as well as in the support they enjoy from powerful actors. Analysing institutional resilience often requires attention to the wider complex of institutions relevant to a particular governance objective – and such attention must start with the actors with high stakes in that objective, examining their configurations of power and interests within as well as outside the component institutions.

Notes

1 This chapter is an abridged and updated version of Stokke (2018).
2 The UN Fish Stocks Agreement, Article 8, provides that regional management regimes shall be open to states with a 'real interest' but fails to define the concept; see Stokke (2001); historical catches are an important allocative criterion in regional fisheries management organizations.
3 A 'non-courtesy boarding' is one not explicitly accepted by the vessel captain.
4 NTBTekst, 29 April 1993; details in Hønneland (2012: 61), including the estimate that Russian overfishing of own quota was about 60 per cent.
5 The actual ICES advice was 309,000 tonnes; the hypothetical advice without illegal catches would be around 570,000 tonnes, according to Asgeir Aglen of the Norwegian Institute of Marine Research; see *Fiskeribladet*, 10 June 2006, p. 9.
6 Norwegian Minister of Justice, Knut Storberget, quoted in *Fiskaren*, 7 September 2007, p. 6.
7 Later on, the qualification 'frozen' was removed, so the requirement now applies to all fish. Updated text of the scheme available at NEAFC Scheme of Control and Enforcement. www.neafc.org/scheme.

References

Agnew, D. J. (2000), 'The Illegal and Unregulated Fishery for Toothfish in the Southern Ocean, CCAMLR Catch Documentation Scheme', *Marine Policy*, 24: 361–74.

Burke, W. T. (1989), 'Fishing in the Bering Sea Donut: Straddling Stocks and the N0ew International Law of Fisheries', *Ecology Law Quarterly*, 16: 285–310.

FAO (2001), International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. http://www.fao.org/fishery/ipoa-iuu/en.

FAO (2009), Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. Revised 2016. http://www.fao.org/3/i5469t/I5469T.pdf.

GATT (1994), General Agreement on Tariff and Trade (superseding GATT 1947). https://www.wto.org/english/docs_e/legal_e/06-gatt_e.htm.

Holling, C. S. (1973), 'Resilience and Stability of Ecological Systems', *Annual Review of Ecology and Systematics*, 4: 1–23.

Hønneland, G. (2012), *Making International Fisheries Agreements Work: Post-Agreement Bargaining in the Barents Sea*, Cheltenham: Edward Elgar.

ICES (2021), Cod (*Gadus morhua*) in Subareas 1 and 2 (Northeast Atlantic), *ICES Advice*, https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2021/2021/cod.27.1-2.pdf.

NEAFC (1998), 'Report of the 17th Annual Meeting of the North-East Atlantic Fisheries Commission', London: North-East Atlantic Fisheries Commission. https://www.yumpu.com/en/document/read/27747156/17th-annual-meeting-north-east-atlantic-fisheries-commission-.

NEAFC (2007), Scheme of Control and Enforcement (adopted 2006, with subsequent amendments), London: North-East Atlantic Fisheries Commission. Updated text of the scheme available at https://www.neafc.org/mcs/scheme.

Norway (2007), Norwegian Directorate of Fisheries, 'Status Report for 2007: Russian Fishing of Cod and Haddock/ Transhipment at Sea', Norwegian version available at https://fdir.brage.unit.no/fdir-xmlui/bitstream/handle/11250/131865/russisk_fiske_2007_nor.pdf?sequence=1&isAllowed=y.

Oberthür, S. and O. S. Stokke (2011), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change*, Cambridge, MA: MIT Press.

Orsini, A., J.-F. Morin and O. Young (2013), 'Regime Complexes: A Buzz, a Boom, or a Boost for Global Governance?', *Global Governance*, 19: 27–39.

Palmer, A., B. Chaytor and J. Werksman (2006), 'Interactions between the World Trade Organization and International Environmental Regimes', in S. Oberthür and T. Gehring (eds), *Institutional Interaction in Global Environmental Governance: Synergy and Conflict among International and EU Policies*, 181–204, Cambridge, MA: MIT Press.

Stokke, O. S. (2001), 'Managing Fisheries in the Barents Sea Loophole: Interplay with the UN Fish Stocks Agreement', *Ocean Development and International Law*, 32: 241–62.

Stokke, O. S. (2009), 'Trade Measures and the Combat of IUU Fishing: Institutional Interplay and Effective Governance in the Northeast Atlantic', *Marine Policy*, 33: 339–49.

Stokke, O. S. (2010), 'Barents Sea Fisheries: The IUU Struggle', *Arctic Review of Law and Politics* 2: 207–24.

Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.

Stokke, O. S. (2014), 'Actor Configurations and Compliance Tasks in International Environmental Governance', in N. Kanie, S. Andresen and P. M. Haas (eds), *Improving Global Environmental Governance: Best Practices for Architecture and Agency*, 83–107, London: Routledge.

Stokke, O. S. (2018), 'Stock Shifts, Value Chains and Institutional Resilience: Fisher Compliance in the Barents Sea', in S. V. Rottem and I. F. Soltvedt (eds), *Arctic Governance Volume II: Energy, Living Marine Resources and Shipping*, 228–52, London: I.B.Tauris.

Stokke, O. S. (2019), 'Management Options for High Seas Fisheries: Making Regime Complexes More Effective', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 51–78, Oxford: Hart.

Stokke, O. S. (2020), 'Interplay Management', in F. Biermann and R. Kim (eds), *Architectures of Earth System Governance: Institutional Complexity and Structural Transformation*, 165–85, Cambridge: Cambridge University Press.

Stokke, O. S. and C. Coffey (2004), 'Precaution, ICES and the Common Fisheries Policy: A Study of Regime Interplay', *Marine Policy*, 28: 117–26.

Stokke, O. S., L. G. Anderson and N. Mirovitskaya (1999), 'The Barents Sea Fisheries', in O. R. Young (ed.), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, 91–154, Cambridge, MA: MIT Press.

UNCLOS (United Nations Convention of the Law of the Sea) (1982). http://www.un.org/Depts/los/index.htm.

UNFSA (UN Fish Stocks Agreement) (1995), 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 Stocks. https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-7&chapter=21&clang=_en.

WTO (1995), Agreement Establishing the World Trade Organization. WTO agreements are available at www.wto.org.

Young, O. R. and M. A. Levy (1999), 'The Effectiveness of International Environmental Regimes', in O. R. Young (ed.), *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioral Mechanisms*, 1–32, Cambridge, MA: MIT Press.

10

Snow Crabs, the EU and Diplomatic Headaches

Andreas Østhagen and Andreas Raspotnik

Introduction

In 2017, the European Union decided to award licences to catch snow crab (*Chionoecetes opilio*) in the Fisheries Protection Zone (FPZ) around the Arctic archipelago of Svalbard – despite not having jurisdiction to manage snow-crab licences in those waters. The snow crab is a relatively new species in the Barents Sea, first discovered in 1996 as it moved westwards from Russian waters (see Ch. 6). It is assumed to have migrated westwards along the Russian coast from its natural habitat in the northern Pacific Ocean. Despite limited Norwegian fisheries of this resource, conflict ensued. Per Sandberg, Norwegian Minister of Fisheries, vowed that Norway 'would not give away one crab!' (Haugan 2017), while a Member of the European Parliament (MEP) followed up by characterizing the Norwegians as 'pirates' of the Arctic (Mamikins 2018).

There are more dimensions to this dispute than just catching *Chionoecetes opilio*: 'Oil lurks beneath EU–Norway snow crab clash' (Bolongaro 2017). It is particularly the applicability of the 1920 Svalbard Treaty to maritime zones beyond the territorial waters of the archipelago, where Norway and the EU hold differing views, that sparks such statements (Pedersen and Henriksen 2009; Molenaar 2012).[1] Further, general Norway–EU relations come into play. This chapter explores the interests of the EU in the 'snow-crab case', as well as the complexities that involve legal, political and economic considerations – all spurred by the appearance of a new species in Norwegian Arctic waters.

Why is the EU pursuing a relatively minor issue over the right to catch snow crab in the Barents Sea? Is the EU using snow crabs to challenge Norway's Svalbard regime? (Madsen 2017). If so, what are the interests of related EUropean actors driving this challenge? A common fallacy in academic literature on Arctic politics, as well as in the popular media, is to simplify the EU down to an actor with one single interest (for more on this, see Ch. 4 on the EU as a foreign policy and/or fisheries actor). The EU is in fact a complex actor, so a final question concerns the matter of EU coherence: does one coherent interest exist within the EU system, on that can explain the Union's 'actions' concerning snow crab?

Any dispute has at least two sides. This chapter focuses specifically on EU interests and policy process, searching beneath oversimplified headlines to add a crucial building-block to our understanding of the EU's interests concerning snow crab specifically, and of the EU as a fisheries actor more generally. Thus, it links to Chapter 4, which delves further into the link between fisheries and foreign policy in the specific case of the EU. We link this to questions number two and three as set out in the Introduction (challenges caused by stock-shifts, and adaptation by institutions). In fact, the snow-crab dispute between Norway and the EU is rather a case of a completely new 'stock' (species) prompting the establishment of some form regulatory regime – which is what has caused the conflict in the first place. This unfolds within the overarching framework of the Svalbard marine living resources management regime that Norway created with the FPZ in 1977, and illustrates how economic interests situated in a larger ocean governance dispute can result in a relatively minor issue growing beyond what most would have expected.

Our analysis draws on previous scholarly work on Svalbard and the disputes surrounding the archipelago, diplomatic notes and statements by Norwegian and EU officials, as well as a series of interviews conducted in February 2018 with representatives of the relevant branches of the EU system in Brussels: officials in the European Commission (hereafter 'Commission') and the European External Action Service (EEAS), politicians and staffers in the European Parliament (EP), and EU member-state officials dealing with the issue studied here.[2]

We begin by outlining the standpoint of EU and its member-states regarding the Svalbard Treaty, and then unpack the complexities of the snow-crab dispute. Thereafter we apply this information to explain the EU's interests concerning snow crab.

The EU and Svalbard: what position?

The Norway/EU dispute over snow crab should be understood with reference to the related dispute over the maritime zones around the Svalbard archipelago. Located approximately 650 kilometres north of the Norwegian mainland and 1,000 kilometres from the North Pole, Svalbard has a resident population of about 2,500 (Statistics Norway 2021). Initially named 'Spitsbergen' by the Dutch explorer Willem Barentsz in the late sixteenth century, Spitsbergen is today the name of the largest island in the archipelago; the whole archipelago bears the Norwegian name 'Svalbard' ('cold coasts' in Old Norse).

Controversy surrounding Svalbard's maritime zones stems from a treaty signed in 1920, as part of the post-WW1 settlements, granting Norway full sovereignty over the archipelago.[3] According to Article 3 of the Svalbard Treaty, Norwegian exercise of this sovereignty is subject to certain conditions concerning taxation and use of the islands for military purposes, as well granting equal access to specified economic activities to nationals from the signatory countries.

Despite this early-twentieth-century diplomatic compromise (Anderson 2009), diverging views on the geographical scope of the treaty have persisted, also among legal experts, concerning the status of the maritime zones beyond Svalbard's territorial sea (see Pedersen and Henriksen 2009; Churchill and Ulfstein 2010; Molenaar 2012). Norway holds that the restrictions in the treaty concern only the territorial waters of the archipelago, as this is explicitly referred to in the treaty (Jensen 2014: 102). Other countries, however, have claimed that the principles of the treaty apply to the 200-mile zone and shelf as well, although this was not stated when the treaty was formalized in 1920 (Jensen 2014: 102–5). The latter reading of the treaty would grant *all* signatories equal rights to economic activity in the water column and on the continental shelf around Svalbard, even though these areas are governed by Norway (Pedersen and Henriksen 2009: 160).

This chapter will not attempt to ascertain which position is more valid. The presentation here builds on the conclusion reached by Churchill and Ulfstein: '[i]t is … not possible to reach a clear-cut and unequivocal conclusion as to the geographical scope of the non-discriminatory right of all parties to the Svalbard Treaty to fish and mine in the waters around Svalbard' (Churchill and Ulfstein 2010: 593). However, diverging legal positions are one thing: political actions are something different.

Although it claims to have a right to establish an exclusive economic zone (EEZ) around Svalbard, Norway has not yet done so. In 1977, when Norway had established its full EEZ along its coast, it decided to establish 'only' a FPZ around Svalbard, for the purpose of the conservation and management of living marine resources (Molenaar 2012: 14–15). Using the argument that this was needed to protect and manage a central nursery area for the Northeast Arctic cod stock avoided a potential outright challenge to the Norwegian claim. (For more on management of the cod stock, see Chs. 8 and 9, as well as Jensen 2014: 103.)

The other treaty signatories have accepted this, although Iceland and Russia have been outspokenly critical of Norwegian efforts to manage the fisheries (Pedersen 2008a, 2008b; Molenaar 2012). According to the Soviet Union, later Russia, Norway had no right to establish the FPZ unilaterally. However, for all practical purposes, Russia has accepted the Norwegian regulatory and enforcement regime in the FPZ, as it has been in its own interest to manage fish stocks sustainably and get a considerable share of the total quota for all of the Barents Sea (see Chs. 8 and 9, and Østhagen et al. 2020).

Further, Norway claims that the treaty does not apply to the continental shelf around the archipelago (Jensen 2014: 110–11). In 2006, Norway submitted its claim to an extended continental shelf in accordance with the United Nations Convention on the Law of the Sea (UNCLOS); the Commission on the Limits of the Continental Shelf (CLCS) gave its final recommendations in 2009 (Jensen 2014: 46). The CLCS found that the continental shelf around Svalbard was indeed contiguous to that of the Norwegian mainland, but – per its mandate – did not discuss whether the treaty was applicable to the continental shelf areas around Svalbard.

The EU's position concerning the treaty and the archipelago's maritime zone has been somewhat unclear (for more on the EU's external fisheries policy, see Ch. 4). The EU as such is not party to the Svalbard Treaty, but twenty of its member-states are parties. In recent decades, several member-states have had diplomatic spats with Norway over the maritime zones around Svalbard (Pedersen 2008a: 915). All these incidents were related to specific actions of Norway in the FPZ, either fisheries-enforcement measures or general issues concerning oil and gas exploration. EU member-states have also held varying positions with regard to the zones around Svalbard – ranging from seeing them as international waters, to arguing that the Svalbard Treaty applies. In 2006, the UK arranged a meeting in London concerning Svalbard and its maritime zones.[4] This meeting, Molenaar holds, 'may have led several of these states to align their positions on the Svalbard Treaty closer to that of the United Kingdom' (2012: 18).

The current position of the Commission is confined to the domain of fisheries, stressing the acceptance of the Norwegian fisheries regulations concerning the maritime areas of Svalbard (and its FPZ) as long as they are applied in a non-discriminatory manner and are respected by all parties to the treaty (Molenaar 2012: 53–4). The EU neither accepts Norway's claim to unrestricted sovereign rights in the FPZ, nor accepts conservation measures that amount to access restrictions for the EU. However, as long as these measures are applied in a non-discriminatory manner and are scientifically based, the EU will abide by them (Interview 1).

Despite the Commission's rather straightforward position, the Svalbard issue resurfaces in Brussels from time to time, usually through statements made by MEPs (Østhagen and Raspotnik 2018: 60). In the fourth resolution of the EP on an *Integrated European Union Policy for the Arctic* (March 2017), reference was made to Svalbard in connection with fisheries and access for EU member-states (European Parliament 2017). This must be seen as directly related to then-ongoing dispute over the catching of snow crab, described below. After the snow-crab dispute emerged (as described further below), another dispute that also concerns EU rights in waters around Svalbard has featured on the political agenda in Norway–EU relations, related to cod quotas in the FPZ post-Brexit. Thus, in the EU's latest Arctic policy update from October 2021 (European Commission & High Representative 2021), the EU explicitly refers to the dispute, albeit subtly and without specifying it further: 'The international legal regime that governs Svalbard and its waters must be fully respected. Under the EU's exclusive competence for conservation of marine biological resources, it represents 22 EU Member States that are Parties to the 1920 Treaty of Paris on Spitsbergen (Svalbard).'

The snow-crab dispute

Banning fisheries except …

Snow crab was first recorded in the eastern Barents Sea in 1996. According to the Norwegian Institute of Marine Research, its total biomass today in these waters is considerable: '[r]ough estimates by Russian scientists indicate that snow-crab biomass is approximately ten times higher than that of red king crab, and about half the biomass of shrimp' (McBride et al. 2016: 85; see also Ch. 6). In Canada and the USA, snow-crab fishery ranks among the most valuable fisheries (Hansen 2015: 9). Thus, expectations in Norway have been high concerning the economic potential of this new species, even that it might surpass cod – the most valuable fisheries in the Norwegian EEZ.

From 2015, however, Norway introduced a ban on the catching of snow crab on the Norwegian continental shelf (which, according to Norway, includes Svalbard)

(NFD 2014). According to the Norwegian Minister of Fisheries, the regulation was introduced to gain control of the activity, as well as greater knowledge and data on the spread of the stock (Norwegian Parliament 2017).

In practice, however, in the regulation implementing the ban, the Norwegian government opened for a limited number of licences, exclusively to Norwegian fishermen, through special requests (Norwegian Parliament 2017). This separation between Norwegian and EU fishermen lies at the heart of the dispute between Norway and the EU (Interview 1). *If* the continental shelf around Svalbard is not subject to the Svalbard Treaty, as Norway argues, then Norway has exclusive rights to the resources and may award licences/quotas as it wishes. However, *if* the treaty applies, that means that Norway may manage the licensing of fishing rights but cannot discriminate against vessels from signatory states, many of which are EU members.

A few vessels from EU member-states, predominantly Latvia, Poland and Spain, had already engaged in snow-crab fisheries on the continental shelf from 2013 onwards (Staalesen 2017). However, Norway notified the EU that these vessels would be evicted from both the Loophole (a small area of international waters between Norway and Russia) and the waters around Svalbard (Norwegian Parliament 2017); and in 2015, Lowri Evans, the Director-General of DG MARE (the Directorate-General of the Commission responsible for Fisheries, the Law of the Sea and Maritime Affairs) wrote a note to member-states, requesting a halt in the catching of snow crab (European Commission 2015: 2).

As the note highlighted, the *continental shelf* in the Loophole is under the national jurisdiction of either Norway or Russia, as extended continental shelf claims have been proved and accepted by the CLCS. The note also engaged in the debate concerning the status of snow crab: is it to be defined as a sedentary species (hence, belonging to the seabed) or as a resource belonging to the water column and thus subject to regulations covering fisheries resources? Norway and Russia – which cooperate on the management of marine living resources in the Barents Sea – decided to treat the crab as a sedentary resource, *not* as a shared stock (Hansen 2016: 38). On behalf of the EU, the Commission argued in its 2015 note:

> With regard to snow crab, it appears that this species is 'unable to move except in constant physical contact with the seabed or the subsoil' and it thus falls within the definition of 'sedentary species' of Article 77(4) of UNCLOS.
>
> (European Commission 2015: 1)

It is thus reasonable to assume that both the EU and Norway define the species as belonging to the continental shelf regime. Therefore, the broader legal ramifications of this dispute concern not only the right to catch snow crab on the continental shelf around Svalbard: they relate to other sedentary resources as well, including as oil and gas and seabed minerals. Although there has been no oil/gas drilling on the continental shelf around Svalbard, the outcome of the dispute over snow crab might set a precedent for such industrial activity in the future (Pedersen and Henriksen 2009; Tiller and Nyman 2015; Bolongaro 2017).

Arrests, re-licensing and end of negotiations

In 2016, the Commission took the initiative to informal talks on swapping quotas for snow crab. Norway demanded that all catches be landed in Norway and that the offer concerning crab be made applicable to the entire Norwegian Shelf, not just Svalbard; further, Norway demanded reciprocal quotas in return from the EU. The Commission refused, and negotiations stalled (Norwegian Parliament 2017). In December 2016, as no agreement had been reached between Norway and the Commission, the latter proposed to the Council of the European Union (hereafter 'Council') to authorize up to twenty vessels to catch snow crab on the continental shelf around Svalbard (Mehren and Abelsen 2017). In January 2017, the Council adopted this proposal and accorded five EU member-states – Estonia, Latvia, Lithuania, Poland and Spain – the right to issue twenty licences altogether (Interview 1).

Norway reacted to the decision by the Commission and the Council with public statements (Mehren and Mehren 2017), as well as diplomatic notes. Several *notes verbales* were sent to the EU in early January 2017, outlining Norway's position (Norwegian Ministry of Foreign Affairs 2017: 4). In late 2016, the Norwegian Coast Guard arrested the EU-registered vessels *Juros Vilkas* from Lithuania (with licence from Latvia) in the Loophole, and *Senator* from Latvia (also with licence from Latvia) in the waters around Svalbard in January 2017.

It is particularly the arrest in 2017 that provoked EU actors and placed the issue of snow-crab fisheries on the agenda. In a parliamentary question to the Commission from 5 April 2017, three MEPs criticized the Norwegian refusal to 'recognise the legitimate right of EU vessels to sustainably and legally operate in these areas [Barents Sea and Svalbard]', further pointing out that 'EU operators are losing an average of EUR 1 million per month each' by having to remain in port, for fear of being arrested (Millán Mon, Mato and Wałęsa 2017). In a follow-up and a major interpellation from October 2017, MEP Cadec – on behalf of the EP's Committee on Fisheries (PECH) – criticized the Commission's negotiation effort for not being 'resolute enough' (Cadec 2017).

In December 2017, the Council again awarded licences for twenty vessels to catch snow crab in waters around Svalbard, divided amongst the same five member-states (Council of the European Union 2017). This was done to uphold the EU's position concerning the dispute and Svalbard: the twenty licences for 2017 had never been utilized, as no vessel apart from *Senator* had ventured north (Interview 1).

In response to this second round of licensing by the EU, the Norwegian Minister of Fisheries announced that Norway would not negotiate this issue further with the Commission, thus ending official talks aimed at finding a solution (Johannesborg 2017). Around the same time, snow crab became the source of a debate in the EP plenary session on 18 January 2018. As MEP Wałęsa stated: 'European fishermen continue to lose out and Norway is still disrespecting the European Union as a partner […] maybe it is time to move forward with legal action against Norway. I would like to avoid this situation, but maybe it will be the only way to convince our partners in Norway to respect and uphold the law' (Wałęsa 2018).

Wałęsa additionally argued that the EU should assist in efforts to catch crab for *environmental* reasons, beyond political or business interests, as the spread of the crab could harm the 'fragile benthic ecosystem' of the Barents Sea (Wałęsa 2018). That, however, is not a universally agreed conclusion. As Hansen writes: '[w]ithout doubt snow crab affects the benthic community through predation and foraging behavior, but it is currently difficult to assess the magnitude of this influence' (2016: 40).

The then EU Commissioner in charge of Maritime Affairs, Karmenu Vella, responded diplomatically, noting that the Commission had been attempting to find a solution with Norway through negotiations, although they were stalled at the moment (Vella 2017). In the written answer to the EP question from 5 April 2017, Commissioner Vella similarly highlighted the Commission's efforts at finding a 'practical solution' (Vella 2017). At the time of this writing (late 2021), no such solution has been found, and the situation remains stalled.

Moreover, another and somewhat related dispute has emerged: that over the division of *cod quotas* in the FPZ post-Brexit. As the Brexit negotiations came to a conclusion at the end of 2020, the EU awarded itself the same quotas for cod as pre-Brexit, even though approximately one-third of the quota had been linked to British fisheries post-1977 and the establishment of FPZ (Moens and Galindo 2021). The Norwegian government notified the EU, which led to a rather sharp – in diplomatic terms – exchange of *notes verbales* solidifying the two positions. Although here we focus on the snow-crab dispute, which concerns a *new* species where no historic rights or quotas can be referred to, the underlying argumentation of both disputes is the same: whether or not the provisions in the Svalbard Treaty apply to the maritime zones and shelf around the archipelago.

Thus, the dispute between Norway and the EU over snow-crab fisheries in the Barents Sea is both complex and multifaceted. From the EU side, various actors and institutions are involved. That leads to the final point in this chapter: how to understand 'the EU' as an actor as regards the snow-crab dispute?

Understanding EU interests

Special interests and agenda-setting

Where did the EU's interest in the question of Norway and snow-crab fishery originate? An issue may find its way onto the EU agenda by many routes. In this case, all three core EU institutions have been involved: the Commission, the Council and the EP. In fisheries policy, the EU has supranational authority under the Common Fisheries Policy (CFP) (TFEU, Art. 3) (*Official Journal of the European Union* 2010) (see also Ch. 4.) Our interviews with officials working in or with the EU on this issue indicate that the initial driver came from the interests of specific member-states. As one EU institution official put it: '[t]his issue [snow crab] is clearly driven by continuous pressure by member-states who have entitlements' (Interview 1). In this case, then, the Commission and its DG MARE are operating at the behest of member-states and their interests. Where do these interests derive from?

The answer is relatively straightforward: the industry concerned with a potentially new snow-crab industry acted as instigator. As one EU official explained: 'We initially became engaged in this issue because of industry interests that contacted us' (Interview 4).

Thus, what has earlier been argued to be a Brussels-based initiative (Bolongaro 2017; Madsen 2017), was, according to our interview material, initially driven by very specific interest groups in a few countries – Latvia and Poland in particular (Interview 4). These interests were worried about being evicted from the Russian continental shelf and the emerging snow-crab industry, which had entailed investments in equipment and vessels (Interview 4). It seems clear that these interests managed to find some key actors to speak on their behalf – for example, MEP Wałęsa.

When the specific issue of snow crabs was put on the EU agenda in late 2015 and early 2016, a few member-states actively worked towards the Commission to ensure that their interests would be represented. According to multiple sources, Latvia was a major driver in pursuing licences to catch snow crab (Interviews 1, 3, 4 and 5). Although Latvia had only two companies interested in this activity, it became a key issue for the government in Riga (Interview 9). In 2016, Latvia became the 44th party to the treaty, thereby consolidating its claims to equal access around Svalbard. However, a Latvian representative interviewed for this study stressed that the country's interests concern *only* fisheries, and not oil and gas (Interview 9).

Other EU diplomats as well as diplomats working for third countries have expressed surprise at the willingness of some member-states to create a dispute with Norway over an issue they consider minor (Interviews 1, 3, 4 and 5). As MEP Wałęsa argued: 'We are so close to Norway. We share common values. We share a common market … If we can't find a solution with Norway, then what does that say about other countries?' (Interview 7). From being a relatively minor issue concerning quotas and access discussed informally between the Commission and Norway, active engagement by MEPs in the PECH Committee brought the issue higher on the EU agenda. Suddenly, the topic also concerned international law. As Wałęsa explained to us: 'I don't want to create conflict. I want to be understood. I respect the sovereign authority of Norway over these waters. Sovereign rights to govern these waters anyway they please. But as long as we have international agreement in place, we should try to respect them' (Interview 7).

A few MEPs and member-states saw it as being in their interest that this issue should come to the forefront of Norway–EU relations over fisheries. In turn, this complicated the work of the Commission in trying to find a solution with Norway (Interview 1). The Norwegian media ensured that the Minister of Fisheries became engaged in a case where it would be relatively easy to be seen as standing up for local fishermen (Mehren and Abelsen 2017; Mehren and Mehren 2017). Being seen as protecting your country's own fisheries can have great political appeal, as demonstrated by Canadian Minister of Fisheries Brian Tobin during the 'Turbot War' with Spain in the 1990s (Missios and Plourde 1996: 144). The same goes for MEPs and ministers intent on re-election. As MEP Wałęsa admitted: 'When I talk about fish I can tell them [voters] exactly, "listen, this is what's going to happen to you"' (Interview 7).

As theories about path dependence, or 'issue stickiness', make clear, 'the set of decisions one faces for any given circumstance is limited by the decisions one has made in the past, even though past circumstances may no longer be relevant' (Praeger 2007). From a legal point of view, it was argued that the Commission had to uphold the licences for the following year (2018), so as not to be seen as yielding in its overall position on Svalbard (*Official Journal of the European Union* 2018). As regards the economic aspect, the 2017 licences were never utilized, apart from the vessel *Senator*, which was arrested. From a political point of view, once EU member-states and MEPs had become sufficiently engaged in the issue, raising it on the agenda and investing resources and reputations, it became difficult to abandon (Interviews 4, 7 and 8). In the end, the Council adopted the continuation of the twenty licences, which in turn resulted in Norway walking away from the negotiations. By late 2017, the issue had become 'stuck'.

Finding a solution?

This dispute between Norway and the EU over snow crabs can be said to concern two related issues. First, Norway disputes the EU's interpretation of the applicability of the Svalbard Treaty to the 200-nautical-mile continental shelf zone around the archipelago. Norway argues the treaty does not apply, whereas both the EU Commission and the Council have argued, directly or indirectly, that the treaty confers equal access/non-discrimination concerning the resources of the Svalbard archipelago – including snow crab.

Second, Norway argues that *even if* the treaty should apply, despite Norwegian reservations, Norway is *still* the sole regulator of the continental shelf around Svalbard. Such actions on the part of the EU are seen as being in violation of both UNCLOS (Art. 77) and the Svalbard Treaty, as Norway – regardless of the outcome of the dispute on the status of the maritime zone – has the undisputed right to *manage* economic activity in this area. Thus, any licensing of vessels, also as regards catching snow crab, is to be done by the Norwegian authorities and subject to Norwegian laws: licensing by the Council of the European Union is a violation of international law. Both these points mirror the more recent dispute over cod quotas post-Brexit, although that also links to the EU's former acceptance of the cod quota regime in the FPZ.

As to solving the snow-crab dispute, similar disputes over quotas are generally settled by swapping of quotas between the negotiating parties. From the Norwegian side, a quota swap with the EU on snow crab would suffice to allow EU vessels to catch snow crab on its continental shelf (Norwegian Parliament 2017). On several occasions Norway has proposed to the EU to swap snow-crab quotas in connection with the ordinary fisheries quota. Such offers were first presented by the Norwegian side during negotiations with the EU in November 2015. The EU rejected the offer, claiming there were no available 'means of payment' (i.e. other fishing quotas) (Norwegian Parliament 2017). The explanation here lies in two separate relationships.

The EU member-states that traditionally benefit most from the fisheries quota with Norway have not considered expanding the scheme to include more species, as that would be at the expense of their other quotas from Norway. Generally, the fisheries agreement with Norway is regarded as politically sensitive, as it must be carefully balanced with the varying interests of the member-states. The quotas that the EU obtains for fishing in Norwegian waters are of interest to certain member-states, but the resources Norway obtains in EU waters can be of interest for others (Peñas Lado 2016: 238–9). The countries that have been actively working to get snow-crab quotas – mainly the three Baltic states and Poland – are newcomers to the EUropean table and have otherwise few other quotas to offer (Interview 4).

Furthermore, if the EU were to accept the Norwegian position on snow-crab quotas for the *entire* Norwegian continental shelf and have to 'pay' for these quotas by swapping with something else, that would imply recognizing the Norwegian position, thereby weakening its own concerning the Svalbard Treaty (Interview 1). As argued by Norwegian officials: 'the snow crab is an exclusive resource to us and Russia, and we do not give away a resource for free' (Interview 2). However, several EU member-states hold that, under the Svalbard Treaty, they are entitled to quotas on the continental shelf around Svalbard without any form of compensation to Norway (noted by Interview 9). As accepting the Norwegian offer would weaken the EU's position concerning Svalbard, the EU has deemed it necessary to license its own vessels, thereby forcing the issue.

In sum, the EU position is that its member-states, as parties to the Svalbard Treaty, have the right to equal access regarding these resources. EU fishermen are entitled to catch snow crab under the Svalbard Treaty: a right that Norway ignored by awarding licences only to its own fishermen. The Commission consequently found it necessary to award licences to EU member-states 'in order to claim EU rights' (Interview 1).

Only about fisheries?

The EU has multiple interests and voices, even within a policy domain like fisheries where the member-states have ceded competence and authority to the supranational level (see Ch. 4). In fisheries, the EU does speak with one voice. But, as we have shown, that voice can be 'hijacked' by special interests if there are few counter-positions and – as in this case – the issue is seen as otherwise being of limited importance. In fact, it seems that a window was about to open for greater dialogue between Norway and the EU/Commission on this matter – but that attracted widespread attention, and positions became entrenched. Given Norway's sensitivity to debates over Svalbard and opposing legal views, it might have been more fruitful to engage directly with these special interests in the EU member-states, to prevent the issue from rising higher on the EU agenda.

However, this limited dispute has still been kept separate as an issue pertaining solely to fisheries. From 2007/8 onwards, the EU has engaged increasingly in Arctic affairs. At times, questions of Svalbard and/or larger governance issues have arisen, especially in the EP.[5] And yet the snow-crab issue has been deliberately kept as a fisheries issues – by the DG MARE and the EEAS, the EU member-states and by Norway. Again, it is predominantly the EP and certain MEPs who would (still) like to see a broader debate on Arctic governance. As put by MEP Wałęsa: 'Discussions about Arctic governance are long overdue. The EU should talk about the Arctic's future' (Interview 7). Similarly, as MEP Pietikäinen noted: 'We need to work to preserve the Arctic. In the longer run I think we should work for a regime in the Arctic like what we have for the Antarctic' (Interview 8).

If these political interests can be combined with economic interests relevant to member-states, there might be greater impetus for a debate over Svalbard. In view of the generally high unemployment among fishermen, concerns over the EU 'losing out' on potential access around Svalbard are politically and economically understandable (Raspotnik and Østhagen 2014; European Commission 2016). However, the EU in general (through those of its member-states that are parties to the Svalbard Treaty) seems to have opted to adhere to the FPZ and the Norwegian jurisdiction that it implies.

This issue ties in with the EU's overarching aspiration of being seen as a sensible and responsible actor as regards the Arctic, whether through official observer status in the Arctic Council (still pending), or its relations with relevant European Arctic states (Keil and Raspotnik 2014). Norway and the Commission could still manage to find a practical 'under the table' solution that would safeguard the interests of both parties (Interview 4). It is therefore of considerable interest to see what trajectory will be taken by this relatively minor dispute in the near future.

This chapter deals only with the snow-crab dispute, but it should be noted that the emerging FPZ-cod dispute is linked to the same overarching disagreement between Norway and the EU over the geographical scope of the Svalbard Treaty's provisions. Nor can it be discounted that one reason why the EU (DG Mare in particular) has chosen to escalate the 2021 cod dispute is connected with the attention given to the issue brought by the snow-crab dispute described here. Further, although this does not involve the *same* economic interests (i.e. from Latvia, Lithuania and Poland), there are several EU member-states with a direct economic interest in cod fisheries in the Arctic. Similarly, the heated exchange of *notes verbales* in the first half of 2021 showcases exactly our point about widening the scope of the dispute and dragging other Arctic governance issues into the debate. Both Norway and the EU have referred to wider governance concerns and Norway has highlighted that acceptance of the EU to formal observer status on the Arctic Council is contingent on respect for the governance structures in the Arctic, including the Law of the Sea (Moens and Galindo 2021).

Whether or not the westerly movement of snow crabs is related to climate change is another debate (see Ch. 6). This issue gives rise to a range of pertinent questions regarding the set-up of management institutions, the viability of the FPZ regime as regards the impact of various changes in marine living resources[6] and how certain fisheries issues find their way onto the political agenda (or not). More widely, the snow-crab issue is an example of how shifting stocks (or new ones, in this case) can cause management challenges for coastal states, and how relatively minor economic interests can gain political clout when interlinked with wider disagreements over ocean governance.

Interviews

1. Commission officials. Brussels, 15 February 2018.
2. Norwegian diplomat I. Brussels, 15 February 2018.
3. Russian diplomat I. Brussels, 15 February 2018.
4. EU member-state diplomat I. Brussels, 19 February 2018.
5. Norwegian diplomat II. Brussels, 19 February 2018.
6. Jarosław Leszek Wałęsa, MEP. Brussels, 20 February 2018.
7. Sirpa Pietikäinen, MEP. Brussels, 20 February 2018.
8. EU member-state diplomat II. Brussels, 20 February 2018.

Notes

1 Treaty concerning the Archipelago of Spitsbergen, 9 February 1920; in force 14 August 1925, here: Svalbard Treaty.

2 In total twelve semi-structured interviews were conducted in February 2018 in Brussels and Oslo. As all interviewees had the option of remaining anonymous, full names and details of their positions remain with the authors, with the exception of two MEPs who agreed to be mentioned by name. Interviews lasted between 45 and 80 minutes, with a set of open questions as the basis of the conversation.

3 Treaty concerning the Archipelago of Spitsbergen, 9 February 1920; in force 14 August 1925, here: Svalbard Treaty.

4 Attended by representatives from Canada, Denmark, France, Germany, Iceland, the Netherlands, Russia, Spain and the USA.

5 Over the past ten years of EU Arctic policymaking it has often been the EP and its elected representatives that have rocked the EU's Arctic boat (Raspotnik 2018: 93–119).

6 We could further highlight the potential for conflict between Norway and Russia over FPZ fisheries inspections, as the relevant fish stocks are likely to change their geographical distribution (see Ch. 8, as well as Østhagen 2018).

References

Anderson, D. H. (2009), 'The Status under International Law of the Maritime Areas around Svalbard', *Ocean Development & International Law*, 40 (4): 373–84.

Bolongaro, K. (2017), 'Oil Lurks beneath EU–Norway Snow Crab Clash', *Politico*, 18 June. https://www.politico.eu/article/of-crustaceans-and-oil-the-case-of-the-snow-crab-on-svalbard/.

Cadec, A. (2017), 'Major Interpellation for Written Answer with Debate to the Commission Pursuant to Rule 130b by Alain Cadec, on Behalf of the Committee on Fisheries on Major Interpellation: EU–Norway Dispute on Snow Crab Fisheries in Svalbard', O-000077/2017, 11 October.

Churchill, R. and G. Ulfstein (2010), 'The Disputed Maritime Zones around Svalbard', in M. H. Nordquist, J. N. Moore and T. H. Heidar (eds), *Changes in the Arctic Environment and the Law of the Sea*, 551–93, Leiden: Martinus Nijhoff.

Council of the European Union (2017), '2018 EU Total Allowable Catches in the Atlantic and North Sea'. http://www.consilium.europa.eu/media/32118/final-table.pdf.

European Commission (2015), 'Subject: Snow Crab Fisheries in the NEAFC Regulatory Area, Brussels, 5 August 2015, MARE'.

European Commission (2016), 'Facts and Figures on the Common Fisheries Policy: Basic Statistical Data'. https://ec.europa.eu/oceans-and-fisheries/facts-and-figures/facts-and-figures-common-fisheries-policy_en.

European Commission & High Representative (2021), 'A Stronger EU Engagement for a Peaceful, Sustainable and Prosperous Arctic' (JOIN(2021) 27 final), Brussels, 13 October.

European Parliament (2017), 'European Parliament Resolution of 16 March 2017 on an Integrated European Union Policy for the Arctic' (2016/2228(INI)).

Hansen, H. S. B. (2015), 'Snow Crab (Chionoecetes Opilio) in the Barents Sea: Diet, Biology and Management'. Master's thesis, UiT, The Arctic University of Norway.

Hansen, H. S. B. (2016), 'Three Major Challenges in Managing Non-Native Sedentary Barents Sea Snow Crab (Chionoecetes Opilio)', *Marine Policy*, 71: 38–43.

Haugan, B. (2017), 'Fiske-Sandberg: Vi gir ikke bort en krabbe', *VG*, 24 January. https://www.vg.no/nyheter/innenriks/eu/fiske-sandberg-vi-gir-ikke-bort-en-krabbe/a/23906465/.

Hønneland, G. (2012), *Making Fishery Agreements Work: Post-Agreement Bargaining in the Barents Sea*, Cheltenham: Edward Elgar.

Jensen, Ø. (2014), *Norge og havets folkerett*, Trondheim: Akademia Forlag.

Johannesborg, P. A. (2017), 'Norge bryter forhandlingene med EU om snøkrabbe', *NRK*, 13 December. https://www.nrk.no/finnmark/norge-bryter-forhandlingene-med-eu-om-snokrabbe_-1.13823930.

Keil, K. and A. Raspotnik (2014), 'The European Union's Gateways to the Arctic', *European Foreign Affairs Review*, 19 (1): 101–20.

Madsen, P. A. (2017), 'Norge og EU krangler om krabbefangst. Egentlig handler det om Svalbardtraktaten', *Aftenposten*, 2 February. https://www.aftenposten.no/meninger/kommentar/i/GELAq/Norge-og-EU-krangler-om-krabbefangst-Egentlig-handler-det-om-Svalbardtraktaten--Per-Anders-Madsen.

Mamikins, A. (2018), 'European Parliament, Debates, Thursday, 18 January 2018, EU–Norway Dispute on Snow Crab Fisheries in Svalbard'.

McBride, M. M., J. R. Hansen, O. Korneev, O. Titov, J. E. Stiansen, J. Tchernova, A. Filin and A. Ovsyannikov (2016), 'Joint Norwegian–Russian Environmental Status 2013: Report on the Barents Sea Ecosystem', Bergen: IMR/PINRO.

Mehren, E. and T. Abelsen (2017), 'Fisker ulovlig på norsk sokkel med EUs velsignelse'. *NRK*, 20 January. https://www.nrk.no/troms/fisker-ulovlig-pa-norsk-sokkel-med-eus-velsignelse-1.13333132.

Mehren, N. and E. Mehren (2017), 'EU fikk klar beskjed fra europaministeren i fastlåst konflikt', *NRK*, 23 January. https://www.nrk.no/troms/eu-fikk-klar-beskjed-fra-europaministeren-i-fastlast-konflikt-1.13338024.

Millán Mon, F. J., G. Mato and J. L. Wałęsa (2017), 'Question for Written Answer to the Commission Pursuant to Rule 130 by Francisco José Millán Mon (PPE), Gabriel Mato (PPE), Jarosław Wałęsa (PPE) on Snow Crab Fishing', E-002532-17, 5 April.

Missios, P. C. and C. Plourde (1996), 'The Canada–European Union Turbot War: A Brief Game Theoretic Analysis', *Canadian Public Policy*, 22 (2): 144–50.

Moens, B. and G. Galindo (2021), 'EU Faces Arctic Cod War with Oslo over Post-Brexit Rights', *Politico*, 9 August.

Molenaar, E. J. (2012), 'Fisheries Regulation in the Maritime Zones of Svalbard', *The International Journal of Marine and Coastal Law*, 27 (1): 3–58.

NFD (Norwegian Fisheries Directorate) (2014), *J-280-2014: (Utgått) Forskrift om forbud mot fangst av snøkrabbe (J-280-2014: (Expired) Regulation Concerning Ban of Catching of Snow Crab)*, NFD, Bergen.

Norwegian Ministry of Foreign Affairs (2017), 'Norwegian Note Verbale to EU', 9 January.

Norwegian Parliament (2017), 'Skriftleg spørsmål Fra Helga Pedersen (A) til fiskeriministeren' (Written question from Helga Pedersen Lab. to the Minister of Fisheries).

Official Journal of the European Union (2010), Consolidated Version of The Treaty on the Functioning of the European Union TFEU.

Official Journal of the European Union (2018), Council Regulation (EU) 2018/120 of 23 January 2018 Fixing for 2018 the Fishing Opportunities for Certain Fish Stocks and Groups of Fish Stocks, Applicable in Union Waters and, for Union Fishing Vessels, in Certain Non-Union Waters, and Amending Regulation (EU) 2017/127.

Pedersen, T. (2008a), 'The Constrained Politics of the Svalbard Offshore Area', *Marine Policy*, 32 (6): 913–19.

Pedersen, T. (2008b), 'The Dynamics of Svalbard Diplomacy', *Diplomacy & Statecraft*, 19 (2): 236–62.

Pedersen, T. and T. Henriksen (2009), 'Svalbard's Maritime Zones: The End of Legal Uncertainty?', *The International Journal of Marine and Coastal Law*, 24 (1): 141–61.

Peñas Lado, E. (2016), *The Common Fisheries Policy: The Quest for Sustainability*, Chichester: Wiley-Blackwell.

Praeger, D. (2007), 'Our Love of Sewers: A Lesson in Path Dependence', Daily Kos. https://www.dailykos.com/stories/2007/6/15/346883/-.

Raspotnik, A. (2018), *The European Union and the Geopolitics of the Arctic*, Cheltenham: Edward Elgar.

Raspotnik, A. and A. Østhagen (2014), 'From Seal Ban to Svalbard – The European Parliament Engages in Arctic Matters', The Arctic Institute, 10 March. https://www.thearcticinstitute.org/seal-ban-svalbard-european-parliament/.

Staalesen, A. (2017), 'Snow Crabs Raise Conflict Potential around Svalbard', *The Barents Observer*, 23 January. https://thebarentsobserver.com/en/arctic/2017/01/snow-crabs-raises-conflict-potential-svalbard.

Statistics Norway (SSB) (2021), 'Befolkningen på Svalbard', 5 October. https://www.ssb.no/befolkning/folketall/statistikk/befolkningen-pa-svalbard.

Tiller, R. and E. Nyman (2015), 'Having the Cake and Eating It Too: To Manage or Own the Svalbard Fisheries Protection Zone', *Marine Policy*, 60: 141–8.

Vella, K. (2017), 'Answer given by Mr Vella on Behalf of the Commission', E-002532/2017, 15 June. European Parliament. https://www.europarl.europa.eu/doceo/document/E-8-2017-002532-ASW_EN.html?redirect.

Wałęsa, J. L. (2018), 'European Parliament, Debates, EU–Norway Dispute on Snow Crab Fisheries in Svalbard', 18 January.

Østhagen, A. (2018), 'Managing Conflict at Sea: The Case of Norway and Russia in the Svalbard Zone', *Arctic Review on Law and Politics*, 9 (2): 100–23.

Østhagen, A. and A. Raspotnik (2018), 'Crab! How a Dispute over Snow Crab became a Diplomatic Headache between Norway and the EU', *Marine Policy*, 98: 58–64. doi: 10.1016/j.marpol.2018.09.007.

Østhagen, A., A.-K. Jørgensen and A. Moe (2020), 'The Svalbard Fisheries Protection Zone: How Russia and Norway Manage an Arctic Dispute', *Arctic and North*, 40 (2020): 150–68.

Part Four

Southern Ocean

11

Southern Ocean: Climate and Biology

Margaret Mary McBride

Introduction

The Southern Ocean surrounds Antarctica, the frozen and ice-covered landmass that makes up the southernmost continent (Figure 11.1).[1] This is an ancient system that tends to be thermally isolated from the rest of the planet. It can be delineated as the continent and Southern Ocean waters south of the Polar Front: a well-defined circum-Antarctic oceanographic feature marking the northernmost extent of cold surface water. The total ocean is ~34.8 million km^2, of which up to 21 million km^2 are covered by ice at winter maximum and ~7 million km^2 at summer minimum (Aronson et al. 2007). The ecosystem is characterized by high latitudes, seasonal light levels, cold air and sea temperatures, and sea ice.

The Southern Ocean comprises the southernmost waters of the World Ocean, generally understood as those south of 60°S latitude. Its seas as defined in the never-approved 2002 draft fourth edition of the International Hydrographic Organization (IHO) publication 'Limits of Oceans and Seas' are as follows, in clockwise order: Weddell Sea (57°18'W–12°16'E), Lasarev Sea (0°–14°E), Riiser-Larsen Sea (14°–30°E), Cosmonauts Sea (30°–50°E), Cooperation Sea (59°34'–85°E), Davis Sea (82°–96°E), Mawson Sea (95°45'–113°E), D'Urville Sea (140°E), Somov Sea (150°–170°E), Ross Sea (166°E–155°W), Amundsen Sea (102°20'–126°W), Bellinghausen Sea (57°18'–102°20'W) and a portion of the Scotia Sea (26°30'–65°W).

This chapter provides an overview of the physical conditions and biotic components of this large marine ecosystem. Particular attention is paid to how climate change and other environmental changes affect the spatial distribution and abundance of Antarctic krill (*Euphausia superba*), a cold-adapted stenothermic species that provides a key link between primary producers and higher trophic levels, and supports the largest fishery in the region. This chapter addresses research question one of this book (see Ch. 1) by examining how the biology of krill makes it vulnerable to warming waters and other climate-related environmental changes which impact its abundance and spatial distribution. It also addresses research question two, with emphasis on how the rate of these ongoing changes challenges existing management structures, threatening to outpace their capacity to ensure sustainable krill fisheries.

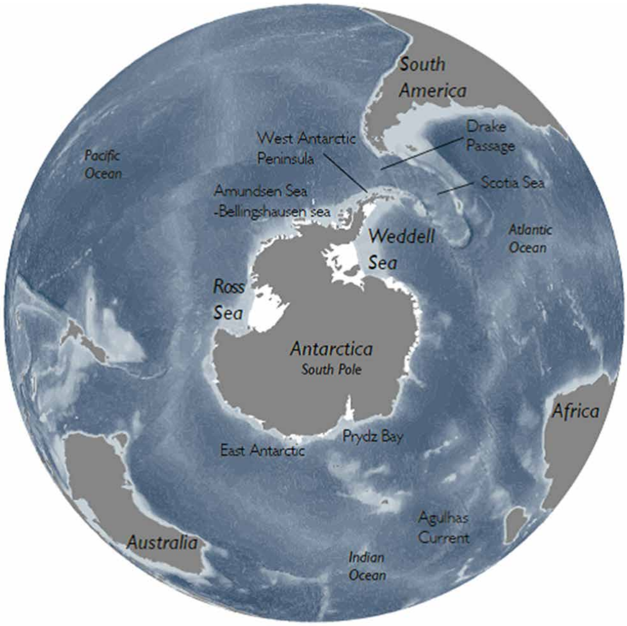

Figure 11.1 The Antarctic is a frozen continent surrounded by open oceanic waters. (Source: courtesy of NOAA www.climate.gov)

Physical conditions

The Antarctic–Southern Ocean marine system encompasses ~20.3 million km^2 of oceanic surface area with deep narrow shelves – except for ice cover, a relatively stable physical environment with very little terrestrial input. The Antarctic has great pack-ice seasonality and much vertical mixing (Table 11.1) (Dayton et al. 1994).

Winds and currents play important roles in the advection of heat and salt around Antarctica. The Antarctic Circumpolar Current (ACC, also called the West Wind Drift) is the strongest ocean current in the world, continuously circling the continent in a clockwise direction (Barker and Thomas 2004). This current is driven by strong westerly winds that are unimpeded by land. Most ACC water is transported by jets in the Sub-Antarctic Front and the Polar Front (Figure 11.2). Closer to the continent, easterly winds form a series of clockwise gyres, notably in the Ross and Weddell Seas, forming the west-flowing Antarctic Coastal Current.

There is relatively rapid connectivity or residence time in the surface waters around the Antarctic on a scale of years (Thorpe et al. 2007). This factor is important for spatial connections between the circumpolar populations of Antarctic krill.

The Antarctic Coastal Current, also known as the East Wind Drift, flows closer to the shore in a counter-clockwise direction; it can connect the near-continental regions of higher krill density, whereas the ACC provides transport in the opposite direction at lower latitudes. Transfer between these current systems – whether by

Table 11.1 Physical and biological characteristics of the Southern Ocean

Geographic disposition	Surrounds Antarctica between 50° and 70°S
Total ocean area	35–38 x 10^6 km^2
Extent of continental shelf	Narrow, few islands
Depth of continental shelf	400–600 m
Shelf continuity with ocean	Open to oceans to the north
Direction of currents	Circumpolar
Upwelling and vertical mixing	Extensive
Nutrient availability	Continuously high
Seasonality of solar illumination	Weak
Primary productivity	Moderate to high
Fluvial input to ocean	None
Salinity at 100–150 m	34.5–34.7%
Seasonality of pack ice	High
Physical disturbance of benthos by large predators	Low
Physical disturbance of benthos by ice scour	High

(Source: modified from Eastman 1997 and McBride et al. 2014.)

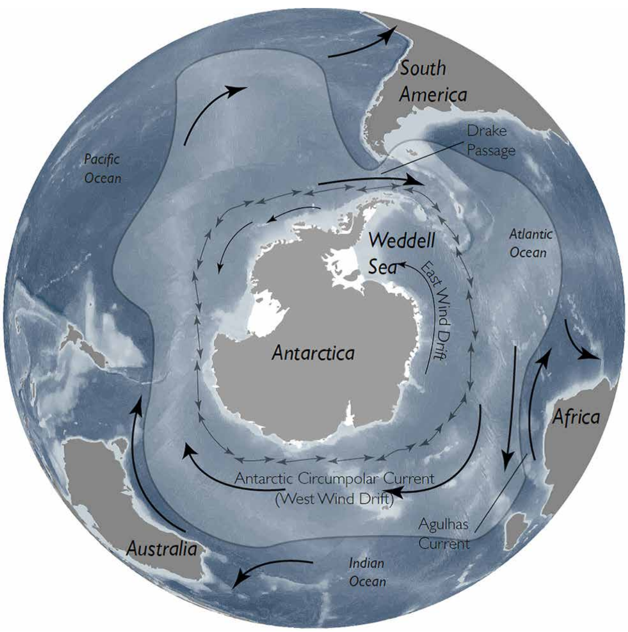

Figure 11.2 The Antarctic marine system: circulation patterns. (Source: courtesy of NOAA, www.climate.gov)

meso-scale ocean features, movement with sea ice or small-scale krill movements, for example – will affect regional dispersal or retention, which could enhance population stability.

Water flows out of the Southern Ocean and enters the Pacific, Atlantic and Indian Oceans. However, water flowing into the Southern Ocean from these same adjacent oceans is not well documented (Rintoul et al. 2012). The Polar Front acts as a major barrier to the exchange of surface waters between sub-Antarctic waters to the north, and polar waters to the south.

Biotic components

The Southern Ocean food web is considered to have a small number of trophic levels and a large number of apex predators, but the importance of alternative and longer routes of energy flow has been increasingly recognized (Ducklow et al. 2007; Murphy et al. 2007). Antarctic fish diversity has been characterized as relatively low, given the large size of the Southern Ocean (Eastman 2005). Some groups of fish and decapod crustaceans are completely absent in today's Antarctic marine system, although fossil records who that they have occurred there previously (Griffiths 2010).

Antarctic krill form the major link between phytoplankton and higher trophic levels. The many higher trophic-level marine species that feed on krill include fish, whales, seals, penguins, albatrosses, petrels and squid (Rintoul et al. 2012; Rogers et al. 2012). Although there are other ecological pathways in the Southern Ocean, the dependence of so many upper-level vertebrate predators on a single species results in a 'wasp-waist ecosystem' where the intermediate trophic level is dominated by one species (Bakun 2006). Hence, any major perturbation in the krill population is likely to have ramifications throughout the Southern Ocean system (Flores et al. 2012b).

Fishes

Eastman (2005) estimated Southern Ocean fish fauna to consist of 322 species representing 50 families. Among these, five groups (notothenioids, myctophids, liparids, zoarcids and gadiforms) account for ~74 per cent of the fish species, with notothenioids alone comprising 35 per cent. One major feature of Antarctic fish fauna is the almost total absence of epipelagic species south of the Polar Front. Suitable freshwater habitats for fish do not exist in Antarctica (Table 11.2) (Eastman 1997).

Biogeographers agree that most Antarctic biota are very old and unique (Rogers et al. 2012). During its geological history, the area was first isolated for some twenty–thirty million years, and only then was it subject to intense cooling, later followed by the opportunity to evolve into an isolated, relatively stable, and uniform system for perhaps another twenty million years (Dayton et al. 1994). This history has implications for evolution in response to ongoing climate change.

Table 11.2 Characteristics of Southern Ocean fish fauna

Number of families	49
Number of species (freshwater/marine)	247 (0/274)
Species endemism for freshwater fish	—
Age of freshwater ecosystem (my)	—
Species endemism for marine fish	High (88%)
Generic endemism for marine fish	High (76%)
Familial endemism for marine fish	High (12%)
Age of marine ecosystem (my *)	13–22
Faunal boundaries	Distinct
Adaptive radiation of an old indigenous faunal element	Yes

Note: * my: million years.
Eastman (2005) revised the estimated size of Southern Ocean fish fauna to 322 species from 50 families.
(Source: modified from Eastman 1997 and McBride et al. 2014.)

Endemic species predominate, with an estimated 88 per cent endemism (174 species) for benthic fauna of the shelf and upper slope. This high degree of species-level endemism indicates a long period of evolution in isolation (Eastman 1997). Any inability to cope or adapt to warming waters could result in reduced abundance of these species, at regional as well as global levels (Hogg et al. 2011). Antarctic fish tend to have a combination of life-history characteristics (often referred to as K-selection) – including delayed maturity, reduced growth rates, low mortality rates, large body size and longer lifespans – that heightens their vulnerability to fishing pressure and other ecosystem perturbations (King and McFarlane 2003). Several fish species that were depleted through industrial fisheries in the Southern Ocean during the 1970s had these characteristics of K-selected species, including the marbled notothenia (*Notothenia rossii*) (Ainley and Blight 2008).

Whales

The removal of large whales from the Southern Ocean stands as one of the most dramatic and destructive exploitations of natural resources carried out by humankind. It is estimated that population numbers of large baleen whales were depleted by around 68 per cent (range: 3–99.6 per cent) during the period of exploitation in the 1900s (Christensen 2006). For the most important krill predators combined (sei, fin, blue and humpback whales), the estimated rate of depletion was over 90 per cent. The rate of whale stock recovery in the Southern Ocean has varied between species, but many stocks are now well on their way to recovery. In the case of humpback whales, current population size in the Scotia Sea is estimated to be back to ~91 per cent of pre-exploitation levels, and the predicted size by 2030 is ~98.8 per cent of pre-exploitation levels. It is safe to assume that similar recoveries of whale species have occurred elsewhere in the Southern Ocean.

Antarctic krill: biology, life cycle and distribution

Given its central position in the Southern Ocean ecosystem and in regional fisheries, Antarctic krill (*Euphausia superba*) has been described in detail, including its biology, life cycle, and spatial distribution (McBride et al. 2021, and references therein). This cold-adapted, planktivorous marine crustacean is a large euphausiid species; adults can reach 65 mm in length at the end of their 5- to 7-year life cycle (Table 11.3). Krill respond quickly and profoundly to ecosystem perturbations such as climate change (Flores et al. 2012b), to changing conditions in food availability and to the risk of predation, by migrating vertically in the water column (Russell 1927) and by swarming (Ritz 1994). Due to its abundance, many species feed on krill, making it a key link between primary producers and higher trophic levels in the Southern Ocean food web. Krill also support the largest fishery in the region. Any major perturbation in the krill population will have severe ramifications, both ecologically and economically.

The krill life cycle is complicated. During different life phases, it utilizes benthic, sea-ice and pelagic environments (Nicol 2006); it can also form large swarms, sometimes reaching densities of 10,000–30,000 individuals per cubic metre (Hamner et al. 1983). The species has adapted to annual and life cycle phases in close association with sea ice, where it feeds on ice algae and may find shelter from some predators (Smetacek and Nicol 2005).

Piñones and Fedorov (2016) identify three critical periods of the early life cycle during which krill survival is most affected: 1) development of larvae into the first

Table 11.3 Biological characteristics of Antarctic krill (Euphausia superba) living in the Southern Ocean south of the Antarctic Polar Front

Characteristic	Description	References
Vertical range of krill living south of the Antarctic Polar Front	Surface to 3,000 m	Taki et al. 2008
Temperature range	−1.8 to 5 °C	Ross et al. 2000; Schmidt et al. 2014
Swarming behaviour	Yes	Ross and Quetin 2000
Vertical migration	Yes	Taki et al. 2008
Adult size (mm)	65	Ross and Quetin 2000
Lifespan (years)	5 to 7 years	Siegel 1987; Ross and Quetin 2000
Spawning period (cycles)	December–April (cycles 1 to 3)	Mauchline 1980; Ross and Quetin 2000
Diet (adults)	Phytoplankton (diatoms, flagellates), zooplankton (copepods)	Mauchline and Fisher 1969; Phleger et al. 2002
Predators	Whales, seals, birds, fish, squid	Nemoto et al. 1985; Murphy et al. 2016

(Source: adapted from De Broyer et al. 2014.)

feeding stage; 2) late summer and autumn, when food availability allows larvae to accumulate sufficient lipid reserves; and 3) the first winter, when undersea ice habitat provides food (algae) and shelter (Figure 11.3). During each of these periods, environmental conditions such as ocean temperature and sea-ice extent exert dominant control over the survival of larvae. Temperature affects the krill descent/ascent cycle (Quetin and Ross 1984) and moderates the extent of sea ice, which influences the availability of food and shelter during winter (Daly 1990; Ross and Quetin 1991; Meyer et al. 2002). Piñones and Fedorov (2016) project that the sea-ice coverage may shrink by ~80 per cent by 2100, reducing krill spawning grounds along the west Antarctic Peninsula. This area is recognized as important habitat for krill in the Southwest Atlantic sector (Hofmann et al. 1992; Fach et al. 2002, 2006; Thorpe et al. 2004, 2007; Atkinson et al. 2008).

Stages of the krill life cycle can be associated with sea ice year-round (Quetin and Ross 2001; Brierley et al. 2002) (Figure 11.3). During summer, under-ice (0 to 2 m depth) concentrations of mostly juvenile krill are estimated to be greater than in open waters (Flores et al. 2012a; De Broyer et al. 2014). The winter under-ice population is dominated by larvae and juvenile krill surviving on the available ice algae. A flexible physiology and the capacity to withstand starvation using a body combustion strategy results in a negative growth rate for adults, which regress in size to a sub-adult stage (reduced development of petasma or thelycum) and to a lesser degree for larvae and juveniles (Daly 1998; Ross et al. 2000; Quetin et al. 2003; De Broyer et al. 2014). In spring, larval, juvenile and adult krill are found at the ice-edge, which provides rich spring phytoplankton blooms. This allows krill to resume growth following winter, develop sexually (Siegel 1987, 2012), and mate (Cuzin-Roudy

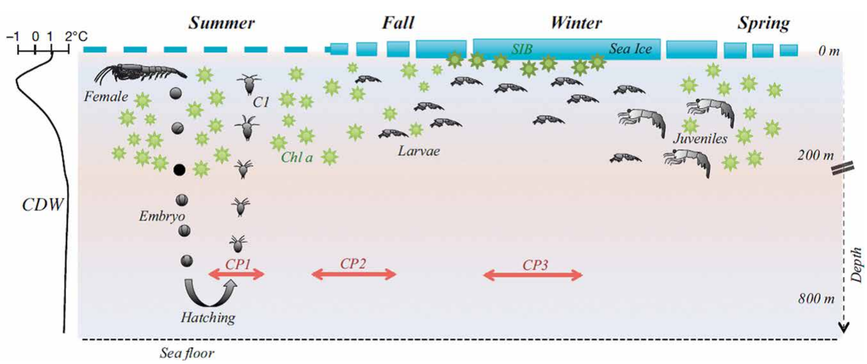

Figure 11.3 Antarctic krill early life cycle. After hatching, embryos develop from nauplii to first feeding stage calyptopis 1 (CP1); after the descent/ascent cycle (CP1), they feed on chlorophyll-a (Chl-a) during summer and early autumn. They overwinter underneath sea ice and moult into juveniles in spring. Three critical periods (CP1, -2 and -3) are indicated. SIB: sea-ice biota for winter-feeding by krill larvae. CDW: Circumpolar Deep Water. (Source: modified figure and description, used with permission from Piñones and Fedorov 2016.)

1987). During this period, adult females begin the early phase of egg development for the first reproductive cycle of the season (Cuzin-Roudy and Amsler 1991; Cuzin-Roudy and Labat 1992). The intensity of reproduction in summer is highest under 'average' conditions of sea-ice retreat, whereas late retreat is associated with faster oocyte development (Quetin and Ross 2001; De Broyer et al. 2014). Subsequently, juveniles and mature adults migrate into the pelagic zone – where the penetration of sunlight supports photosynthesis for phytoplankton production (Siegel 2012) – to find suitable foraging conditions for swarming and swimming, moult development and growth, egg production (Cuzin-Roudy 2000), and recruitment (Tarling et al. 2007; De Broyer et al. 2014). Consequently, sea-ice retreat, particularly in winter, can become a dominant driver of krill population development (Flores et al. 2012a, 2012b; Piñones and Fedorov 2016).

The horizontal distribution of Antarctic krill is uneven, with more than 50 per cent of the circumpolar population reported to occur in the Atlantic sector (Atkinson et al. 2004). The largest concentrations and highest densities (observed and predicted) occur in the Scotia- and Weddell Seas surrounding the Antarctic Peninsula – particularly in the Polar Front zone and the Southern ACC Front (SACCF) – and from the continental coast to the northern limit of the Polar Front in the whole eastern sector (Atkinson et al. 2004; Nicol 2006; De Broyer et al. 2014). Data from comparable net and acoustic surveys indicate that average krill densities in the South Atlantic may be ten times higher than off East Antarctica (30°–150°E) (Nicol et al. 2000a, 2000b; Nicol 2006); this region, with its convoluted coastline and many island groups, offers more available habitat for krill (Nicol 2006; Atkinson et al. 2008).

Fisheries

Fishing is the major industry in Antarctic waters: hundreds of thousands of tonnes are landed each year. There is a history of industrial fishing for marine mammals and fish species as well as krill. Ongoing fisheries currently target Patagonian toothfish (*Dissostichus eleginoides*), Antarctic toothfish (*Dissostichus mawsoni*), mackerel icefish (*Champsocephalus gunnari*) and Antarctic krill (*Euphausia superba*) (CCAMLR 2017). The krill fishery, the largest in terms of biomass, has been conducted since 1973 (Dayton et al. 1994; Leaper and Miller 2011; Rintoul et al. 2012). The fishery for Antarctic toothfish has the highest economic value (Griffiths 2010); in recent years, catches have been ~12,000–15,000 tonnes (CCAMLR 2013, 2017).

Over the period from 1969 to the mid-1980s, several finfish stocks were on average reduced to less than 20 per cent of their original size (Ainley and Blight 2008). It has been hypothesized that, during the mid-1980s, a shift occurred in the ecological structure of significant portions of the Southern Ocean – following the serial depletion of fish stocks by intensive industrial fishing – in combination with a reduction in the krill food-base (Ainley and Blight 2008). Subsequently, fisheries have been heavily regulated following

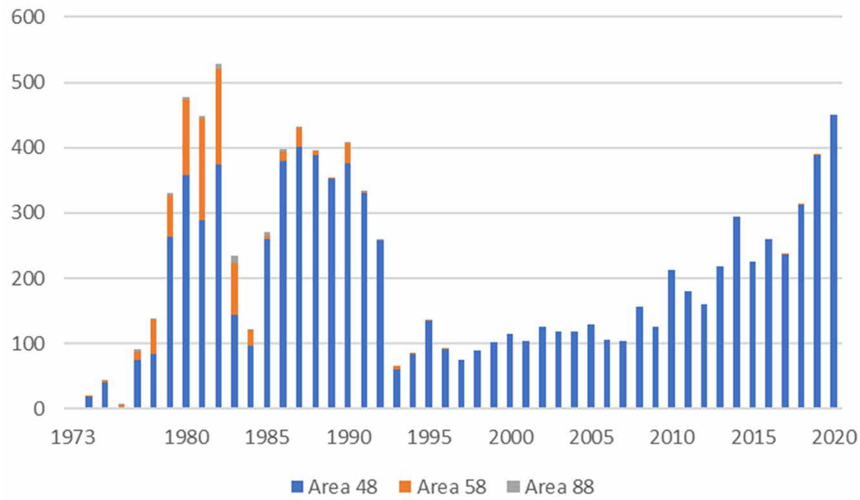

Figure 11.4 Total annual catches of krill (Euphausia superba) in the CAMLR Convention Area (thousand tonnes). (Source: www.ccamlr.org/node/74620.)

the establishment of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in 1982 (see Chs. 12 and 13). CCAMLR's management actions (such as banning benthic trawling in several areas) appear to have led to increased levels in toothfish stocks in some regions (Ainley and Blight 2008; CCAMLR 2011; Shotton and Tandstad 2011). Stocks of mackerel icefish, however, remain diminished; they have high annual variability, and may still be declining. Indeed, concern over the low and variable stock levels led to closure of fisheries for this species in the early 1990s. Fisheries for mackerel icefish are now permitted only if adequate stock levels are assessed to be available (CCAMLR 2019b).

The history of catches in the krill fishery (Figure 11.4) shows major changes around 1984 associated with technical difficulties (Budzinski et al. 1985) and/or with a 1984 ecosystem anomaly that impacted the reproductive performance of krill predators at South Georgia (Priddle et al. 1988). The steep drop in catches from 1992 through 1993 reflects the redeployment of the Soviet distant-water fishing fleet following the dissolution of the USSR (CCAMLR 2018).

As the fishery has developed, the location of fishing has moved from the Indian Ocean to the Atlantic Ocean sector, focusing almost entirely on the Atlantic sector since the early 1990s (Figure 11.5). Currently, the spatial distribution of the fishery is focused on the Bransfield Strait region off the Antarctic Peninsula (Subarea 48.1), to the northwest of Coronation Island (Subarea 48.2) and also north of South Georgia (Subarea 48.3) (CCAMLR 2018; Table 11.14).

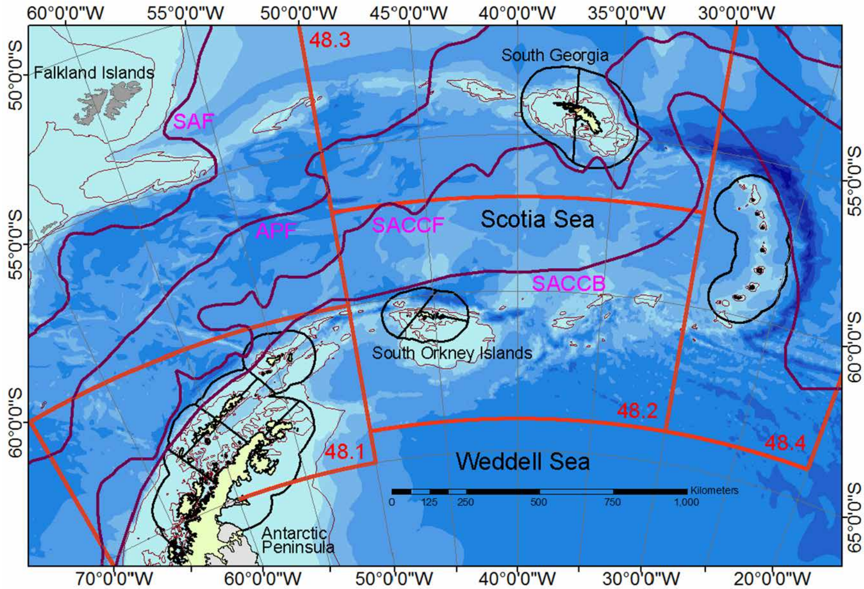

Figure 11.5 The Antarctic Peninsula, Scotia Sea and Weddell Sea, where most of the harvesting for Antarctic krill occurs. Boundaries of FAO Statistical Subareas 48.1, 48.2, 48.3 and 48.4; boundaries of the CCAMLR Small Scale Management Units (SSMU) for the krill fishery. Major fronts of the ACC: Southern ACC Boundary (SACCB); Southern ACC Front (SACCF); Antarctic Polar Front (APF); and Sub-Antarctic Front (SAF). (Source: BAS 2018; courtesy of Dr Philip Trathan, British Antarctic Survey.)

Table 11.4 Catch (tonnes) of Arctic krill reported from the fishery 2000–18

Year	48.1	48.2	48.3	58.4.1	58.4.2	Total
2010	153,262	49,999	8,712	–	–	211,973
2011	9,215	115,995	55,801	–	–	181,011
2012	75,630	29,040	56,415	–	–	161,085
2013	153,830	31,306	32,221	–	–	217,357
2014	146,191	72,455	75,169	–	–	293,815
2015	154,177	17,101	54,368	–	–	225,646
2016	154,442	34,302	71,407	–	–	260,151
2017	149,335	69,045	18,558	9	504	237,451
2018	151,692	137,878	23,173	–	246	312,989
Total	1,147,774	557,121	395,824	9	750	2,101,478

(Source: https://www.ccamlr.org/en/fisheries/krill.)

Climate development and climate impact

Effects of future climate change on Antarctic krill

Parts of the Southern Ocean warmed considerably during the second half of the twentieth century, with greater temperature increases in some regions than those of the global ocean (Figure 11.2) (Levitus et al. 2000, 2005; Gille 2002, 2008; Whitehouse et al. 2008). Some of the oceanographic characteristics on which krill rely, such as the deep waters of the ACC, are not expected to move south as the ocean warms (Hill et al. 2013). However, the Atlantic sector, where most krill is located, has exhibited rapid upper-ocean warming (Meredith and King 2005), loss of winter sea-ice (Parkinson 2002), and great inter-annual variability in Chl-*a* concentrations (Constable et al. 2003). Summer foraging sites for Antarctic krill in the Atlantic sector have experienced sea surface temperature (SST) warming of up to 0.2 °C per decade; it is projected that further widespread increase in SST of 0.27 °C to 1.08 °C per decade may occur by the late twenty-first century (Figure 11.6) (Hill et al. 2013). However, the warming trend is not spatially uniform: certain parts of the Southern Ocean are cooling (Gille 2008; Schmidtko et al. 2014).

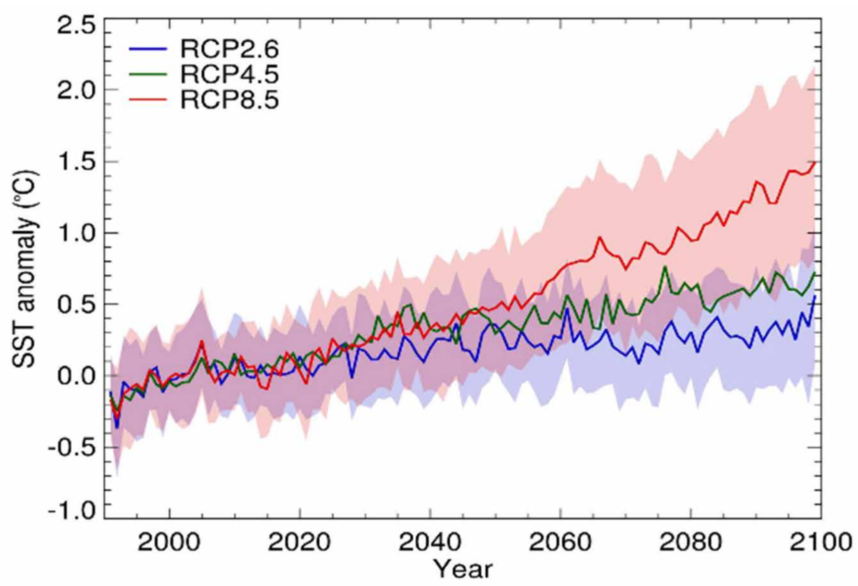

Figure 11.6 Projected twenty-first-century summer surface warming of the Southern Ocean between 6° and 90°W. Projected summer (January to March) sea surface temperature (SST) anomaly for the region between 0° and 90°W and south of the Antarctic Polar Front (Antarctic Convergence). The SST anomaly is the annual mean of spatially resolved summer SSTs for a specific model realization minus the 1991–2020 mean of spatially resolved summer SSTs for the same model realization. The lines indicate the mean SST anomaly for 1991–2099 across all available models for each of three Representative Concentration Pathways (RCPs) – 2.6, 4.5 and 8.5 – and the shaded envelopes indicate the between-realization standard deviation for RCPs 2.6 and 8.5. (Source: courtesy of Hill et al. 2013.)

Antarctic krill is sensitive, directly and indirectly, to changes in the marine environment. By reducing the area of sea-ice formation near the Antarctic Peninsula and other critical regions of the Southern Ocean, climate change is reducing the feeding potential for krill and, consequently, its recruitment and overall production (Flores et al. 2012a, 2012b). This may result in food-web and economic consequences (Walther et al. 2002). The central role of krill in Southern Ocean food webs makes understanding how climate affects its abundance and distribution a prerequisite for effective management of commercial fisheries. Particularly with the rapid warming underway, it is important to anticipate how inter-annual variability in environmental conditions may influence krill production, and the effects on krill-dependent species at higher trophic levels.

Poleward shifts in distribution

Modelling studies to predict the fate of krill under different warming scenarios seem in general agreement, forecasting both reduction and poleward contraction of the available habitat for krill spawning and growth (Hofmann et al. 1992; Hill et al. 2013; Cuzin-Roudy et al. 2014; CCAMLR 2015a; Piñones and Fedorov 2016). The Cuzin-Roudy model of habitat suitability explained 63 per cent of variance; and has been used to infer the presence of krill in regions where sampling data are limited. The results show a high probability of occurrence almost everywhere south of the Polar Front, and a low probability beyond (north of) it (Cuzin-Roudy et al. 2014). Habitat modelling also indicates that, at high latitudes, horizontal distribution and spawning may extend to areas of suitable habitat where krill has not been observed in the past, including in the Indian Ocean and Pacific sectors (Atkinson et al. 2008).

A recent study by Atkinson and colleagues (2019) reports that, near their northern limit, numerical krill densities have declined sharply, manifested as a major decrease in mean density in the north and a modest decrease in the south. According to this study, within the main population centre, Antarctic krill distribution has shifted southward (~440 km) over the past ninety years; with the population now centring more strongly over Antarctic continental shelves (Figure 11.7) (Atkinson et al. 2019; Hill et al. 2019). These findings agree with predictions of poleward shifts in species distribution made by the Intergovernmental Panel on Climate Change (IPCC 2007: 28). Uncertainties remain, however. For example, recent studies by Cox et al. (2018, 2019) – based on the same KRILLBASE dataset as Atkinson et al. (2019) and Hill et al. (2019) – found no evidence of long-term decline in krill density or biomass, nor did they report a poleward contraction of distribution in the Southwest Atlantic sector. The contrasting results from these two studies – regarding long-term changes in krill density and biomass – may be due to fundamental differences in how these researchers pre-process and transform the data before submitting them to their respective modelling approaches; how log transformations are carried out, and statistical treatment of datasets (McBride et al. 2021).

A poleward shift in krill distribution may reflect the attempts of a physiologically stressed organism to cope with a rapidly changing environment, compounded with other ecosystem pressures. Such adjustments in species habitat do not necessarily meet

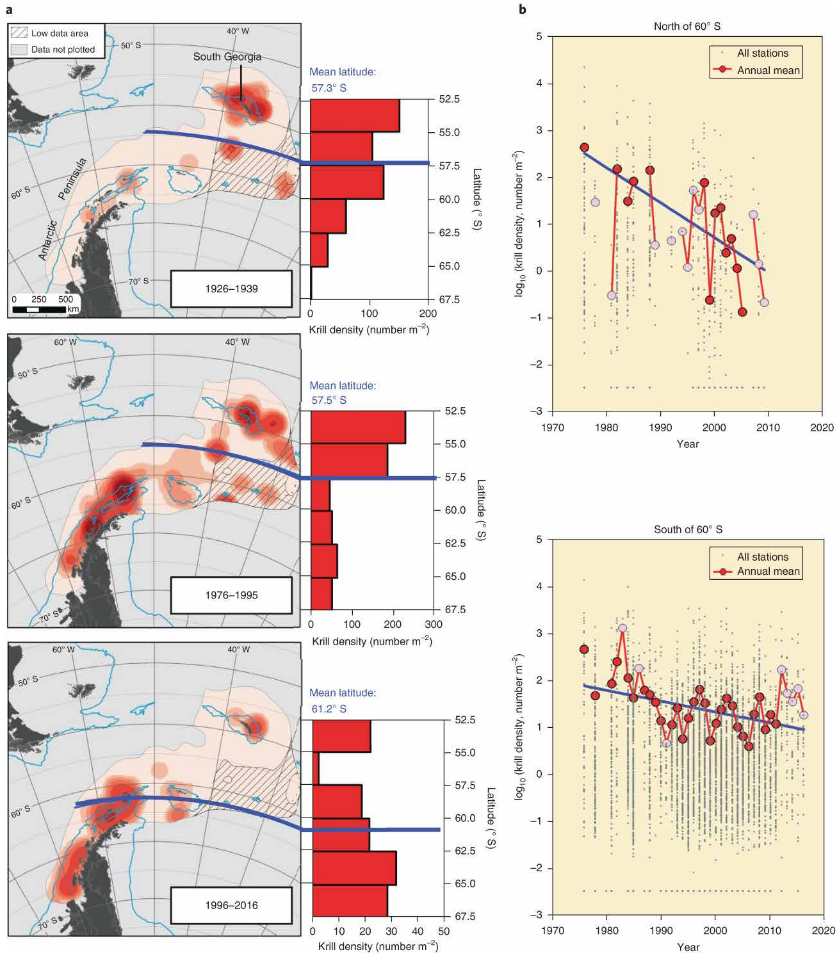

Figure 11.7 Southward contraction of krill distribution within the SW Atlantic sector. a) Kernel analysis visualizing hotspots of krill density in the SW Atlantic sector during the Discovery sampling era (1926–39) and the first and second halves of the modern era, based on the area sampled heavily across all three periods. Isobaths denote the 1,000 m boundary between shelf and oceanic habitats. Within each map, the kernel analysis identifies relative hotspot areas of high density, signified by the intensity of shading. For a quantitative analysis, the histograms denote the mean density of krill in six comparable 2.5° latitude bands with >50 stations sampled in each era. Note changes in scale. Thick lines across maps and histograms indicate the centre of krill density (i.e. density-weighted mean latitude). b) Trends in log10-transformed mean standardized krill density north and south of 60°S. Small points represent the densities in underlying records; large dots represent the annual means of these data, weighted by the number of stations per record. Dots represent seasons with <50 stations (average 27 compared to an overall average of 123 stations per season). Solid trend lines were fitted using simple linear regression ($p < 0.001$, $p < 0.01$ adjusted R2 = 0.52, 0.22 for north and south of 60°S, respectively). (Source: Figure and description used with permission from Atkinson et al. 2019.)

the requirements for population persistence, due to the complex interactions among animal behaviour and the confounding roles of advection and retention in maintaining population distributions in specific regions (Hofmann and Murphy 2004). Various aspects of the new, changed environment (e.g. temperature, timing and abundance of food, and food quality) will affect individual growth, reproductive success, survival rates, recruitment success, as well as the ability to fully determine habitat requirements (Quetin et al. 2007; Murphy et al. 2013). A poleward shift in krill distribution may also be modified by species interactions which have wider consequences for food webs and fished species (Murphy et al. 2013). For example, shifts towards higher latitudes of suitable krill habitat may result in reduced overall production and abundance of krill, with concentration of predator demand for food into a reduced area nearer the continent (Hanson et al. 2009).

Another obvious aspect of a poleward shift in krill distribution is the inference of a contraction into diminished habitat space – due to the meridians converging most rapidly at high latitudes – while further retreat is blocked by the continent itself (Atkinson et al. 2019). Such a shift may also involve declines in biomass and the quality of phytoplankton food resources (Montes-Hugo et al. 2009). This may well have negative effects on feeding conditions, impacting larval and adult stages of the krill life cycle. The exact mechanisms are likely to vary with latitude (Meyer et al. 2017).

Two additional environmental aspects of sustainable krill habitat relative to a possible poleward shift in krill distribution should be noted. 1) Changes in latitude determine the seasonal cycle of light, and variation in the timing and amount of energy input into the ecosystem is crucial to the amount of food available to larval krill in the winter ice habitat. At higher latitudes, differences in day length and sun angle – determining the amount of solar energy reaching the Earth's surface in autumn and winter – are significantly less. For some polar organisms, this decrease in light input could be critical. 2) Concerns regarding the direct impact of the changing seasonal light-cycle on krill physiology. This potentially critical area of research on krill ecology has not received much attention.

Vertical shifts in distribution

It is evident that deep migrations and seabed foraging are significant aspects of krill ecology, and the vertical fluxes involved in this behaviour are important for the coupling of benthic and pelagic food webs and cycling of the iron needed for phytoplankton production (Schmidt et al. 2011). With predicted decreases in phytoplankton production, vertical foraging migrations of adult krill to the seabed – resulting from suboptimal feeding conditions in surface waters – may become more frequent. If only a small part of the estimated 379 million tonne (MT) circumpolar krill biomass migrates between surface and seabed, that would have implications for benthic–pelagic coupling and nutrient cycling within Southern Ocean food webs (Schmidt et al. 2011). Background information is limited, however, and this behavioural phenomenon has not been incorporated into krill energy budgets (Fach et al. 2006), life-history models (Nicol 2006), stock assessments (Siegel 2005; Schmidt et al. 2011), or fisheries management (Schmidt et al. 2011).

Interacting effects of climate change and other environmental variables on krill

Together with other changing environmental factors, the above-mentioned climate-driven shifts in krill distribution present challenges to ecosystem-based management of krill fisheries. Other environmental changes that may impact krill distribution and abundance include ongoing increases in ocean acidification (Flores et al. 2012b; Kawaguchi et al. 2013a, 2013b), elevated levels of ultraviolet radiation (Newman et al. 1999; Flores et al. 2012b), and changes in food-web structure/predator–prey interactions which include increasing abundance and distribution of salps, and the possible return of the great whales.

Ongoing ocean acidification will exacerbate krill habitat losses deriving from higher temperatures and receding sea ice, mainly through deleterious effects on hatching and embryo development. Acidification is expected to be particularly strong in parts of the Southern Ocean where krill are now concentrated: in the Atlantic sector, and in some areas off East Antarctica where ice- and temperature-based models predict improved spawning conditions (Figure 11.8) (Fabry et al. 2008, 2009; McNeil and Matear 2008; Feely et al. 2009; Orr et al. 2009; Flores et al. 2012b; Weydmann et al. 2012).

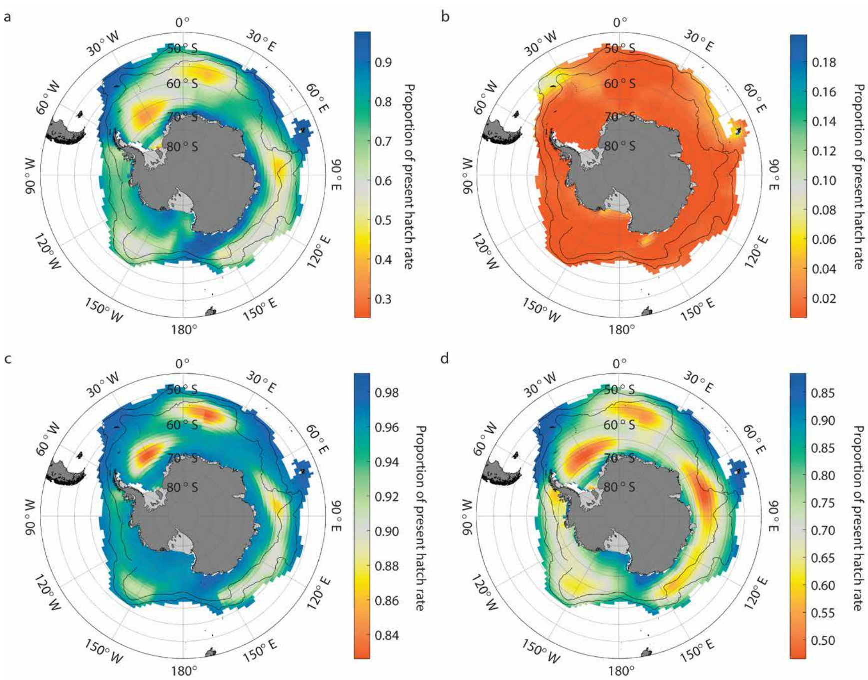

Figure 11.8 Circumpolar risk-maps of krill hatching success under projected future pCO_2 levels. A–d, Hatching success under the RCP 8.5 emission scenario for 2100 (a) and 2300 (b); and under the RCP 6.0 emission scenario for 2100 (c) and 2300 (d). Note the different shading scales on each panel. The southernmost black line shows the northern branch of the Southern Antarctic Circumpolar Current Front, and the northernmost line shows the middle branch of the Polar Front. (Source: courtesy of Kawaguchi et al. 2013b.)

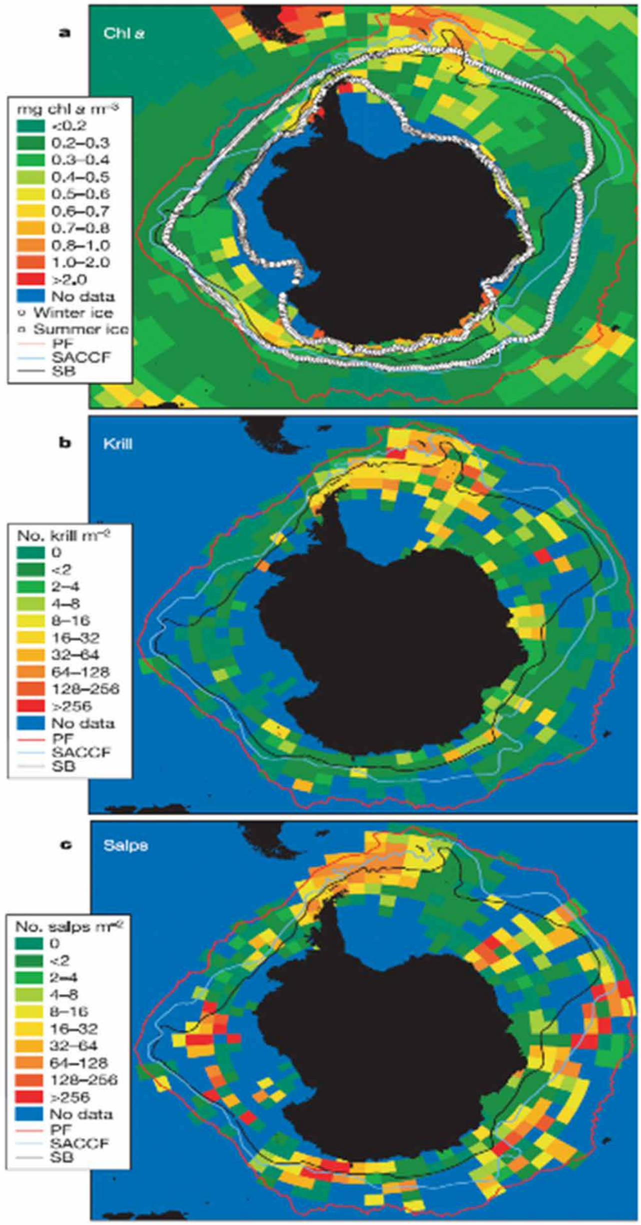

Figure 11.9 Krill, salps and their food. a: Mean (November–April) Chl-a concentration, 1997–2003. b: Mean krill density (6,675 stations, 1926–2003). c: Mean salp density (5,030 stations, 1926–2003). Log_{10} (no. krill m^2) ¼ 1.2 $\log_{10}$ (mg Chl-a m^{-3}) þ 0.83 (R^2 = 0.051, P = 0.017, n = 110 grid cells). Historical mean positions are shown for the PF[29], Southern ACC Front (SACCF)[30], SB[30] and northern 15 per cent sea-ice concentrations in February and September (1979–2004 means). (Source: courtesy of Atkinson et al. 2004.)

Laboratory studies indicate that Antarctic krill are extremely susceptible to elevated levels of UV radiation equivalent to those penetrating depths of up to 10 m in clear Antarctic waters. Ultraviolet radiation and photosynthetically active radiation (PAR) are likely to accelerate the mortality of juvenile krill (Newman et al. 1999). Direct impacts of UVB on the krill population may occur through genetic damage (Jarman et al. 1999; Dahms et al. 2011), physiological effects (Newman et al. 1999, 2000) or behavioural reactions (Newman et al. 2003). Indirect effects may arise through declines in primary productivity caused by increased UV radiation and changes in the structure of food webs (Flores et al. 2012b).

Increasing abundance and distribution of salps (mainly *Salpa thompsoni*) in the Southern Ocean are reported in the southern part of their range approaching the Antarctic continent (Figure 11.9) (Atkinson et al. 2004). These planktonic tunicates are major consumers of production at lower trophic levels. While salps feed efficiently on a wide range of plankton (Foxton 1956), they may not efficiently transmit that energy up to higher levels of the food web (Loeb et al. 1997). The consequences of their trophic activities, and changes in their abundance and distribution, are likely to have major effects on the pelagic food web in the Southern Ocean, and, through the sedimentation of particulate matter, on pelagic–benthic coupling (Raskoff et al. 2005).

Baleen whales rely heavily on Antarctic krill for food (Nowacek et al. 2011). It is estimated that population numbers of large baleen whales were depleted by 68 per cent (range: 3–99.6 per cent) during the period of exploitation in the 1900s (Christensen 2006). For the most important krill predators combined (sei, fin, blue and humpback whales), the estimated rate of depletion was over 90 per cent (Reilly et al. 2004). Recovery rates have varied among species, but many stocks are now improving. The continued recovery of humpback whales alone could represent an increase in annual krill consumption of almost 1 MT per year from today through 2030. If all baleen whales recover at similar rates krill consumption by these large predators may be expected to increase dramatically over the coming decades

Conclusions

The Southern Ocean is a region of high physical and biological variability. Its diverse biota, adapted to extreme environmental conditions, respond quickly to ecosystem perturbations. Climate change may affect organisms and populations physiologically and by altering their habitats. A better understanding of these habitat effects can facilitate understanding the effects on biological variables such as population distribution and movement patterns, abundance, and biomass production.

Antarctic krill plays a major role in Southern Ocean food webs. The many species preying on krill make it a key link between primary producers and higher trophic levels. Krill also support the largest fishery in the region. Any major perturbation in the krill population will have severe ramifications, ecologically and economically. Possible shifts in the distribution of commercially harvested Antarctic krill populations in response to climate variability present a key challenge to effective management.

Krill respond quickly and dramatically to changing ecosystem conditions, such as warming temperatures, changing food availability, and the risk of predation. Ongoing climate-driven temperature increase in the Southern Ocean has caused, and will likely continue to cause, shifts in the spatial range (horizontal and vertical) of krill stocks by exacerbating physiological challenges and reducing food availability. Higher sea temperatures, receding sea ice, increasing ocean acidification, elevated levels of ultraviolet radiation and changes in food-web structure – including increasing abundance and distribution of salps, and the possible return of the great whales – are expected to have a cumulative negative impact on krill productivity.

The reported poleward shift in distribution of the krill stock implies a significant reduction of habitats suitable for krill spawning, hatching, larval survival and juvenile growth. Additional uncertainties as to the extent of deep-sea migrations and benthic feeding of the krill stock may have implications for reliable assessment of krill-stock biomass and effective management of fisheries targeting the krill resource, as well as for ecosystem-based management of the Antarctic–Southern Ocean marine system as a whole.

Note

1 This chapter draws on the author's contribution to McBride et al. (2021).

References

Ainley, D. G. and L. K. Blight (2008), 'Ecological Repercussions of Historical Fish Extraction from the Southern Ocean', *Fish and Fisheries*, 9: 1–26.

Aronson, R. B., S. Thatje, A. Clarke, L. S. Peck, D. B. Blake, C. D. Wilga and B. A. Seibel (2007), 'Climate Change and Invasibility of the Antarctic Benthos', *Annual Review of Ecology Evolution and Systematics*, 38: 129–54.

Atkinson, A., S. L. Hill, E. A. Pakhomov, V. Siegel, C. S. Reiss, V. J. Loeb, D. K. Steinberg, K. Schmidt, G. A. Tarling, L. Gerrish and S. F. Sailley (2019), 'Krill (*Euphausia superba*) Distribution Contracts Southward during Rapid Regional Warming', *Nature Climate Change Letters*, 9: 142–7. https://doi.org/10.1038/s41558-018-0370-z.

Atkinson, A., V. Siegel, E. A. Pakhomov and P. Rothery (2004), 'Long-term Decline in Krill Stock and Increase in Salps within the Southern Ocean', *Nature*, 432: 100–3.

Atkinson, A., V. Siegel, E. A. Pakhomov, P. Rothery, V. Loeb, R. M. Ross, L. B. Quetin, K. Schmidt, P. T Fretwell, E. J. Murphy, G. Tarling and A. H-Fleming (2008), 'Oceanic Circumpolar Habitats of Antarctic Krill', *Marine Ecology Progress Series*, 362: 1–23. doi: 10.3354/meps07498.

Bakun, A. (2006), 'Wasp-waist Populations and Marine Ecosystem Dynamics: Navigating the "Predator Pit" Topographies', *Progress in Oceanography*, 68: 271–88.

Barker, P. F. and E. Thomas (2004), 'Origin, Signature and Palaeoclimatic Influence of the Antarctic Circumpolar Current', *Earth-Science Reviews*, 66: 143–62.

BAS (British Antarctic Survey) (2018), 'Managing the Fishery for Antarctic Krill: A Brief Review of Important Environmental and Management Considerations', *Science Report* (ed. P. Trathan). https://www.bas.ac.uk/data/our-data/publication/managing-the-fishery-for-antarctic-krill-a-brief-review-of-important-environmental-and-management-considerations/.

Brierley, A. S., P. G. Fernandes, M. A. Brandon, F. Armstrong, N. W. Millard, S. D. McPhail, P. Stevenson, M. Pebody, J. Perrett, M. Squires, D. G. Bone and G. Griffiths (2002), 'Antarctic Krill under Sea Ice: Elevated Abundance in a Narrow Band just South of Ice Edge', *Science*, 295: 1890–2.

Budzinski, E., P. Bykowski and D. Dutkiewicz (1985), 'Possibilities of Processing and Marketing of Products Made from Antarctic Krill', *FAO Fisheries Technical Paper*, 268, FAO, Rome.

CCAMLR (Convention on the Conservation of Antarctic Marine Living Resources) (2015a), *Krill – Biology, Ecology and Fishing*. https://www.ccamlr.org/en/fisheries/krill-%E2%80%93-biology-ecology-and-fishing.

CCAMLR (2017), *Fisheries*. https://www.ccamlr.org/en/fisheries/fisheries.

CCAMLR (2018), *Krill Fishery Report 2018*. https://www.ccamlr.org/en/system/files/00%20KRI48%202018.pdf.

CCAMLR (2019a), *Toothfish Fisheries*. https://www.ccamlr.org/en/fisheries/toothfish-fisheries.

CCAMLR (2019b), *Icefish Fisheries*. https://www.ccamlr.org/en/fisheries/icefish-fisheries.

CCAMLR (2011), *Report of the Thirtieth Meeting of the Scientific Committee*. https://www.ccamlr.org/en/sc-camlr-xxx.

CCAMLR(2013), *Statistical Bulletin*, 25. www.ccamlr.org/node/74362. http://www.ccamlr.org/en/fisheries/fisheries.

Christensen, L. B. (2006), 'Marine Mammal Populations: Reconstructing Historical Abundances of Exploited Marine Mammals at the Global Scale', University of British Columbia, Vancouver. https://open.library.ubc.ca/soa/cIRcle/collections/facultyresearchandpublications/52383/items/1.0074757.

Constable, A. J., S. Nicol and P. G. Strutton (2003), 'Southern Ocean Productivity in Relation to Spatial and Temporal Variation in the Physical Environment', *Journal of Geophysical Research*, 108(C4): 8079. doi: 10.1029/2001JC001270.

Cox, M. J., S. Candy, W. K. De la Mare, S. Kawaguchi, S. Nicol and N. Gales (2018), 'No Evidence for a Decline in the Density of Antarctic Krill *Euphausia superba* Dana, 1850, in the Southwest Atlantic Sector between 1976 and 2016', *Journal of Crustacean Biology*, 38 (6): 656–61.

Cox, M. J., S. Candy, W. K. De la Mare, S. Nicol, S. Kawaguchi and N. Gales (2019), 'Clarifying Trends in the Density of Antarctic Krill *Euphausia superba* Dana, 1850 in the South Atlantic: A Response to Hill et al.', *Journal of Crustacean Biology*, 39 (3): 323–27. doi: 10.1093/jcbiol/ruz010.

Cuzin-Roudy, J. (1987), 'Gonad History of the Antarctic Krill *Euphausia superba* during its Breeding Season', *Polar Biology*, 7: 237–44.

Cuzin-Roudy, J. (2000), 'Seasonal Reproduction, Multiple Spawning, and Fecundity in Northern Krill, *Meganyctiphanes norvegica* and Antarctic krill, *Euphausia superba*', *Canadian Journal of Fisheries and Aquatic Sciences*, 57: 6–15.

Cuzin-Roudy, J. and M. O. Amsler (1991), 'Ovarian Development and Sexual Maturity Staging in Antarctic Krill *Euphausia superba* Dana (Crustacea: Euphausiacea)', *Journal of Crustacean Biology*, 11: 236–49.

Cuzin-Roudy, J. and J. P. Labat (1992), 'Early Summer Distribution of Antarctic Krill Sexual Development in Scottia–Weddell Region: A Multivariate Approach', *Polar Biology*, 12: 65–74.

Cuzin-Roudy, J., J.-O. Irisson, F. Penot, S. Kawaguchi and C. Vallet (2014), 'Southern Ocean Euphausiids', in C. De Broyer, P. Koubbi, H. J. Griffiths, B. Raymond, B. C. d'Udekem d'Acoz, A. P. Van de Putte, B. Danis, B. David, S. Grant, J. Gutt, C. Held, G. Hosie, F. Huettmann, A. Post and Y. Ropert-Coudert (eds), *Biogeographic Atlas of the Southern* Ocean, 309–20, Cambridge: Scientific Committee on Antarctic Research.

Dahms, H. U., S. Dobretsov and J. S. Lee (2011), 'Effects of UV Radiation on Marine Ectotherms in Polar Regions', *Comparative Biochemistry and Physiology. Toxicology & Pharmacology*, 153: 363–71.

Daly, K. L. (1990), 'Overwintering Development, Growth, and Feeding of Larval *Euphausia superba* in the Antarctic Marginal Ice Zone', *Limnology and Oceanography*, 35: 1564–76.

Daly, K. L. (1998), 'Physioecology of Juvenile Antarctic Krill (*Euphausia superba*) during Spring in Ice-covered Seas', *Antarctic Research Series*, 73: 183–98.

Dayton, P. K., B. J. Mordida and F. Bacon (1994), 'Polar Marine Communities', *American Zoologist*, 34: 90–9.

De Broyer, C., P. Koubbi, H. J. Griffiths, B. Raymond, C. D' Udekem D'acoz, A. P. Van de Putte, B. Danis, B. David, S. Grant, J. Gutt, C. Held, G. Hosie, F. Huettmann, A. Post and Y. Ropert-Coudert, eds (2014), *Biogeographic Atlas of the Southern Ocean*. Scientific Committee on Antarctic Research, Cambridge.

Ducklow, H. W., K. Baker., D. G. Martinson, L. B. Quetin, R. M. Ross, R. C. Smith, S. E. Stammerjohn, M. Vernet and W. Fraser (2007), 'Marine Pelagic Ecosystems: The West Antarctic Peninsula', *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362: 67–94.

Eastman, J. T. (1997), 'Comparison of the Antarctic and Arctic Fish Faunas', *Cybium*, 21: 335–52.

Eastman, J. T. (2005), 'The Nature of the Diversity of Antarctic Fishes', *Polar Biology*, 28: 93–107. doi: 10.1007/s00300-004-0667-4.

Fabry, V. J., C. Langdon, W. M. Balch, A. G. Dickson, R. A. Feely, B. Hales, D. A. Hutchins, J. A. Kleypas and C. L. Sabine (2009), 'Present and Future Impacts of Ocean Acidification on Marine Ecosystems and Biogeochemical Cycles', *Report of the Ocean Carbon and Biogeochemistry Scoping Workshop on Ocean Acidification Research* (UCSD, Scripps Institution of Oceanography, 9–11 October).

Fabry, V. J., B. A. Seibel, R. A. Feely and J. C. Orr (2008), 'Impacts of Ocean Acidification on Marine Fauna and Ecosystem Processes', *ICES Journal of Marine Science* 65: 414–32.

Fach, B. A., E. E. Hofmann and E. J. Murphy (2002), 'Modeling Studies of Antarctic Krill *Euphausia superba* Survival during Transport across the Scotia Sea', *Marine Ecology Progress Series*, 231: 187–203.

Fach, B. A., E. E. Hofmann and E. J. Murphy (2006), 'Transport of Antarctic krill (*Euphausia superba*) across the Scotia Sea. Part II: Krill Growth and Survival', *Deep-Sea Research Part I*, 53: 1011–43.

Feely, R. A., S. C. Doney and S. R. Cooley (2009), 'Ocean Acidification: Present Conditions and Future Changes', *Oceanography*, 22: 36–47.

Flores, H., A. Atkinson, S. Kawaguchi, B. A. Krafft, G. Milinevsky, S. Nicol, C. Reiss, G. A. Tarling, R. Werner, E. Bravo Rebolledo, V. Cirelli, J. Cuzin-Roudy, S. Fielding, J. A. van Franeker, J. J. Groeneveld, M. Haraldsson, A. Lombana, E. Marschoff, B. Meyer, E. A. Pakhomov, A. P. Van de Putte, E. Rombolá, K. Schmidt, V. Siegel, M. Teschke, H. Tonkes, J. Y. Toullec, P. N. Trathan, N. Tremblay and T. Werner (2012b), 'Impact of Climate Change on Antarctic Krill', *Marine Ecology Progress Series*, 458: 1–19. doi: 10.3354/meps09831.

Flores, H., J. A. van Franeker, V. Siegel, M. Haraldsson, V. Strass, E. H. Meesters, U. Bathmann and W. J. Wolff (2012a), 'The Association of Antarctic Krill *Euphausia superba* with the Under-ice Habitat', *PLOS ONE*, 7: e31775.

Foxton, P. (1956), 'The Distribution and the Standing Crop of Zooplankton in the Southern Ocean', *Discovery Reports*, 28: 191–236.

Gille, S. T. (2002), 'Warming of the Southern Ocean since the 1950s', *Science*, 295: 1275–7.

Gille, S. T. (2008), 'Decadal-scale Temperature Trends in the Southern Hemisphere Ocean', *Journal of Climate*, 21: 4749–65. doi: 10.1175/2008JCLI2131.1.

Griffiths, H. J. (2010), 'Antarctic Marine Biodiversity – What Do We Know about the Distribution of Life in the Southern Ocean?' *PLOS ONE*, 5 (8): e11683. doi: 10.1371/journal.pone.0011683.

Hamner, W. M., P. P. Hamner, S. W. Strand and R. W. Gilmer (1983), 'Behavior of Antarctic Krill, *Euphausia superba:* Chemoreception, Feeding, Schooling, and Molting', *Science*, 220: 433–5.

Hanson, N. N., C. M. Wurster, M. I. Bird, K. Reid and I. L. Boyd (2009), 'Intrinsic and Extrinsic Forcing in Life Histories: Patterns of Growth and Stable Isotopes in Male Antarctic Fur Seal Teeth', *Marine Ecology Progress Series*, 388: 263–72.

Hill, S. L., A. Atkinson, E. A. Pakhomov and V. Siegel (2019), 'Evidence for a Decline in the Population Density of Antarctic Krill Euphausia superba Dana, 1850 still Stands: A Comment on Cox et al.', *Journal of Crustacean Biology*, 39 (3): 316–22. doi: 10.1093/jcbiol/ruz004.

Hill, S. L., T. Phillips and A. Atkinson (2013), 'Potential Climate Change Effects on the Habitat of Antarctic Krill in the Weddell Quadrant of the Southern Ocean', *PLOS ONE*, 8(8): e72246. doi: 10.1371/journal.pone.0072246.

Hofmann, E. E. and E. J. Murphy (2004), 'Advection, Krill and Antarctic Marine Ecosystems', *Antarctic Science*, 16: 487–99.

Hofmann, E. E., J. E. Capella, R. M. Ross and L. B. Quetin (1992), 'Models of the Early Life History of *Euphausia superba* – Part I. Time and Temperature Dependence during the Descent– Ascent Cycle', *Deep Sea Research Part I*, 39: 1177–200.

Hogg, O. T., D. K. A. Barnes and H. J. Griffiths (2011), 'Highly Diverse, Poorly Studied and Uniquely Threatened by Climate Change: An Assessment of Marine Biodiversity on South Georgia's Continental Shelf', *PLOS ONE*, 6: e19795. doi: 10.1371/journal.pone.0019795.

IHO (International Hydrographic Organization) (1953), *Limits of Oceans and Seas*. Special Publication No. 23, 3rd edn, Monte Carlo: Imp. Monegasque.

IPCC (Intergovernmental Panel on Climate Change) (2007), *Fourth Assessment Report: Climate Change (AR4)*. Working Group II Report: Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar4/wg2/.

Jarman, S., N. Elliott, S. Nicol, A. McMinn and S. Newman (1999), 'The Base Composition of the Krill Genome and its Potential Susceptibility to Damage by UV-B', *Antarctic Science*, 11: 23–6.

Kawaguchi, S., A. Ishida, R. King, B. Raymond, N. Waller, A. Constable, S. Nicol and A. Ishimatsu (2013a), 'Seawater Carbonate Chemistry and Hatch Rates of Antarctic Krill', PANGAEA. https://doi.org/10.1594/PANGAEA.826460.

Kawaguchi, S., A. Ishida, R. King, B. Raymond, N. Waller, A. Constable, S. Nicol, M. Wakita and A. Ishimatsu (2013b), 'Risk Maps for Antarctic Krill under Projected Southern Ocean Acidification', *Nature Climate Change*, 3(9): 843–7. https://doi.org/10.1038/nclimate1937.

King, J. R. and G. A. McFarlane (2003), 'Marine Fish Life History Strategies: Applications to Fishery Management', *Fisheries Management and Ecology*, 10: 249–64.

Leaper, R. and C. Miller (2011), 'Management of Antarctic Baleen Whales amid Past Exploitation, Current Threats and Complex Marine Ecosystems', *Antarctic Science*, 23: 503–29. doi: 10.1017/S0954102011000708.

Levitus, S., J. I. Antonov and T. P. Boyer (2005), 'Warming of the World Ocean, 1955–2003', *Geophysical Research Letters*, 32: L02604.

Levitus, S., J. I. Antonov, T. P. Boyer and C. Stephens (2000), 'Warming of the World Oceans', *Science*, 287: 2225–9.

Loeb, V., V. Siegel, O. Holm-Hansen, R. Hewitt Loeb, V. Siegel, O. Holm-Hansen, R. Hewitt, W. Fraser, W. Trivelpiece and S. Trivelpiece (1997), 'Effects of Sea-ice Extent and Krill or Salp Dominance on the Antarctic Foodweb', *Nature*, 387: 897–900.

Mauchline, J. (1980) 'The Biology of Mysids and Euphausiids', in J. H. S. Blaxter, F. S. Russell and M. Yonge (eds), *Advances in Marine Biology*, vol. 18, 1–681, London: Academic Press.

Mauchline, J. and L. R. Fisher (1969), 'The Biology of Euphausiids', in F. S. Russell and M. Yonge (eds), *Advances in Marine Biology*, vol. 7, 1–45, New York, NY: Academic Press.

McBride M. M., P. Dalpadado, K. F. Drinkwater, O. R. Godø, A. J. Hobday, A. B. Hollowed, T. Kristiansen, E. J. Murphy, P. H. Ressler, S. Subbey, E. E. Hofmann and H. Loeng (2014), 'Krill, climate, and Contrasting Future Scenarios for Arctic and Antarctic Fisheries', *ICES Journal of Marine Science*, 71: 1934–55.

McBride, M. M., O. S. Stokke, A. H. H. Renner, B. H. Krafft, O. A. Bergstad, M. Biuw, A. D. Lowther and J. E. Stiansen (2021), 'Antarctic Krill (*Euphausia superba*): Spatial Distribution, Abundance, and Management of Fisheries in a Changing Climate', *Marine Ecology Progress Series*, 668: 185–214.

McNeil, B. I. and R. J. Matear (2008), 'Southern Ocean Acidification: A Tipping Point at 450-ppm Atmospheric CO_2', *Proceedings of the National Academy of Sciences of the United States of America*, 105: 18860–4.

Meredith, M. P. and J. C. King (2005), 'Rapid Climate Change in the Ocean West of the Antarctic Peninsula during the Second Half of the 20th Century', *Geophysical Research Letters*, 32(19): L19604–L19608. doi: 10.1029/2005GL024042.

Meyer, B., A. Atkinson, B. Blume and U. V. Bathmann (2002), 'Feeding and Energy Budgets of Antarctic Krill *Euphausia superba* at the Onset of Winter–I–Furcilia III Larvae', *Limnology and Oceanography*, 47: 943–52.

Meyer, B., U. Freier, V. Grimm, J. Groeneveld, B. P. V. Hunt, S. Kerwath, R. King, C. Klaas, E. Pakhomov, K. M. Meiners, J. Melbourne-Thomas, S. E. Thorpe, S. Stammerjohn, D. Wolf-Gladrow, L. Auerswald, A. Götz, L. Halbach, S. Jarman, S. Kawaguchi, T. Krumpen, G. Nehrke, R. Ricker, M. Sumner, M. Teschke, R. Trebilco and N. I. Yilmaz (2017), 'The Winter Pack-ice Zone Provides a Sheltered but Food-poor Habitat for Larval Antarctic Krill', *Nature Ecology and Evolution*. https://doi.org/10.1038/s41559-017-0368-3.

Montes-Hugo, M., S. C. Doney, H. W. Ducklow, W. Fraser, D. Martinson, S. E Stammerjohn and O. Schofield (2009), 'Recent Changes in Phytoplankton Communities Associated with Rapid Regional Climate Change along the Western Antarctic Peninsula', *Science*, 323: 1470–3.

Murphy, E. J., R. D. Cavanagh, K. F. Drinkwater, S. M. Grant, J. J. Heymans, E. E. Hofmann, G. L. Hunt Jr. and N. M. Johnston (2016), 'Understanding the Structure and Functioning of Polar Pelagic Ecosystems to Predict the Impacts of Change', *Proceedings of the Royal Society B*, 283: 20161646. http://dx.doi.org/10.1098/rspb.2016.1646.

Murphy, E. J., E. E. Hofmann, J. L. Watkins, N. M. Johnston, A. Piñones, T. Ballerini, S. L. Hill, P. N. Trathan, G. A. Tarling, R. A. Cavanagh, E. F. Young, S. E. Thorpe and

P. Fretwell (2013), 'Comparison of the Structure and Function of Southern Ocean Regional Ecosystems: The Antarctic Peninsula and South Georgia', *Journal of Marine Systems*, 109, 22–42. doi: 10.1016/j. jmarsys.2012.03.011.

Murphy, E. J., J. L. Watkins, P. N. Trathan, K. Reid, M. P. Meredith, S. E. Thorpe, N. M. Johnston, A. Clarke, G. A. Tarling, M. A. Collins, J. Forcada, R. S Shreeve, A. Atkinson, R. Korb, M. J. Whitehouse, P. Ward, P. G. Rodhouse, P. Enderlein, A. G. Hirst, A. R. Martin, S. L. Hill, I. J. Staniland, D. W. Pond, D. R. Briggs, N. J. Cunningham and A. H. Fleming (2007a), 'Spatial and Temporal Operation of the Scotia Sea Ecosystem: A Review of Large-scale Links in a Krill Centred Food Web', *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362: 113–48.

Nemoto, T., M. Okiyama and M. Takahashi (1985), 'Aspects of the Roles of Squid in Food Chains of Marine Antarctic Ecosystems', in W. R. Siegfried, P. R. Condy and R. M. Laws (eds), *Antarctic Nutrient Cycles and Food Webs*, Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-82275-9_58.

Newman, S. J., W. C. Dunlap, S. Nicol and D. Ritz (2000), 'Antarctic krill (*Euphausia superba*) acquire a UV-absorbing mycosporine-like amino acid from dietary algae', *Journal of Experimental Marine Biology and Ecology*, 255: 93–110.

Newman, S. J., S. Nicol, D. A. Ritz and H. J. Marchant (1999), 'Susceptibility of Antarctic Krill (*Euphausia superba* Dana) to Ultraviolet Radiation', *Polar Biology*, 22: 50–55.

Newman, S. J., D. Ritz and S. Nicol (2003), 'Behavioural Reactions of Antarctic Krill (*Euphausia superba* Dana) to Ultraviolet and Photosynthetically Active Radiation', *Journal of Experimental Marine Biology and Ecology*, 297: 203–17.

Nicol, S. (2006), 'Krill, Currents, and Sea Ice: *Euphausia superba* and its Changing Environment', *BioScience*, 56: 111–20.

Nicol, S., A. Constable and T. Pauly (2000b), 'Estimates of Circumpolar Antarctic Krill Abundance Based on Recent Acoustic Density Measurements', *CCAMLR Science*, 7: 87–99.

Nicol, S., T. Pauly, N. L. Bindoff, S. Wright, D. Thiele, G. W. Hosie, P. G. Strutton and E. Woehler (2000a), 'Ocean Circulation off East Antarctica Affects Ecosystem Structure and Sea-ice Extent', *Nature*, 406: 504–7.

Nowacek, D. P., A. S. Friedlaender, P. N. Halpin, E. L. Hazen, D. W. Johnston, A. J. Read, B. Espinasse, M. Zhou and Y. Zhu (2011), 'Super-aggregations of Krill and Humpback Whales in Wilhelmina Bay, Antarctic Peninsula', *PLOS ONE*, 6(4): e19173. doi: 10.1371/journal.pone.0019173.

Orr, J. C., K. Caldeira, V. Fabry, J.-P. Gattuso, P. Haugan, P. Lehodey, S. Pantoja, H.-O. Pörtner, U. Riebesell, T. Trull, E. Urban, M. Hood and W. Broadgate (2009), 'Report on Research Priorities for Ocean Acidification', Second International Symposium on the Ocean in a High-CO_2 World, *Oceanography*, 22: 182–9.

Parkinson, C. L. (2002), 'Trends in the Length of the Southern Ocean Sea-ice Season, 1979–99', *Annals of Glaciology*, 34: 435–40.

Phleger, C. F., M. M. Nelson, B. D. Mooney and P. D. Nichols (2002), 'Inter-annual and between Species Comparison of the Lipids, Fatty Acids and Sterols of Antarctic Krill from the US AMLR Elephant Island Survey Area', *Comparative Biochemistry and Physiology Part B Biochemistry and Molecular Biology*, 131(4): 733–47. doi: 10.1016/S1096-4959(02)00021-0.

Piñones, A. and A. V. Fedorov (2016), 'Projected Changes of Antarctic Krill Habitat by the End of the 21st Century', *Geophysical Research Letters*, 43: 8580–9.

Priddle, J., J. P. Croxall, I. Everson, R. B. Heywood, E. J. Murphy, P. A. Prince and C. B. Sear (1988), 'Large-scale Fluctuations in Distribution and Abundance of Krill – a

Discussion of Possible Causes', in D. Sahrhage (ed.), *Antarctic Ocean and Resources Variability*, 169–82, Berlin Heidelberg: Springer.

Quetin, L. B. and R. M. Ross (1984), 'Depth Distribution of Developing *Euphausia superba* Embryos, Predicted from Sinking Rates', *Marine Biology*, 79: 47–53.

Quetin, L. B. and R. M. Ross (2001), 'Environmental Variability and its Impact on the Reproductive Cycle of Antarctic Krill', *American Zoologist*, 41: 74–89.

Quetin, L. B., R. M. Ross, T. K. Frazer, M. O. Amsler and C. Wyatt-Evens (2003), 'Growth of Larval Krill, *Euphausia superba*, in Fall and Winter West of the Antarctic Peninsula', *Marine Biology*, 143: 833–43.

Quetin, L. B., R. M. Ross, C. H. Fritsen and M. Vernet (2007), 'Ecological Responses of Antarctic Krill to Environmental Variability: Can We Predict the Future?', *Antarctic Science*, 19: 253–66. doi: 10.1017/S0954102007000363.

Raskoff, K. A., J. E. Purcell and R. R. Hopcroft (2005), 'Gelatinous zooplankton of the Arctic Ocean: in situ observations under the ice', *Polar Biology*, 28(3): 207–17. https://doi.org/10.1007/s00300-004-0677-2.

Reilly, S., S. Hedley, J. Borberg, R. Hewitt, D. Thiele, J. Watkins and M. Naganobu (2004), 'Biomass and Energy Transfer to Baleen Whales in the South Atlantic Sector of the Southern Ocean', *Deep-Sea Research Part II: Topical Studies in Oceanography*, 51(12–13 SPEC.ISS.): 1397–409. https://doi.org/10.1016/j.dsr2.2004.06.008.

Rintoul, S. R., M. Sparrow, M. P. Meredith, V. Wadley, K. Speer, E. Hofmann, C. Summerhayes, E. Urban, R. Bellerby, S. Ackley, K. Alverson, I. Ansorge, S. Aoki, R. Azzolini, L. Beal, M. Belbeoch, A. Bergamasco, M. Biuw, L. Boehme, G. Budillon, L. Campos, D. Carlson, R. Cavanagh, E. Charpentier, H. Chul Shin, M. Coffin, A. Constable, D. Costa, M. Cronin, H. De Baar, C. De Broyer, T. De Bruin, L. De Santis, E. Butler, P. Dexter, M. Drinkwater, M. England, E. Fahrbach, E. Fanta, M. Fedak, K. Finney, A. Fischer, R. Frew, S. Garzoli, H. Gernandt, S. Gladyshev, D. Gomis, A. Gordon, J. Gunn, J. Gutt, C. Haas, J. Hall, K. Heywood, K. Hill, M. Hindell, M. Hood, M. Hoppema, G. Hosie, W. Howard, C. Joiris, L. Kaleschke, S. H. Kang, M. Kennicutt, A. Klepikov, L. Lembke-Jene, N. Lovenduski, V. Lytle, P. P. Mathieu, T. Moltmann, R. Morrow, M. Muelbert, E. Murphy, M. Naganobu, A. Naveira Garabato, S. Nicol, S. O'Farrell, N. Ott, A. Piola, S. Piotrowicz, R. Proctor, F. Qiao, F. Rack, R. Ravindra, K. Ridgway, E. Rignot, V. Ryabinin, E. Sarukhanian, S. Sathyendranath, P. Schlosser, J. Schwarz, G. Smith, S. Smith, C. Southwell, S. Speich, W. Stambach, D. Stammer, K. Stansfield, J. Thiede, E. Thouvenot, B. Tilbrook, P. Wadhams, I. Wainer, V. Willmott Puig, S. Wijffels, P. Woodworth, T. Worby and S. Wright (2012), *The Southern Ocean Observing System: Initial Science and Implementation Strategy*, *SCAR and SCOR*. https://epic.awi.de/id/eprint/25881/.

Ritz, D. A. (1994), 'Social Aggregation in Pelagic Invertebrates', *Advances in Marine Biology*, 30: 155–216.

Rogers, A. D., N. M. Johnston, E. J. Murphy and A. Clarke, eds (2012), *Antarctic Ecosystems: An Extreme Environment in a Changing World*, Oxford: Blackwell. doi: 10.1002/9781444347241.

Ross, R. M. and L. B. Quetin (1991), 'Ecological Physiology of Larval Euphausiids, *Euphausia superba* (Euphausiaceae)', *Memoirs of the Queensland Museum*, 31: 321–33.

Ross, R. M. and L. B. Quetin (2000), 'Reproduction in Euphausiacea', in I. Everson (ed.), *Krill: Biology, Ecology and Fisheries*. Fish and Aquatic Resources Series, 6, 150–80, Oxford: Blackwell Science.

Ross, R. M., L. B. Quetin, K. S. Baker, M. Vernet and R. S. Smith (2000), 'Growth Limitation in Young *Euphausia superba* under Field Conditions', *Limnology and Oceanography*, 45: 31–43.

Russell, F. S. (1927), 'The Vertical Distribution of Plankton in the Sea', *Biological Review*, 2(3): 213–62.

Schmidt, K., A. Atkinson, S. Steigenberger, S. Fielding, M. C. M. Lindsay, D. W. Pond, G. A. Tarling, T. A. Klevjer, C. S. Allen, S. Nicol and E. P. Achterberg (2011), 'Seabed Foraging by Antarctic Krill: Implications for Stock Assessment, Bentho-pelagic Coupling and the Vertical Transfer of Iron', *Limnology and Oceanography*, 56: 1411–28.

Schmidtko, S., K. J. Heywood, A. F. Thompson and S. Aoki (2014), 'Multidecadal Warming of Antarctic Waters', *Science*, 346(6214): 1227–31. doi: 10.1126/science.1256117.

Shotton, R. and M. Tandstad (2011), *FAO Review of the State of World Marine Fishery Resources 2011: Southern Ocean*. FAO Fisheries and Aquaculture Technical Paper, 569. https://www.fao.org/3/i2389e/i2389e.pdf.

Siegel, V. (1987), 'Age and Growth of Antarctic Euphausiacea (Crustacea) under Natural Conditions', *Marine Biology*, 96: 483–95.

Siegel, V. (2005), 'Distribution and Population Dynamics of *Euphausia superba*: Summary of Recent Findings', *Polar Biology*, 29: 1–22. doi: 10.1007/s00300-005-0058-5.

Siegel, V. (2012), 'Krill Stocks in High Latitudes of the Antarctic Lazarev Sea: Seasonal and Inter-annual Variation in Distribution, Abundance and Demography', *Polar Biology*, 35: 1151–77.

Smetacek, V. and S. Nicol (2005), 'Polar Ocean Ecosystems in a Changing World', *Nature*, 437: 362–8. doi: 10.1038/nature04161.

Taki, K., T. Yabuki, Y. Noiri, T. Hayashi and M. Naganobu (2008), 'Horizontal and Vertical Distribution and Demography of Euphausiids in the Ross Sea and its Adjacent Waters in 2004/2005', *Polar Biology*, 31: 1343–56.

Tarling, G. A., J. Cuzin-Roudy, S. E. Thorpe, R. S. Shreeve, P. Ward and E. J. Murphy (2007), 'Recruitment of Antarctic Krill *Euphausia superba* in the South Georgia Region: Adult Fecundity and the Fate of Larvae', *Marine Ecology Progress Series*, 331: 161–79. doi: 10.3354/meps331161.

Thorpe, S. E., K. J. Heywood, D. P. Stevens and M. A. Brandon (2004), 'Tracking Passive Drifters in a High-resolution Ocean Model: Implications for Interannual Variability of Larval Krill Transport to South Georgia', *Deep Sea Research Part I*, 51: 909–20.

Thorpe, S. E., E. J. Murphy and J. L. Watkins (2007), 'Circumpolar Connections between Antarctic Krill (*Euphausia superba* Dana) Populations: Investigating the Roles of Ocean and Sea Ice Transport', *Deep-Sea Research I: Oceanographic Research Papers*, 54: 792–810.

Walther, G. R., E. Post, P. Convey, A. Menzel, C. Parmesank, T. J. C. Beebee, J.-M. Fromentin, O. Hoegh-Guldberg and F. Bairlein (2002), 'Ecological Responses to Recent Climate Change', *Nature*, 416: 389–95.

Weydmann, A., J. E. Søreide, S. Kwasniewski and S. Widdicombe (2012), 'Influence of CO_2-induced Acidification on the Reproduction of a Key Arctic Copepod *Calanus glacialis*', *Journal of Experimental Marine Biology and Ecology*, 428: 39–42.

Whitehouse, M. J., M. P. Meredith, P. Rothery, A. Atkinson, P. Ward and R. E. Korb (2008), 'Rapid Warming of the Ocean around South Georgia, Southern Ocean, during the 20th Century: Forcings, Characteristics and Implications for Lower Trophic Levels', *Deep-Sea Research Part I*, 55: 1218–28. https://doi.org/10.1016/j.dsr.2008.06.002.

12

Climate Change and Management of Antarctic Krill Fisheries

Olav Schram Stokke

Introduction

What challenges does climate change pose to effective management of fisheries for Antarctic krill – and is the international management regime dimensioned to meet those challenges?[1] The combination of rising levels of sea temperature, acidification and ultraviolet radiation in the Southern Ocean is expected to induce a poleward shift in the distribution of the world's biggest marine stock: Antarctic krill (see Ch. 11). Some reports indicate that such a shift is already underway (Atkinson et al. 2009; Hill et al. 2019), although these findings have been disputed (Cox et al. 2018, 2019). From what we know about krill biology, inter-species interaction and oceanographic conditions in the Southern Ocean, a poleward shift would most probably imply significant reduction of habitats suitable for krill spawning, hatching, larval survival and juvenile growth (McBride et al. 2021).

Such potentially cumulative impacts of climate change further compound a management challenge that the regional regime, centred on the Commission for Conservation of Antarctic Marine Living Resources (CCAMLR), has not fully met thus far. In contrast to the agility shown in developing responses to steep increases in illegal, unreported and unregulated (IUU) fishing for valuable deep-sea species like Patagonian toothfish in the late 1990s and early 2000s (Miller et al. 2010), CCAMLR's management of the krill fisheries has not evolved according to the Commission's own aspirations. Monitoring and research of the stock and associated species have been irregular and spatially limited; and the existing harvest-control rule is not linked to the best available information on the status of Antarctic krill and krill-dependent stocks.

This chapter briefly reviews the institutional framework for managing krill fisheries, outlining how climate change has been addressed within CCAMLR, and examining the prospects for further advances toward ecosystem risk assessment and a more adaptive management system. Thereby it contributes to answering the second and the third overarching research questions addressed in this volume (see Ch. 1): management challenges deriving from stock-shifts and the extent to which those operating the regime are able to modify it, if that is necessary for maintaining high performance.

CCAMLR and climate change

Adopting and revising conservation and management measures in response to changes in the status of harvested stocks is a core task of any institution responsible for fisheries management. CCAMLR's ecosystem management objective entails the obligation to consider also the impacts on krill-dependent species – which include penguins and other sea birds as well as fish, seals and whales (Hill et al. 2016). The institutional framework for pursuing this objective consists of the decision-making Commission and the advisory Scientific Committee (SC-CAMLR), both with subsidiary bodies, as well as a secretariat. CCAMLR's attention to the impacts of climate change has been rising steadily during the past fifteen years.

Institutional framework

The Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention) was adopted in 1980 amidst concerns that expanding krill fisheries could have substantial and negative impacts on the Southern Ocean ecosystem. Commercial harvesting of krill had begun in 1961/2; by the late 1970s, there was a multinational fishery operating in the Atlantic sector (FAO Statistical Area 48) as well as in the Indian Ocean sector (Divisions 58.4.1 and 58.4.2) – and annual catches rose from less than 100,000 tonnes to nearly 500,000 tonnes by the late 1980s (CCAMLR 2018: 3–4). The dissolution of the Soviet Union, which had dominated the krill fishery, resulted in considerably reduced effort; today's catch levels (around 450,000 tonnes) are taken largely by Norway, South Korea and China (CCAMLR 2018: 4); Ukraine, Chile and in some years Russia also participate in an 'Olympic'-style fishery (no national or vessel quotas). Since the early 1990s, harvesting has been mostly confined to Area 48, which covers the Scotia Sea and the western Antarctic Peninsula (CCAMLR 2018: 4; see Ch. 11).

The Commission is to give effect to the three-pronged precautionary ecosystem management objective set forth in Article II of the CAMLR Convention: 1) prevent a targeted stock from falling below levels 'which ensure its stable recruitment'; 2) maintain the 'ecological relationships between harvested, dependent, and related populations … and the restoration of depleted populations'; and 3) minimize 'the risk of changes in the marine ecosystem which are not potentially reversible after two or three decades'. Meeting annually, the Commission adopts, by consensus (Art. XII), conservation measures that become legally binding on members unless they opt out within ninety days (Art. IX).

For krill, the Commission has adopted a series of conservation measures which set the maximum amount that can be taken in each of the sub-areas where the fishery occurs. Other measures oblige members to notify the secretariat of vessels planning to participate in the krill fishery well ahead of the season; to report regularly on catch and effort; to ensure that their vessels adhere to all krill-specific regulations and adhere to general regulations on matters such as vessel marking, gear restrictions and bycatch mitigation.

The Scientific Committee is charged with promoting cooperation on research with respect to Antarctic marine living resources. It is to advise the Commission on measures to implement the objectives of the Convention, including by establishing assessment criteria and methods, analysing direct and indirect effects of harvesting, and evaluating the effects of proposed conservation measures (Art. XV). This advice derives from assessments conducted by five working groups, including those on Ecosystem Management and Monitoring (EMM, responsible for krill, including predator–prey interactions and how they relate to environmental features) and Fish Stock Assessment (FSA, responsible for targeted finfish resources, mostly toothfish). Other working groups and sub-groups evaluate new assessment methods and models.

The Standing Committee on Inspection and Compliance (SCIC) advises the Commission on ways to improve adherence to conservation measures. Important compliance mechanisms include the System of Inspection, which ensures access for inspectors designated by non-flag states to fishing vessels and logbooks at sea as well as in port, and the System of International Scientific Observations. The latter was established primarily for scientific monitoring purposes, but now also provides information on the compliance of specific vessels; the required observer coverage in the krill fishery has increased gradually, achieving full coverage by 2020 (CCAMLR 2018a: 8).

The CAMLR Convention applies south of a line that approximates the Antarctic Polar Front (Art. I), a natural and dynamic boundary for the regional marine ecosystem (see Ch. 11), and forms part of a larger institutional complex (Oberthür and Stokke 2011) that includes the Antarctic Treaty System (ATS) (Stokke and Vidas 1996). The centrepiece of that system is the 1959 Antarctic Treaty with its annual Consultative Meeting (ATCM), advised by the Scientific Committee for Antarctic Research (SCAR) and, after the adoption of the 1991 Environmental Protocol, by the Committee for Environmental Protection (CEP). Other major components of the ATS are the 1972 Convention on the Conservation of Antarctic Seals, as well as all measures in force under these various agreements, such as the Agreed Measures for Conservation of Antarctic Fauna and Flora (including birds and mammals) (Vidas 1996). The CAMLR Convention's spatial ambit and placement in a larger institutional complex are conducive to ecosystem-based management: among the major krill predators, only whales are managed by an institution that is not a formal part of the ATS – the International Whaling Commission. CCAMLR cooperates with that institution through regular exchange of scientific information, as it also does with the Commission for the Conservation of Southern Bluefin Tuna, which manages a stock with some occurrence in northern parts of the CCAMLR area.

Rising attention to climate change

A recent review of responses to climate change by regional fisheries management bodies (Rayfuse 2019) found that CCAMLR has been more explicit than other organizations on the need to take climate change into consideration, adding, however, that none of the organizations studied had advanced substantially toward integrating climate impacts into their research and regulatory activities. References to climate change and its potential impacts on the Southern Ocean ecosystem can be found in Scientific Committee reports since 1989 (SC-CAMLR 1989: Annex 2) but their frequency and prominence remained low, well into the early 2000s.

As with other fisheries management bodies (Sumby et al. 2021), a turning point occurred in 2007, coinciding with the publication of the IPCC Fourth Assessment Report as well as the International Polar Year (2007–8) with its many climate-related projects. That year, the Commission 'urged Members to develop and maintain long-term scientific monitoring programmes studying the krill-based ecosystem as these will allow the Scientific Committee to investigate the effects of climate change as well as the effects of the fishery' (CCAMLR 2007: 14). The Commission also noted that climate-change impacts could be upgraded to a separate agenda item for the Scientific Committee (CCAMLR 2007: 70–3), thereby reinforcing expectations of concrete advice on the matter. The year after, it endorsed three work-areas designated by the Scientific Committee with a view to examining: 1) the robustness of stock assessments and scientific advice to the rising uncertainty accompanying climate change; 2) the need for improved monitoring programmes of harvested and associated species to provide robust and timely indicators of climate change impacts; and 3) whether climate-change uncertainty calls for modification of management objectives or performance indicators (CCAMLR 2008).

Subsequent progress in these three work-areas has been uneven. Within the first two areas, on robustness and monitoring, the Scientific Committee soon advised that climate change might induce rapid change within ecosystems, and that distinguishing climate impacts from fisheries impacts would probably require that existing CCAMLR Ecosystem Monitoring Programme (CEMP) sites for ecosystem monitoring be supported by data collection in reference areas with no fishing (SC-CAMLR 2009). The Commission responded promptly: it adopted Resolution 30/XXVIII, urging members and others to increase their consideration of the impacts of climate change in the Southern Ocean to better inform CCAMLR management decisions, and endorsed a review of CEMP (CCAMLR 2009). More than a decade later, however, that CEMP review is still forthcoming, awaiting consensus within the Commission on a new krill management procedure (SC-CAMLR 2018) – which in practice will require successful completion of the third designated work-area, on possible modifications of management objectives and performance indicators.

Since 2015, the Commission has examined climate-change impacts on conservation as a separate agenda item, involving controversy over two issues in particular: a proposed addition to Resolution 30/XXVIII, requesting that all papers submitted to the Scientific Committee or the Commission include a climate-change implications statement; and a proposed Climate Change Response Work Programme (CCRWP) modelled on one implemented by the Committee for Environmental Protection under the Antarctic Treaty's Environmental Protocol (CCAMLR 2017). The controversy over climate-change statements has revolved around the scientific value of requiring such statements also in CCAMLR papers that do not examine time-series of climate data (CCAMLR 2018b). Critics of the CCRWP have focused on its proposed mechanism for identifying and revising climate-change responsive goals and actions by the Commission and the Scientific Committee, arguing that it might duplicate activities in other forums and bypass assessments by the Scientific Committee and its working groups (CCAMLR 2018b).

Although climate change has received growing attention in CCAMLR, the agreed approach has been to deal with its implications not through climate-specific requirements or structures, but by seeking to improve the general institutional capacity to detect and respond to any detrimental impacts of harvesting. With respect to the krill fisheries, as the remainder of this chapter will show, those efforts have revolved around risk-assessment procedures and the Commission's longstanding aspiration to move closer to 'feedback management, which involves the continuous adjustment of management measures in response to information' (CCAMLR 1991a: 15).

Ecosystem risk assessment: progress and limitations

The harvesting pressure on Antarctic krill in the Southwest Atlantic sector, where the fishery is concentrated, has never exceeded one per cent of the estimated spawning-stock biomass in this area. Assessments of risk have therefore focused less on replenishment of the krill stock than on any impacts that reduced abundance may have on krill-dependent predators in the local areas where fisheries occur.

Catch reports from the commercial krill fisheries, required by CCAMLR on a haul-by-haul basis at gradually finer spatio-temporal scales, are the main sources of data on the distribution of harvesting operations. Several factors – including the patchiness of these operations compared to the distribution of the stock, and the scarce knowledge held on the mechanisms and patterns of krill flux (movement) – limit the use of catches per unit effort for stock-assessment purposes (Santa Cruz et al. 2018), so abundance estimates derive mostly from standardized net and acoustic surveys (Meyer et al. 2020). For cost reasons, large, area-scale surveys have been rare – for the Southwest Atlantic sector, they have been conducted only in 2000 and 2019.

In contrast, regional biomass estimates, as part of local monitoring programmes in the main fishing areas, have been sufficiently regular to provide time-series data that reveal very wide fluctuations in local abundance, as in the Bransfield Strait and north of the South Shetland Islands, where inter-annual differences can be as large as two to three orders of magnitude (Reiss 2008). Knowledge of such fluctuating abundance in fisheries hotspots has made the question underlying most of the krill management discussions in CCAMLR even more pressing: to what extent do krill fisheries put local predators at risk?

A major response to this question came in 1985, with the establishment of CEMP, focused on selected life-history stages of land-based seals, penguins and several other seabird species with restricted mobility during the foraging season (Agnew 1997; Kock et al. 2007). However, a review of that programme, nearly two decades later, found it 'unlikely that the existing design of CEMP, with the data available to it, would be sufficient to distinguish between ecosystem changes due to harvesting of commercial species and changes due to environmental variability, whether physical or biological' (SC-CAMLR 2003: 8).

Ecosystem-based risk assessment of the krill fisheries requires data on fisheries, on krill abundance at various scales (to account for flux), and on local predator requirements in fisheries hotspots (Krafft et. al 2015) – all collected and analysed in ways that allow evaluation of functional relationships (Kawaguchi and Nicol 2020; Meyer et al. 2020). When examining advances in the ecosystem risk assessment underlying Scientific Committee advice on krill, it is instructive to focus on a few particularly important regulatory decisions by the Commission:

1. The advice to set a first precautionary catch limit on krill in the Southwest Atlantic sector (CCAMLR 1991b)) was motivated by concerns that localized overfishing might negatively affect predator populations, fuelled by fine-scaled fisher reports indicating concentration near colonies of foraging penguins and seals (SC-CAMLR 1991). The basis for setting this catch limit was data on krill abundance derived from surveys conducted in the pre-CCAMLR era; the first and second international BIOMASS experiments.
2. A second important krill Conservation Measure (CCAMLR 1992) subdivided the catch limit among sub-areas of the Southwest Atlantic, largely proportional to distribution estimates from the pre-CCAMLR area survey (SC-CAMLR 1992). Implementing that subdivision, however, would be required only if total catch in heavily fished sub-areas reached a 'trigger level' of 620,000 tonnes, corresponding to the highest recorded annual catch in each sub-area. Whereas predator demand formed the basic rationale for the catch limit as well as the trigger, the report from the scientific deliberations made only a single reference to CEMP predator monitoring, which by then had been underway for seven years – namely, that despite such monitoring, 'it is currently impossible to estimate total consumption for all krill predators in the subareas' (SC-CAMLR 1992: 15).
3. The next major step in krill conservation (CCAMLR 2000a) was taken immediately after the CCAMLR 2000 synoptic krill survey of the Southwest Atlantic sector: on the basis of improved acoustic analysis methods, greater knowledge on krill life history and a concomitant improvement in stock-assessment methods, the Commission raised the precautionary catch limit for the area and spatially allocated it at the sub-area level based on survey estimates of the stock distribution. Importantly, the Commission also upgraded the trigger level, from a threshold obliging further subdivision to an area-level interim catch limit, applicable until a subdivision of the much higher precautionary catch limit (currently at 5.61 MT) is agreed (CCAMLR 2000b).
4. To facilitate more high-resolution risk assessment and conservation measures, the Scientific Committee two years later proposed several small-scale management units (SSMUs) – distinguishing in each sub-area between one pelagic area and one or more land-based predator areas (SC-CAMLR 2002). However, disagreement on the feasibility and scientific merit of various options for subdividing the krill catch limit among them has prevented consensual advice on the matter thus far. Static or dynamic options under longstanding evaluation by the Scientific Committee require fine-scaled distribution estimates of historical catches; krill biomass, as used already at the sub-area level; predator demand; krill biomass minus predator demand; dynamic predator-based indices of krill availability; and ecosystem

responses to structured fishing, with harvesting effort rotating among SSMUs (e.g. SC-CAMLR 2004; see also Hewitt 2004).

5. The most recent substantive update of conservation measures related to krill fishing (CCAMLR 2009a) allocated the trigger level among four sub-areas (48.1–4) in the Southwest Atlantic, again based largely on survey-derived estimates of the standing krill stock (CCAMLR 2009b). Driving the subdivision was advice by the Scientific Committee, based on improved modelling of functional relationships among fisheries, krill and spatially restricted predators which indicated that even the relatively low trigger-based catch limit might not suffice to protect predators if the fishery should become more concentrated near foraging areas (SC-CAMLR 2009; Meyer et al. 2020). The conservation measure subdividing the trigger level was time-limited and has been renewed several times: the one currently in force expires in November 2022 (CCAMLR 2021).

This brief review of major decisions on krill thus far brings out the progress and limitations in CCAMLR's risk assessment. The 2009 decision to subdivide the trigger level drew upon multispecies modelling parameterized in accordance with the best available knowledge at that time on processes linking fisheries and ecosystem response, using spatially resolved data on variations in krill and predator abundance (Watters et al. 2013). The limitations are equally evident, however: neither the catch limit (based on historical fishing maxima) nor its subdivision (based on estimates of krill distribution from the 2000 survey) reflects updated information from ongoing krill surveys and monitoring of predator abundance and reproductive performance. Important advances in understanding the krill-centric ecosystem had driven the decision to subdivide the trigger-based catch limit, but not the substance of that decision.

A dynamic, whole-ecosystem, data-driven risk-assessment procedure that can support adaptive management of krill is still a work in progress (Kawaguchi and Nicol 2020; Meyer et al. 2020); however, three moves by the Scientific Committee since the latest regulatory update deserve attention. In 2013, the Committee consolidated a staged approach envisaging catch limits above the trigger level based on information that incorporates a steadily broader range of observation series, including multiple-scaled krill surveys and CEMP-based quantification of predator demand (SC-CAMLR 2013). A second move was to develop a risk assessment framework for providing advice on how to distribute future catch levels spatially, in order to spread and moderate the risks to predators (SC-CAMLR 2016). The most recent advance was agreed immediately after the 2019 Area 48 Survey had demonstrated that commercial fishing vessels could effectively collect large-scale scientific data on krill (SC-CAMLR 2019a; see also Ch. 5). The Scientific Committee adopted a detailed work plan to collate data layers and analyses from a wide range of past, ongoing and enhanced monitoring and research activities – including the two large-scale area surveys, annual regional krill surveys and predator monitoring, and tracking of land-based and pelagic predators (SC-CAMLR 2019b).

Moving toward feedback management

Important as it is to ensure that decision-makers obtain updated information on the status of krill stocks and stocks of krill-dependent species in harvesting areas, an effective feedback management system also requires that the decision-making body can agree on regulatory measures that respond to changing indices (Trathan and Agnew 2010). During the past ten years, CCAMLR's ability to reach consensus on proposed conservation measures has been on a downward slope.

Scientific uncertainty concerning the impacts of krill harvesting on local ecosystems has contributed to longstanding disagreement among CCAMLR members on whether to subdivide catch limits among smaller management units in the Southwest Atlantic. Finer subdivision is controversial because small management units imply less flexibility for fishing vessels to deploy their harvesting capacities efficiently. Even with the current much larger management units (four sub-areas in the Southwest Atlantic sector), subdivision of the trigger-based catch limit regularly results in closures in parts of the operational area well before the season ends. Critics of smaller management units also argue that static management measures where modification requires consensus are unlikely to keep pace with dynamic changes to the marine ecosystem and may thus hamper rather than promote the ability to react adaptively.

Thus, subdivision of krill catch limits links up to a larger debate within CCAMLR concerning the balance between environmental protection and rational resource use (see, e.g. Press et al. 2019). In the context of krill management, debates on that balance have revolved around achieving a scientific basis for allocating the trigger level in a way that can be both responsive to changes in the status of the krill stock and its predators *and* attentive to the cost effectiveness of fishing operations and the comparative importance of various marine areas for the economics of the fishery (see, e.g. CCAMLR 2016a: 12–15). As noted above, the spatial allocation of the trigger level comes with an expiry date because the current conservation measure will remain in force only until November 2022. Accordingly, maintaining or increasing the present spatial resolution of krill catch limits to protect krill-dependent predators will require that a new conservation measure be adopted through consensus – and, as discussed below, failure to obtain consensus has become increasingly frequent in CCAMLR decision-making.

Consensus in CCAMLR

As in some other international environmental institutions, legally binding decisions by CCAMLR require consensus (Art. XII), a slightly softer requirement than unanimity, as it suffices that no member *objects* to a proposed conservation measure (see also Ch. 3 by Young and Stokke). The consensus requirement derives in part from disagreement among those who negotiated the Convention regarding the status of seven partially overlapping sovereignty claims to Antarctic territory. Specifically, the consensus rule provides procedural reinforcement of Article IV, which is aimed at ensuring that the general 'freeze' of the sovereignty issue established by the Antarctic Treaty will be upheld also in situations where members regularly engage in fisheries regulation and enforcement that might otherwise be interpreted as deriving from territorial jurisdiction (Stokke 1996). The veto right, ensured by the consensus rule, means that acceptance of CCAMLR regulations and enforcement actions by other states can always be construed as deriving from nationality-based jurisdiction, thus neither strengthening nor undermining claims to territorial jurisdiction. This embeddedness of the consensus requirement in the larger sovereignty issue in Antarctic governance means that strengthening the decision rule to some variety of majority decision is even less likely than for other resource management regimes in which each member has the right of veto.

From a governance point of view, the consensus rule has the obvious disadvantage that decisions can easily be blocked – but the accompanying advantage is that it compels members to search for solutions that can accommodate the most strongly-held concerns of others. In CCAMLR, the consensus-seeking approach typically begins informally at the working-group level; by the time an issue reaches the Commission, any disagreements should have been aired and noted prior to the formal deliberations (Everson 2017: 148). Although this procedure holds no guarantee of consensus, it does allow those who put forward a proposed conservation measure to adjust it in ways that may make it more acceptable to opponents. Conversely, the Rules of Procedure of the Scientific Committee require that its reports to the Commission 'shall reflect all the views expressed at the Committee on the matters discussed' (Rule 3, based in the Convention's Art. XVI); this ensures a high degree of transparency regarding positions taken by various members on controversial matters. Such transparency typically raises the political costs of opposing proposals that enjoy the support of a clear majority of Scientific Committee members.

Controversy on the balancing of protection and rational use

During the past ten years, instances of opposition to proposed conservation measures within CCAMLR have become more frequent, especially on matters concerning marine protected areas (MPAs) (see Brooks et al. 2019; Sykora-Bodie and Morrison 2019). Although not impinging directly on the process of revising the krill management system, MPA controversies have highlighted the balance between the protection and utilization components of CCAMLR's objective, laid out in the provision that '[f]or the purposes of this Convention, the term "conservation" includes rational use' (Art. II).

In line with UN Convention on Biological Diversity, the Commission has pledged to establish a representative network of MPAs in the Convention area (Everson 2017). Building on earlier measures to protect CEMP sites and areas accorded special management or protection status under the Environmental Protocol, in 2009 the Commission designated the South Orkney Islands Southern Shelf MPA (CCAMLR 2009a). Commercial fishing was prohibited, but the MPA boundaries had been drawn to exclude from the original proposal the area where actual harvesting occurred (CCAMLR 2009b: 21). Soon thereafter, the Commission agreed on a general framework for establishing MPAs (CCAMLR 2011), largely consistent with MPA best practices established elsewhere (Brooks et al. 2019: 3); and in 2016 it designated the world's largest MPA, in the Ross Sea region (CCAMLR 2016b).

Notwithstanding this string of regulatory achievements on MPAs, CCAMLR deliberations on the matter had become increasingly polarized, and many proposals failed to obtain consensus. Since around 2012, a subset of fishing-state members have expressed rising concern that MPA proposals might have the effect of undermining the rational-use part of the objective, and have questioned the scientific basis for introducing restrictions on fishing operations beyond the framework already in place (see CCAMLR 2015: 54, 58; CCAMLR 2016a: 58–60; CCAMLR 2018b: 25, 28). On the other side of this debate, a group of members with little or no engagement in Antarctic fisheries have expressed frustration at the lack of progress, emphasizing the CCAMLR commitment to create a representative system of MPAs, and the role of this instrument in providing scientific reference areas for monitoring natural variability, long-term change, and the effects of human activities (see CCAMLR 2012: 23–39; CCAMLR 2017: 46–53; CCAMLR 2018b: 33).

The rising controversy among CCAMLR members over the MPA instrument is also evident in the contrast between the swift adoption of the South Orkney Islands Southern Shelf MPA in 2009 (Brooks et al. 2019: 3) and the protracted deliberations that have marked subsequent proposals. Variants of the Ross Sea region proposal had been submitted four times without obtaining consensus, and the proposal finally adopted had been tailored to accommodate various objections – notably with its thirty-five-year 'sunset clause' and the large Krill Research Area where directed krill fishing will be permitted, even though no significant krill harvesting has occurred in that region for decades. Proposals for new MPAs in the East Antarctic (variants proposed annually since 2012), the Weddell Sea (since 2016) and the Antarctic Peninsula region (since 2018) have failed to obtain consensus, in most cases despite revisions aimed at accommodating criticisms of previous versions (see overview in Sykora-Bodie and Morrison 2019). Even the two MPAs in existence are subject to considerable controversy, as the Commission has not been able to adopt research and monitoring plans for either of them – in the case of the Ross Sea region, despite the endorsement of the Scientific Committee (CCAMLR 2019: 27–39).

Prospects for progress on feedback management

In view of the rising controversy over the MPA instrument, it is clearly in line with CCAMLR's consensus-seeking tradition that neither the Scientific Committee nor the Commission made any reference to MPAs when, respectively, endorsing and adopting the scientific work plan to support a feedback management approach for the krill fisheries (see above) – beyond noting that the planning group for the Antarctic Peninsula MPA proposal has compiled certain data layers of relevance (SC-CAMLR 2019a: 11–16 and tables 1–4; CCAMLR 2019: 13–14). Similarly, sponsors of a revised version of the MPA proposal for the Antarctic Peninsula region, where krill harvesting is currently concentrated, emphasized that regulation of the fishing activity in the MPA would occur within the regular framework of catch limits spatially allocated by the Commission, primarily through the existing conservation measure on spatial allocation (CCAMLR 2021) or measures replacing or revising it (CCAMLR 2019: 33); one of the sponsors, Chile, is a krill-fishing state.

Indeed, several leading fishing-state members have sought to build bridges between the competing positions regarding the balance between protection and resource use. Drawing on numerous in-depth interviews with CCAMLR delegates and observers in 2017, Sykora-Bodie and Morrison (2019: 9) reported that three states actively engaged in Southern Ocean fisheries – Japan, Korea, Norway – were seen by both sides of the MPA controversy as promoting the kind of constructive dialogue needed to obtain consensus, notably by their insistence on a clear scientific rationale for protective measures and their preparedness to contribute to such research.

The subset of fishing states that have sought to build bridges among the parties to the MPA controversy in CCAMLR has also been central in the development of the scientific work plan in support of a feedback management system for the krill fisheries. Only the UK and the USA are mentioned more frequently than Japan and Norway in the listing of coordinators and data providers for various activities planned to make risk assessment more sensitive to changes in the abundance and distribution of krill and its predators (SC-CAMLR 2019a: 11 and associated tables). Further, Norway coordinated the multinational 2019 Area 48 Survey, and in the same year, Japan conducted a krill biomass survey in Division 58.4.1, aimed at updating a biomass estimate from the mid-1990s (SC-CAMLR 2019a: 7–8).

Active engagement by the leading krill-fishing states in the development of the scientific work plan in support of a feedback management system for the krill fisheries is conducive for obtaining consensus on a feedback management system, because these states can hardly be suspected of seeking to dilute the rational-use part of CCAMLR's conservation objective.

A related and similarly conducive circumstance is the positive attitude expressed by important segments of the krill-fishing industry. Members of the Association of Responsible Krill Harvesting Companies (ARK) take more than 80 per cent of the krill catch in the CCAMLR area; their support to advancing feedback management includes active engagement in scientific workshops and stakeholder meetings on the matter as well as provision of vessel hours, free of charge, for the 2019 Area 48 Survey (SC-CAMLR 2018). This association, which holds observer status within CCAMLR, harvesting activities by enacting voluntary restriction zones seasonally near breeding colonies of krill predators (CCAMLR 2016a). Among the drivers for these supportive activities is that major krill-fishing companies have obtained certification from a leading private governance institution, the Marine Stewardship Council (MSC), which now certifies more than 10 per cent of the world's capture fisheries (see Ch. 5). MSC certification improves access to major markets for some of the most lucrative krill applications, such as nutrients and pharmaceuticals. Measures required or recommended by the MSC to renew existing certificates align well with the feedback management agenda: reduction of bycatch and localized harvesting pressure, and better knowledge of the effects of the krill fisheries on the ecosystem (see, e.g. Hønneland et al. 2020; Roel and Ríos 2020; also Nicol et al. 2012: 35–6).

Another circumstance favouring progress toward feedback management is the substantial increase in krill catches since 2017. This stems from the gradually stronger markets for an expanding range of krill-based products, and possibly also from more efficient gear – notably, deployment of continuous pumping technology in part of the fishing fleet (Nicol and Foster 2016). The recent rise in catches is steeper than expected: industry sources cited by Kawaguchi and Nicol (2020) found it unlikely that catches would exceed 350,000 tonnes in the Southwest Atlantic, and yet a catch close to 450,000 tonnes was reported already in the 2019/20 season (CCAMLR 2020). This development makes it more probable that commercially viable krill harvesting could exceed the trigger level for the Southwest Atlantic sector. Lifting that trigger level will require consensus within the Commission on a mechanism for spatially allocating the higher precautionary catch limit among smaller management units (CCAMLR 2010) – or on some other adaptive solution acceptable to all CCAMLR members.

In summary, the combination of institutional, political and economic considerations gives rise to some optimism regarding the ongoing efforts to move closer to a feedback management system for krill. Members that emphasize the protection part of CCAMLR's conservation objective have strong incentives to accommodate those who favour 'rational use' – because, without a new consensus decision, even the existing level of spatial distribution of fisheries will expire. Conversely, fishing states envisaging a continued rise in capacity and demand know that the catch limit will stay at 620,000 tonnes unless all members agree otherwise. Whatever the exact location of one's preferred balance between protection and rational use, simply retaining the status quo is becoming less and less attractive as a long-term option.

Conclusions

Ongoing and expected climate-related environmental changes, as well as the likelihood of a continued rise in krill catches, have made it increasingly important to overcome the longstanding impasse among CCAMLR members on the development of an adaptive management system for the krill fisheries: one in which regularly updated information on krill and krill-dependent species forms the basis for risk assessment and, if necessary, adjustment of conservation measures. Progress towards such a system has been constrained by inadequate monitoring activities and lack of consensus on how to allocate catch levels spatially in order to spread and moderate the risks to predators.

Recent developments reviewed here seem promising in both regards. In 2016, the Scientific Committee endorsed a conceptual model for the risk-assessment framework. Three years later, the large-scale Area 48 Krill Survey enabled an updated stock assessment for the Southwest Atlantic sector where krill fishing is concentrated; and also in 2019, the Scientific Committee specified a comprehensive work plan to enable advice on the spatial distribution of future catch limits based on a range of past, present and future monitoring activities.

Adoption of krill regulations with finer spatial resolution than found in current conservation measures requires consensus among CCAMLR members – which in turn calls for mutual accommodation among the parties to a decade-long debate over how to balance the protection and the rational-use parts of CCAMLR's conservation objective. We have noted several grounds for optimism regarding the prospects for such accommodation and for further progress toward adaptive krill management.

First, the upcoming expiry of the conservation measure that distributes the trigger level among sub-areas in the Southwest Atlantic sector renders the status quo less attractive to all parties to the protection–rational use debate. Members concerned that greater concentration of the fishery would undermine the protection of local predator stocks now have firm incentives to seek solutions that are palatable also to those emphasizing rational use. Conversely, members concerned that the interim catch limit of 620,000 tonnes will soon become a real constraint on harvesting operations have more compelling reasons than before to develop or endorse a procedure for spatial distribution – without it, they cannot hope to lift that limit. Secondly, leading fishing states and the companies responsible for most of the krill catch have actively promoted the advances recently made in monitoring and risk-assessment procedures, thereby helping to reduce concerns among some members that a revised and adaptive procedure for krill management might undermine the rational-use objective of CCAMLR.

Note

1 This chapter draws on parts of the author's contribution to Margaret M. McBride et al. (2021) as well as previously unpublished material.

References

Agnew D. J. (1997), 'The CCAMLR Ecosystem Monitoring Programme', *Antarctic Science*, 9 (3): 235–42.

Atkinson, A., V. Siegel, E. A. Pakhomov, M. J. Jessopp and V. Loeb (2009), 'A Re-appraisal of the Total Biomass and Annual Production of Antarctic Krill', *Deep Sea Research Part I: Oceanographic Research Papers*, 56 (5): 727–40. https://doi.org/10.1016/j.dsr.2008.12.007.

Brooks, C. M., L. B. Crowder, H. Österblom and A. L. Strong (2019), 'Reaching Consensus for Conserving the Global Commons: The Case of the Ross Sea, Antarctica', *Conservation Letters*. doi: 10.1111/conl.12676.

CAMLR Convention (Convention on the Conservation of Antarctic Marine Living Resources) (1980), Canberra, 20 May, *UnitedNations Treaty Series*, vol. 1329, no. 22301. https://treaties.un.org/doc/Publication/UNTS/Volume%201329/v1329.pdf.

CCAMLR (1991a), 'Report of the Tenth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-x.pdf.

CCAMLR (1991b), Conservation Measure 32/X (1991) Precautionary Catch Limitations on Euphausia Superba in Statistical Area 48. https://www.ccamlr.org/en/measure-32/x-1991.

CCAMLR (1992), Conservation Measure 46/XI (1992) Allocation of Precautionary Catch Limit on Euphausia Superba in Statistical Area 48 (Conservation Measure 32/X) to Statistical Subareas. https://www.ccamlr.org/en/measure-46/xi-1992.

CCAMLR (2000a), Conservation Measure 32/XIX (2000) Precautionary catch limitations on Euphausia superba in Statistical Area 48. https://www.ccamlr.org/en/measure-32/xix-2000.

CCAMLR (2000b), 'Report of the Nineteenth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xix.pdf.
CCAMLR (2007), 'Report of the Twenty-Sixth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xxvi.pdf.
CCAMLR (2008), 'Report of the Twenty-Seventh Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-xxvii.
CCAMLR (2009a), Conservation Measure 91-03 (2009) Protection of the South Orkney Islands Southern Shelf. https://cm.ccamlr.org/en/measure-91-03-2009.
CCAMLR (2009b), 'Report of the Twenty-Eighth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xxviii.pdf.
CCAMLR (2010), Conservation Measure 51-01 (2010) Precautionary catch limitations on Euphausia superba in Statistical Subareas 48.1, 48.2, 48.3 and 48.4. https://www.ccamlr.org/en/measure-51-01-2010.
CCAMLR (2011), CCAMLR (2011), Conservation Measure 91-04 (2011) General framework for the establishment of CCAMLR Marine Protected Areas. https://cm.ccamlr.org/en/measure-91-04-2011.
CCAMLR (2012), 'Report of the Thirty-First Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xxxi.pdf.
CCAMLR (2015), 'Report of the Thirty-Fourth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xxxiv_4.pdf.
CCAMLR (2016a), 'Report of the Thirty-Fifth Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-xxxv.
CCAMLR (2016b), Conservation Measure 91-05 (2016) Ross Sea Region Marine Protected Area. https://cm.ccamlr.org/en/measure-91-05-2016.
CCAMLR (2017), 'Report of the Thirty-Sixth Meeting of the Commission'. https://www.ccamlr.org/en/system/files/e-cc-xxxvi_0.pdf.
CCAMLR (2018a), 'Krill Fishery Report 2018'. https://www.ccamlr.org/en/system/files/00%20KRI48%202018.pdf.
CCAMLR (2018b), 'Report of the Thirty-Seventh Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-xxxvii.
CCAMLR (2019), 'Report of the Thirty-Eighth Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-38.
CCAMLR (2020), 'Report of the Thirty-Ninth Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-39.
CCAMLR (2021), Conservation Measure 51-07 (2021) Interim distribution of the trigger level in the fishery for Euphausia superba in Statistical Subareas 48.1, 48.2, 48.3 and 48.4. https://cm.ccamlr.org/en/measure-51-07-2021.
Constable A. J., W. K. de la Mare, D. J. Agnew, I. Everson and D. Millet (2000), 'Managing Fisheries to Conserve the Antarctic Marine Ecosystem: Practical Implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)', *ICES Journal of Marine Science*, 57: 778–91.
Cox, M. J., S. Candy, W. K. de la Mare, S. Kawaguchi, S. Nicol and N. Gales (2018), 'No Evidence for a Decline in the Density of Antarctic Krill *Euphausia superba* Dana, 1850, in the Southwest Atlantic Sector between 1976 and 2016', *Journal of Crustacean Biology*, 38 (6): 656–61. doi: 10.1093/jcbiol/ruy072%.
Cox, M. J., S. Candy, W. K. de la Mare, S. Nicol, S. Kawaguchi and N. Gales (2019), 'Clarifying Trends in the Density of Antarctic Krill *Euphausia superba* Dana, 1850, in the South Atlantic: A Response to Hill et al.', *Journal of Crustacean Biology*, 39 (3): 323–27. doi: 10.1093/jcbiol/ruz010.

Everson I. (2017), 'Designation and Management of Large-scale MPAs Drawing on the Experiences of CCAMLR', *Fish and Fisheries*, 18 (1): 145–59

Hewitt, R., G. Watters, P. Trathan and J. Croxall (2004), 'Options for Allocating the Precautionary Catch Limit of Krill among Small-Scale Management Units in the Scotia Sea', *CCAMLR Science*, 11: 81–97.

Hill, S. L., A. Atkinson, C. Darby, S. Fielding, B. A. Krafft, O. R. Godø, G. Skaret, P. Trathan and J. Watkins (2016), 'Is Current Management of the Antarctic Krill Fishery in the Atlantic Sector of the Southern Ocean Precautionary?', *CCAMLR Science*, 23: 31–51. https://www.ccamlr.org/en/publications/science_journal/ccamlr-science-volume-23/31%E2%80%9351.

Hill, S. L., A. Atkinson, E. A. Pakhomov and V. Siegel (2019), 'Evidence for a Decline in the Population Density of Antarctic Krill Euphausia superba Dana, 1850 still Stands: A Comment on Cox et al.', *Journal of Crustacean Biology*, 39 (3): 316–22. doi: 10.1093/jcbiol/ruz004.

Hønneland G., L. Revenga and J. Addison (2020), 'Aker Biomarine Antarctic Krill: Final Draft Report Conformity Assessment Body: Lloyd's Register', London: Marine Stewardship Council.

Kawaguchi, S. and S. Nicol (2020), 'Krill Fishery', in L. G and T. M (eds), *The Natural History of the Crustacea: Fisheries and Aquaculture*, 137–58, New York, NY: Oxford University Press.

Kock, K.-H., K. Reid, J. Croxall and S. Nicol (2007), 'Fisheries in the Southern Ocean: An Ecosystem Approach', *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 362 (1488): 2333–49.

Krafft, B. A., G. Skaret and T. Knutsen (2015), 'An Antarctic Krill (Euphausia superba) Hotspot: Population Characteristics, Abundance and Vertical Structure Explored from a Krill Fishing Vessel'. https://doi.org/10.1007/s00300-015-1735-7.

McBride, M. M., O. S. Stokke, A. H. H. Renner, B. A. Krafft, A. D. Lowther, O. A. Bergstad, M. Biuw and J. E. Stiansen (2021), 'Antarctic Krill (*Euphausia superba*): Spatial Distribution, Abundance, and Management of Fisheries in a Changing Climate', *Marine Ecology Progress Series*, 668: 185–214.

Meyer, B., A. Atkinson, K. S. Bernard, A. S. Brierley, R. Driscoll, S. L. Hill, E. Marschoff, D. Maschette, F. A. Perry, C. S. Reiss, E. Rombolá, G. A. Tarling, S. E. Thorpe, P. N. Trathan, G. Zhu and S. Kawaguchi (2020), 'Successful Ecosystem-based Management of Antarctic Krill Should Address Uncertainties in Krill Recruitment, Behaviour and Ecological Adaptation', *Communications earth & environment*, 1: 1–12. doi: 10.1038/s43247-020-00026-1.

Miller, D. G. M., N. Slicer and E. N. Sabourenkov (2010), 'IUU Fishing in Antarctic Waters: CCAMLR Actions and Regulations', in D. Vidas (ed.), *Law, Technology and Science for Oceans in Globalisation: IUU Fishing, Oil Pollution, Bioprospecting, Outer Continental Shelf*, 175–96, Leiden: Brill Nijhoff.

Molenaar, E. J. (2020), 'Integrating Climate Change in International Fisheries Law', in I. U. Jakobsen, E. Johansen and S. Busch (eds), *The Law of the Sea and Climate Change: Part of the Solution or the Problem?*, 263–88, Cambridge: Cambridge University Press.

Nicol, S. and J. Foster (2016), 'The Fishery for Antarctic Krill: Its Current Status and Management Regime', in V. Siegel (ed.), *Biology and Ecology of Antarctic Krill*, 387–421, Cham: Springer International Publishing.

Nicol, S., J. Foster and S. Kawaguchi (2012), 'The Fishery for Antarctic Krill – Recent Developments', *Fish and Fisheries*, 13: 30–40.

Oberthür, S. and O. S. Stokke (2011), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change*, Cambridge, MA: MIT Press.
Press, A. J., I. Hodgson-Johnston and A. J. Constable (2019), 'The Principles of the Convention on the Conservation of Antarctic Marine Living Resources: Why Its Commission Is Not a Regional Fisheries Management Organisation', in N. Liu, C. M. Brooks and T. Qin (eds), *Governing Marine Living Resources in the Polar Regions*, 9–29, Cheltenham: Edward Elgar Publishing.
Rayfuse, R. (2019), 'Addressing Climate Change Impacts in Regional Fisheries Management Organizations', in R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 400–33, Oxford: Hart.
Reiss, C. S., A. M. Cossio, V. Loeb and D. A. Demer (2008), 'Variations in the Biomass of Antarctic Krill (Euphausia Superba) around the South Shetland Islands, 1996–2006', *ICES Journal of Marine Science*, 65: 497–508. doi: 10.1093/icesjms/fsn033.
Roel, B. and J. Ríos (2020), 'DERIS, S.A. Pesca Chile: Antarctic Krill Fishery. First Surveillance Audit Report' (Conformity Assessment Body: Bureau Veritas), London: Marine Stewardship Council.
Ruckelshaus, M., T. Klinger, N. Knowlton and D. P. DeMaster (2008), 'Marine Ecosystem-based Management in Practice: Scientific and Governance Challenges', *BioScience*, 58 (1): 53–63.
Santa Cruz, F., B. Ernst, J. A. Arata and C. Parada (2018), 'Spatial and Temporal Dynamics of the Antarctic Krill Fishery in Fishing Hotspots in the Bransfield Strait and South Shetland Islands', *Fisheries Research*, 208: 157–66. doi: 10.1016/j.fishres.2018.07.020.
SC-CAMLR (1989), 'Report of the Eighth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-viii.pdf.
SC-CAMLR (1991), 'Report of the Tenth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-x.pdf.
SC-CAMLR (1992), 'Report of the Eleventh Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xi.pdf.
SC-CAMLR (2002), 'Report of the Twenty-First Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xxi.pdf.
SC-CAMLR (2003), 'Report of the Twenty-Second Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xxii.pdf.
SC-CAMLR (2004), 'Report of the Twenty-Third Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xxiii.pdf.
SC-CAMLR (2009), 'Report of the Twenty-Eighth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xxviii.pdf.
SC-CAMLR (2013), 'Report of the Thirty-Second Meeting of the Scientific Committee'. https://www.ccamlr.org/en/sc-camlr-xxxii.
SC-CAMLR (2016), 'Report of the Thirty-Fifth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/sc-camlr-xxxv.
SC-CAMLR (2018), 'Report of the Thirty-Seventh Meeting of the Scientific Committee'. https://www.ccamlr.org/en/sc-camlr-xxxvii.
SC-CAMLR (2019a), 'Report of the Thirty-Eighth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/sc-camlr-38.
SC-CAMLR (2019b), 'Report of the Working Group on Ecosystem Monitoring and Management (Concarneau, France, 24 June to 5 July 2019)'. https://www.ccamlr.org/en/sc-camlr-38/03.

Stokke, O. S. (1996), 'The Effectiveness of CCAMLR', in O. S. Stokke and D. Vidas (eds), *Governing the Antarctic: The Effectiveness and Legitimacy of the Antarctic Treaty System*, 120–51, Cambridge: Cambridge University Press.

Sumby, J., M. Haward, E. A. Fulton and G. T. Pecl (2021), 'Hot Fish: The Response to Climate Change by Regional Fisheries Bodies', *Marine Policy*, 123: 104284. https://doi.org/10.1016/j.marpol.2020.104284.

Sykora-Bodie, S. T. and T. H. Morrison (2019), 'Drivers of Consensus-based Decision-making in International Environmental Regimes: Lessons from the Southern Ocean', *Aquatic Conservation: Marine and Freshwater Ecosystems*, 29 (12): 2147–61.

Trathan, P. N. and D. Agnew (2010), 'Climate Change and the Antarctic Marine Ecosystem: An Essay on Management Implications', *Antarctic Science*, 22: 387–98. doi: 10.1017/S0954102010000222.

Vidas, D. (1996), 'The Antarctic Treaty System in the International Community: An Overview', in O. S. Stokke and D. Vidas (eds), *Governing the Antarctic: The Effectiveness and Legitimacy of the Antarctic Treaty System*, 35–60, Cambridge: Cambridge University Press.

Watters, G. M., S. L. Hill, J. T. Hinke, J. Matthews and K. Reid (2013), 'Decision-making for Ecosystem-based Management: Evaluating Options for a Krill Fishery with an Ecosystem Dynamics Model', *Ecological Applications*, 23: 710–25. doi: 10.1890/12-1371.1.

13

The EU and its Quest for Antarctic Marine Protected Areas

Andreas Raspotnik and Andreas Østhagen

Introduction

Over the past decade, the European Union and its various institutional actors have developed specific policies for geographical regions where the EU and its member-states hold interests. One example of this – driven by climate-change awareness, economic interests, geopolitical shifts and intra-institutional policy expansion – concerns the polar regions (see Chs. 4, 7 and 10). With most of its territory located in the Northern Hemisphere, EU involvement in Antarctic governance is not self-evident (Vanstappen and Wouters 2017: 271). However, the Antarctic region and issues pertaining to it – particularly research, climate awareness and ocean governance – have slowly emerged on the policy agenda in Brussels in recent years. Moreover, as EU citizens and member-states are involved in various activities in Antarctica, broader EU involvement may not be so unreasonable (Vanstappen and Wouters 2017: 271).

In this chapter, we examine the EU's role in Antarctica and its engagement with this peripheral part of the world, asking: what links the EU to Antarctic? and what drives the EU and some of its member-states to become more relevant Antarctic actors?

We begin by exploring simplified conceptions of the EU policymaking system, offering a broad overview of the EU's relations to Antarctica, as a geographic area and as a policy issue. This includes several specific policy links to Antarctic-relevant issue-areas with exclusive or shared competences for the EU, such as environmental protection, climate change, and research, tourism and fishing. As such, this chapter links to Chapters 4 and 10, providing a nuanced understanding of the relation between specific sectoral policies – fisheries, but also environmental protection – and foreign policy in the special case of the European Union.

Next, we evaluate the prospects of greater EU involvement in Antarctic affairs against the EU's 'gateways to Antarctica'. This provides a starting point for tackling question three as stated in the Introduction, on the extent to which and how the EU may provide for institutional resilience in the case of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

Our analysis draws on a comprehensive review of EU policy documents and policy history concerning Antarctica, complemented by interviews conducted in Brussels in February and November 2018, with all relevant branches of the EU system. We focused on officials in the European Commission (hereafter: 'Commission') and the European External Action Service (EEAS), politicians and staff-members in the European Parliament (EP), and EU member-state officials dealing with Antarctic issues.

We conducted altogether seven semi-formal interviews, returning to some of the same central actors across the two time frames outlined. However, as some interviewees requested anonymity, we decided to use this material only sparingly, combining it with document analysis of relevant material as well as previous scholarship.

The European Union's gateways to Antarctica

Legal connection and institutional set-up

The various EU treaties serve as the legal basis for any EU policy action. The most recent modification to the EU's founding treaties came with the Treaty of Lisbon, which entered into force on 1 December 2009. It amended both the Treaty on European Union (Treaty of Maastricht) and the Treaty Establishing the European Economic Community (Treaty of Rome), the latter now renamed as the Treaty on the Functioning of the European Union (TFEU).

The Lisbon Treaty specifies the EU's legal competences as exclusive, shared and complementary. Being conferred *exclusive* competence in a specific policy area – for example, the conservation of marine biological resources under the Common Fisheries Policy (CFP) – gives the EU sole competence to legislate and adopt legally binding acts (TFEU, Arts 2 and 3). The general rule is, however, that the EU may exercise such competence – internally or externally – only if this is conferred by its member-states. Thus, competence may also be *shared*, enabling both the EU and the member-states to enact legal instruments – for example. regarding environmental policies, energy or transport issues (TFEU, Arts 2 and 4).

In the context of the EU's external relations, the question of external competence and legitimacy is of significant importance, as it concerns the question of who is eventually authorized to act externally – the EU, its member-states or together as a joint effort (Neumann and Rudloff 2010: 9–10)

What does this legal point of departure mean for EU action in and around the Antarctic continent? The EU's exclusive competence – internally and externally – regarding the conservation of marine biological resources under the CFP, but also to common commercial policy, offers an obvious gateway for EU involvement in Antarctic governance (Vanstappen and Wouters 2017: 272). Generally, the international framework for the conservation of Antarctic marine living resources is spread across a range of legal instruments, in particular the United Nations Convention on the Law of the Sea (UNCLOS) and the Convention on Biological Diversity (CBD) – with the EU as a contracting party to both (Liu 2018: 863).

Although the Antarctic Treaty allows any state to accede at any given time, it is essentially restricted to *states* only. Thus, the EU as such cannot become a contracting party to this instrument, but is only 'represented' via its member-states (Vanstappen and Wouters 2017: 271). However, Commission representatives were granted observer status to four Special Antarctic Treaty Consultative Meetings during the negotiations of the Environmental Protocol in the early 1990s (Vanstappen and Wouters 2017: 273). Further, the EU is a contracting party to CCAMLR, together with eight member-states: Belgium, France, Germany, Italy, the Netherlands, Poland, Spain and Sweden; and three member-states have acceded to the Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention): Bulgaria, Finland and Greece.

Southern history and EUropean Antarctic activities

The EU has 'engaged only (very) limitedly in Antarctic governance' (Vanstappen and Wouters 2017: 273), although nineteen of its current twenty-seven member-states are parties to the Antarctic Treaty: eleven as consultative treaty parties and eight as non-consultative treaty parties.[1] Belgium, France and the UK were among the twelve original signatories of the Antarctic Treaty; France retains its sovereignty claim over Terre Adélie, as does the UK (as a former EU member-state) over its British Antarctic Territory (Vanstappen and Wouters 2017: 271).[2]

The region was of interest for the European Community during the 1980s and early 1990s, when the 'Question of Antarctica' was put on the UN General Assembly agenda, but institutional EUropean attention soon dwindled (Vanstappen and Wouters 2017: 274).[3] At the time, debates mainly concerned Antarctic environmental protection issues, particularly within the context of developing the Convention on the Regulation of Antarctic Mineral Resource Activities (CRAMRA) (Idiens 2012: 92–7), a part of the broader Antarctic Treaty System (ATS) that was signed in 1988 but never entered into force (Wehrmann 2019: 60).

Table 13.1 provides an overview – a non-exhaustive list of documents concerning Antarctica in recent decades. In 1979, the Commission issued a Recommendation for a Council Decision authorizing the Commission to negotiate on behalf of the Community for the establishment of a convention on the conservation of Antarctic marine living resources: this resulted in the 1980 CAMLR Convention. The recommendation highlighted not only the interest of some (then) member-states (predominantly Belgium, France and the UK) in the exploitation of living resources but also the Community's own interests in participating in the negotiations for such a convention (Commission of the European Communities 1979).

The EU position on matters dealt with in the CAMLR Convention is set out in multi-annual positions, adopted by the Council for five-year periods, as highlighted in the three most recent documents since 2009. In 1987, the EP adopted two resolutions on the economic and ecological significance of the region, after related motions dating back to 1984 (Vanstappen and Wouters 2017: 280). The 1987 resolutions held that the Community should participate in its own right in decision-making concerning Antarctica (Idiens 2012: 93). Since then, the Commission has issued several proposals for Council Regulations, with conservation and control measures applicable to fishing activities in the Antarctic.

Table 13.1 Talking about the South – European institutions discovering Antarctica

1979	Recommendation for a Council Decision authorizing the Commission to negotiate on behalf of the Community for the establishment of a convention on the conservation of Antarctic marine living resources
1981	Council Decision of 4 September 1981 on the conclusion of the Convention on the conservation of Antarctic marine living resources, 81/691/EEC (*Official Journal of the European Communities*, 5 September 1981 L252/26)
1987	European Parliament Resolution on the protection of the environment and wildlife in Antarctica, Doc. A2-57/87, 19 October 1987 (*Official Journal of the European Communities*, 19 October 1987 C 281/190-5) European Parliament Resolution on the economic significance of Antarctica and the Antarctic Ocean. Doc. A2 101/87, 19 October 1987 (*Official Journal of the European Communities*, 19 October 1987 C 281/190-5) COM(87) 269 final: Proposal for a Council Regulation (EEC) amending Regulation (EEC) No 2245/85 laying down certain technical measures for the conservation of fish stocks in the Antarctic (submitted to the Council by the Commission)
1989	European Parliament Resolution Doc.B2-1347/88 on the dangers of the destruction of the Antarctic ecosystem, 16 February 1989 (*Official Journal of the European Communities,* 20 March 1989 C69/133)
2004	Council Regulation (EC) No 601/2004 of 22 March 2004 laying down certain control measures applicable to fishing activities in the area covered by the Convention on the conservation of Antarctic marine living resources and repealing Regulations (EEC) No 3943/90, (EC) No 66/98 and (EC) No 1721/1999 (*Official Journal of the European Union,* 1 April 2004 L 97/16)
2009	Council Decision on the establishment of the Community position to be adopted in the Commission for the Conservation of Antarctic Marine Living Resources, 13908/1/09 REV 1, 13 October 2009
2014	Council Decision on the position to be adopted, on behalf of the European Union, in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), 10840/14, 11 June 2014
2019	Council Decision (EU) 2019/867 of 14 May 2019 on the position to be taken on behalf of the European Union in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), and repealing the Decision of 24 June 2014 on the position to be adopted, on behalf of the Union, in the CCAMLR (*Official Journal of the European Union*, 28 May 2019 L 140/72)

(Source: authors' compilation.)

Despite limited institutional engagement with the region over the past decades, the EU, its member-states and its citizens are not unfamiliar with the continent and its surrounding waters. As noted by Vanstappen and Wouters (2017), the EU and its member-states/citizens are involved in various key activities in and for the region – not least, in scientific research, fisheries and tourism.

In 2019, the European Polar Board (EPB) listed thirty-two European facilities in the Antarctic: eleven year-round and eleven seasonal stations, five seasonal camps, two seasonal laboratories and three seasonal shelters. Seven of these facilities are operated by two non-EU member-states, Norway and the UK. Out of the sixteen European research vessels that operate regularly in the polar regions, six are non-EU; in addition, the German Alfred Wegener Institute deploys a polar aircraft fleet (European Polar Board 2019: 7).

In recent decades, and under the EU's multi-annual Framework Programmes (FPs) for Research and Technological Development (from FP5 up to the current Horizon2020), the EU and its member-states have been major financial contributors to international research activities and the development of polar research infrastructure, some with distinct Antarctic dimensions.[4] Since 2015, an EU-funded consortium – EU-PolarNet – has worked to improve the coordination among twenty-two European polar research institutions from seventeen countries (including Norway and the UK), among others also the EPB.[5]

In terms of economic activity, marine resource extraction dominates. The revenues of Antarctic fisheries derive mainly from two main targeted species – the Patagonian and Antarctic toothfish, and krill (Molenaar 2001: 465). Fisheries in the Southern Ocean do not differ from areas elsewhere; moreover, the conditions, like extreme sea and weather circumstances, are rather similar to those in the ocean's northern counterpart.

From 2002 to 2012, EU member-states caught approximately 170,000 tonnes of fish, constituting some 9.5 per cent of the total catch quota during this period (Vanstappen and Wouters 2017: 272). From 2008 to 2012, five EU member-states – Germany, France, Poland, Spain and the UK – caught approximately 120,000 tonnes of fish (CCAMLR 2019a). However, catches from France (and the UK) are not included under the EU's *overall* quota, as these catches fall under their claimed sovereignty of their Antarctic territories. [6]Here they retain full competence, also regarding the conservation of marine biological resources (Vanstappen and Wouters 2017: 274). Thus, actual EU catches for 2008–18 were only a fraction of the indicated 120,000 tonnes: 46 tonnes for Germany (2011/12), 18,188 tonnes for Poland (2008–11) and 5,847 tonnes for Spain (2008–18) (CCAMLR 2019a).

For the most recent fisheries season – 1 December 2020–30 November 2021 – only Spain granted fishing licences to one vessel. Over the past decade, there was no change in the involved member-states – France, Spain and the UK as former member-state – or in the number of fishing vessels. For the authorization period 1 December 2021 to 31 November 2022, France and Spain have issued fishing licences to one vessel each.[7]

EUropean citizens have been well represented the numbers of tourists visiting Antarctica. For 2014–15, Vanstappen and Wouters (2017: 272) report a total of 9,886 visitors from EU member-states, of a total of 36,686 tourists. Similar figures can be observed for subsequent years, with some 9,700 tourists coming from three EU countries – Germany, France and the UK – in 2018–19.[8]

In today's globalized world, these linkages between EUrope and Antarctica are hardly surprising, even as regards a region most EUropeans think of mostly in terms of penguins, Japanese whaling efforts and accounts of the race between Amundsen and Scott. We ask: from a political (and economic) perspective, what are the driving forces of the EU as an Antarctic actor? As convincingly argued by Vanstappen and Wouters (2017: 272), legal competences matters, especially with regard to the EU's external actions and the related interplay between the EU and its member-states: and that applies also to questions of Antarctic governance and the EU's potential involvement.

Establishing marine protected areas

Despite the efforts outlined above, in recent decades EU institutions have shown scant interest in Antarctic affairs and related governance structures, as also reflected in the EU's internal organizational structure (Vanstappen and Wouters 2017: 274). Within the Commission, it is essentially only its Directorate-General for Maritime Affairs (DG MARE) that is concerned with Antarctic issues, and that in relation to participation in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) – the main regulatory body of the CAMLR Convention.

In addition to the Commission, which represents the EU, also eight member-states are currently members of CCAMLR, making EUrope's engagement within CCAMLR a case of mixed representation (Vanstappen and Wouters 2017: 274).[9] No 'Antarctic desk' exists within the EEAS, although the first Ambassador-at-Large for the Arctic, Marie-Anne Coninsx, also – to a certain extent – dealt with the Antarctic dimensions. As one of our interviewees highlighted, the Antarctic has spurred EEAS in-house involvement only since 2017, when its Delegation to Australia inquired about the EU's general position on the Antarctic.[10] However, the geographic portfolio of the current Ambassador-at-Large for the Arctic, Michael Mann, does not include the Antarctic.

One area that has received considerable attention in Antarctic governance and resource debates, and where the EU itself has been engaged, has been the establishment of MPAs – marine protected areas. These arose as a concept for the protection of certain sensitive maritime domains, although at its core an 'MPA is nothing more than a particular management strategy applied in a defined area' (Attwood, Harris and Williams 1997: 312). However, since the early 2000s, this particular form of ocean management has become a staple of many countries' attempts at improving zonal regulations and the governance of ocean areas.

In the Antarctic, CCAMLR was established with the objective of conserving marine life, and in response to increasing commercial interest in Antarctic krill resources as well as the history of over-exploitation of several other marine resources in the Southern Ocean (CCAMLR 2019b). Today, CCAMLR has twenty-six members, including the EU, and is headquartered in Tasmania, Australia. Its members 'continuously update conservation measures that determine the use of marine living resources in the Antarctic' (Wehrmann 2019: 60), with related decisions based on consensus (see Ch. 12). However, the limitations of this structural set-up have become clear in connection with efforts to establish MPAs in waters surrounding the Antarctic continent (Chaturvedi 2018: 408). According to CCAMLR: 'MPAs do not necessarily exclude fishing, research or other human activities; in fact, many MPAs are multi-purpose areas. MPAs in which no fishing is allowed are often referred to as "no-take areas"; and other uses may still be permitted' (CCAMLR 2018b).

Starting in 2009, the UK proposed a South Orkney Islands Southern Shelf MPA to CCAMLR (SC-CAMLR 2009: 7). Although portions of it to the north had to be removed, the proposal encountered little opposition amongst the members. Establishing this

MPA was seen as the first step in a larger connected effort to establish a series of MPAs across Antarctic waters, following the more general UN recommendations on MPAs.

In 2011, New Zealand and the USA proposed another MPA, in the Ross Sea (Brooks 2013; Rothwell 2018). Proposals for the East Antarctic and the Weddell Sea were also deliberated. Concerning East Antarctica, Australia, France and the EU took the initiative (European Commission 2013). The EU and the UK worked on a proposal regarding the Weddell Sea (Brooks 2013: 285), which would cover 1.8 million km^2 in a remote, ice-covered part east of the Antarctic Peninsula (Liu 2018: 868). However, these proposals encountered fierce resistance, especially from China and Russia (Lukin 2014: 220), concerning possible limitations on local fisheries – prompting the question of 'whether national economic incentives in the Southern Ocean are now overwhelming science and conservation values' (Brooks 2013: 278).

In 2016, after five consecutive years of China and Russia blocking the proposal (Bray 2016: 263), the members of CCAMLR finally agreed on the Ross Sea MPA, which entered into effect in December 2017. At 1.55 million km^2, it has been hailed as the world's largest MPA, although, as put by Rothwell, 'the length of time taken to reach consensus on the proposal highlighted differences of views amongst member states and it remains to be seen whether CCAMLR members will be supportive of similar initiatives in other parts of the Southern Ocean' (2018: 279). The East Antarctica and the Weddell Sea proposals have still not been affirmed, despite continued efforts by the proposers to reach a joint agreement (Brooks 2017). In addition, other parts of Antarctic waters, like the Antarctic Peninsula region, are under consideration for the establishment of MPAs.

It seems clear – as also affirmed by our interviews – that the issue of establishing MPAs is not only an important dimension regarding the EU's Antarctic involvement (Liu 2018: 867–8) but also one that prompts *further* EU engagement with the southern region.[11] However, this seems to relate to the engagement of one specific unit within DG Mare only, which links the establishment of Antarctic MPAs with the EU's global targets of having 10 per cent of marine areas protected by the year 2020 (CBD 2012; European Commission 2018). Antarctica was seen as one area that could help the EU to achieve its 10 per cent target by implementing large MPAs in waters with little or no economic activity, and thus few objecting interests.[12]

In consequence, in these processes the Commission has been a fairly active proponent of establishing MPAs. As put by Liu: 'The EU and its member-states have been driving initiatives on the establishment of MPAs in the Southern Ocean over the past decade' (2018: 867). This has also become apparent in the reports from the annual CCAMLR meetings, where the EU has used strong language in support of its MPA efforts. Regarding the East Antarctic MPA (EAMPA), the EU stated in 2018:

> The EU and its member States note with regret that this is the seventh consecutive year that the EAMPA proposal has been discussed without result. The proposal was first tabled in 2012 and has been changed several times since then to accommodate concerns raised by other Members […] Considering that the Scientific Committee considered already in 2013 that the proposal is based on best available science, the

> EU and its member States cannot accept that new demands for more scientific work are being made by some delegations year after year.
>
> (CCAMLR 2018a: 26)

Further, regarding the Weddell Sea MPA (WSMPA):

> The EU and its member States indicated their willingness to work closely and constructively with Norway and other CCAMLR members to explore options that could facilitate the rapid adoption of the WSMPA proposal at the next annual meeting.
>
> (CCAMLR 2018a: 28)

And:

> The EU and its member States wish to express profound disappointment at the failure to make significant progress this year on the proposal regarding a MPA in the Weddell Sea.
>
> (CCAMLR 2018a: 29)

The role of the Commission, and DG Mare in particular, was further underscored in arguments on legal competence between the Commission and the Council/member-states concerning which institution has legislative authority (competence) regarding MPAs. The Commission held that it had exclusive competence, as MPAs are measures for the conservation of marine biological resources under the CFP. [13]However, the Council insisted that measures to protect the marine environment were a matter of environmental policies, and thus, as a shared competence, any future proposals for all three Antarctic MPAs (East Antarctic, Ross Sea and Weddell Sea) should be submitted on behalf of both the EU and its member-states (Liu 2018). The Commission then challenged this view and brought two cases (C-625/15 and C-659/16) against the Council before the Court of Justice of the European Union (CJEU) in order to annul two decisions adopted by the Council in 2015 and 2016, respectively.[14]

On 20 November 2018, the CJEU ruled in favour of the Council/member-states, holding that, as protection of the environment is the main purpose of an MPA, the contested decisions fell, not within the exclusive competence of the EU, but within the competence regarding protection of the environment that the EU shares with the member-states ('shared competences') (Court of Justice of the European Union 2018). That decision has given member-states further leverage in what has become an internal political and legal tug-of-war of shared competences and mixed action.

However, concerning Antarctica, all the (then) EU member-states with an active interest – Germany, France and the UK – were supportive of pressing for MPAs in Antarctica. As one Norwegian representative remarked: 'Weddell Sea has become the baby of Germany'[15] – that is, German interest in developing a Weddell Sea MPA has been instrumental in driving the EU's interest in, and engagement with, the matter. Thus, as pointed out in a 2018 EP Q&A-session on MPAs directed at the Commission, the 'establishment of a representative system of marine protected areas (MPAs) is a priority for the EU' (Parliamentary Questions 2018). Asked why Antarctica was singled out regarding MPAs, one interviewee admitted frankly: 'in Antarctica, there is less public opposition'.[16]

The future of EU Antarctic policy: fisheries meet environmental interests

As yet, Antarctica has not ranked high on EU policymaker agendas; with a few exceptions, it has been broader environmental considerations, research efforts and economic activities that have occasionally led EUropeans to look southwards. Accordingly, Vanstappen and Wouters concluded that the EU/Commission is currently lacking any ambition and interest to engage further in the region, especially with regard to the Antarctic Treaty (2017: 277). This is not only because of the continent's low visibility in global politics and the lack of a 'proper' international crisis in and around the region: it also has an inherent EU-internal aspect: the tendency of some member-states to guard what they consider their sovereign domain (Vanstappen 2019).

This becomes evident when we view the EU's Antarctic case from the triple perspective of ocean resources (fisheries), environmental governance (MPAs) and foreign policy. Today, the EU is a global player in the development of international fisheries law and multilateral fisheries governance, and a key actor in international fisheries management. The EU's external fleet represents about a quarter of total EU fleet capacity and provides over a quarter of the EU's total catches. A member of fourteen out of eighteen RFMOs globally, the EU has also concluded various bilateral agreements with third countries, of reciprocal or compensatory nature (Belschner 2015: 985; Peñas Lado 2016: 220).

The distinction between foreign and fisheries policies is further blurred because the use of foreign-policy tools is essential for developing successful policies for trade and the environment (Østhagen 2011). This helps to explain the apparent paradoxes in EU foreign policymaking. In the Arctic, the influence of limited fishing interests and their ability to 'hijack' larger issues of foreign policy is beyond doubt (see Chs. 4 and 10), and the EU's global fisheries activities have at times contradicted the 'declared support for the norms of sustainable development' (Bretherton and Vogler 2008: 408).

One issue that comes to fore in the foreign policy–fisheries policy nexus is that of *sustainable development*, where the EU has shown considerable ambitions in recent decades to assert influence (Bretherton and Vogler 2008: 404). Especially the external dimensions of the CFP have been criticized for deviating from the basic principles of sustainability and precaution (Belschner 2015: 986). A core component of EU climate and growth initiatives (Kovačič 2017; Langan and Price 2017), its external fisheries policies have directly contradicted this goal at times (Daw and Gray 2005; Khalilian et al. 2010; Belschner 2015). Bretherton and Vogler concluded that the external dimension of fisheries is inherently determined by the fundamental contradiction 'between the needs and demands of the EU-based fishing industry and its customers, and the sustainable development objectives of the Union' (2008: 414). However, in the case of Antarctica, the situation is reversed: environmental concerns override those of fisheries. Naturally, the weighting of these issues depends on the size of EU Antarctica fisheries, which have been rather limited. Furthermore, and as highlighted by our interviewees, in a narrow and specific issue such as this, the influence of NGOs – here, the Antarctic Ocean Alliance, which is also a CCAMLR observer – had considerable influence when the EU was formulating its position, through campaigns such as a petition calling on CCAMLR to establish a large-scale network of marine protected areas; this petition gathered more than 200,000 signatures.[17]

Further, there is a contrast between the EU's/Commission's engagement in the ATS in general, which is characterized as limited, and its activity in CCAMLR (Vanstappen and Wouters 2017: 275). This is as much a result of the internal balancing in Brussels as of the lack of specific goals among EU actors: 'it is clear that the EU's member-states prefer the Union not to encroach on what they consider their sovereign domain. It is therefore unlikely that the EU's relationship to the ATCM [Antarctic Treaty Consultative Meeting] will change anytime soon' (Vanstappen 2019)

In this chapter we have shown that, as regards Antarctica, the EU's approach is not driven by a single, coherent approach or framework, but is dominated by limited issue-engagement in a domain where benefits – at least symbolic ones – can be reaped. With limited fisheries activity and scant interest beyond national research initiatives, action on MPAs has become an area where the EU can maintain its image as a forerunner in environmental policies – even though the Antarctic waters are probably the farthest from EUropean waters it is possible to go. We have offered a starting point for delving further into the extent and how the EU may provide for institutional resilience in the case of the CAMLR Convention. In question here is not how to enforce current regulations as such, but how to set up *new* mechanisms to prevent undesirable activities. Therefore, what is most at stake in terms of resilience is what Young and Stokke (Ch. 3) and Stokke (Ch. 14) refer to as 'cognitional challenges' – the credibility and legitimacy behind these new measures, and how the EU is pushing to expand the current CAMLR regime to adapt to the new challenges that come with greater interest in fisheries in waters around Antarctica.

The EU – as a special polity – acts in a cognitional management capacity, but more knowledge is needed on *how* exactly EU policymakers perceive and understand sectoral policies such as fisheries or environmental protection as distinct foreign-policy tools – also for regimes and spaces as distant as CAMLR and the Antarctic. Thus, understanding the EU and the links between foreign policy and fisheries policy is a crucial component in unpacking both institutional adaptation and actors' preference shifts as climate change impacts existing cooperation on managing fish stocks. Placing these findings, however, in the wider context of EU 'actorness' and policymaking, we see that the EU has multiple interests and voices when formulating geographically-focused policies – even *within* policy domains such as fisheries, where the member-states have ceded competence and authority to the supranational level. On the one hand, member-states and their fishers are keen to exploit economic opportunities, no matter how relatively minor in comparison with fisheries elsewhere or with other economic activities. On the other hand, the Commission/EEAS actively promote the principles of sustainable management and precaution regarding marine living resources. Thus, the two positions held by 'the EU' here – one specific and one general – contradict each other *and* reveal the EU's multi-headed nature on such issues (as further discussed in Ch. 4).

Further, EU politics are more concerned with practices in specific locations (physical as well as competence-related) than involving a set of universal principles and traditional anchored power politics (Kuus 2014: 38–9). The EU's Antarctic approach has in many ways been that of a 'geopolitical' actor in terms of environmental policies – pursuing certain policy-interests in a geographically defined space of growing relevance (Raspotnik 2018). However, the EU's *sui generis* policymaking system has also produced an intra-institutional Antarctic 'policy' better suited for internal than external purposes: it showcases how the Commission, in particular, has set about fulfilling its goal of protecting maritime domains.

Despite the EU's insistence and relatively concurrent push for the MPA issue around Antarctica, other actors – notably China, Russia and to some extent Norway – have been sceptical to the creation of new protected areas. Not only do differences in regulatory and management approaches enter the picture (as in the case of Norway): also economic interests and geopolitical rivalries have become more pronounced on this issue in recent years.[18]

Here the EU also finds itself embroiled in a (geo)political rivalry focused on Antarctica, where the clash of interests – economic vs. environmental – seems set to increase. Already in 2017 and 2018, French President Emmanuel Macron discussed the Antarctic with Russian President Vladimir Putin; and, in a speech in Malta in 2017, former High Representative Federica Mogherini highlighted EU and Australian efforts concerning MPAs as a sign of the EU's increasing global role (European External Action Service 2017). One might have assumed that, with van der Leyen's 'Geopolitical Commission', broad EU Antarctic engagement in general and specific engagement in environmental affairs should also rise higher on the recent Brussels agenda. However, the world is still waiting for that to happen.

Notes

1 The eleven states are Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Italy, the Netherlands, Poland, Spain and Sweden. The eight non-consultative parties are Austria, Denmark, Estonia, Greece, Hungary, Portugal, Romania and Slovakia.

2 The French Antarctic territories, *les terres australes et antarctiques françaises*, are a *territoire d'outre-mer* – an autonomous entity: in EU terms, an overseas territory. Thus, Terre Adélie is not governed by the acquis communautaire; and that allows France to, inter alia, circumvent the EU's exclusive competence with regard to marine biological resources conservation.

3 Based on Moisio et al., we use the spelling 'EUrope' or 'EUropean' to highlight the idea that Europe cannot be reduced to the EU only (2013: 754). Thus, whenever we use the adjective 'EUropean' we either refer to something of, from, or related to the European Union (= EU) and not necessarily to all of Europe.

4 The Commission's Community Research and Development Information Service (CORDIS), https://cordis.europa.eu
5 EU-PolarNet, https://www.eu-polarnet.eu.
6 Email exchange with Commission Official, DG Maritime Affairs and Fisheries, European Commission, 21 January 2020
7 CCAMLR, 'Authorised vessels', https://www.ccamlr.org/en/compliance/authorised-vessels.
8 IAATO, Data & Statistics, https://iaato.org/tourism-statistics.
9 The eight member-states are Belgium, France, Germany, Italy, the Netherlands, Poland, Spain and Sweden.
10 Also Chile has indicated its interest in including Antarctica in discussions on the modernization of the 2002 EU–Chile Association Agreement: Interview 1 with EEAS Official, Brussels, 26 November 2018.
11 Interview with Commission Official, DG Maritime Affairs and Fisheries, European Commission, Brussels, 27 November 2018.
12 Interview with Commission Official, DG Maritime Affairs and Fisheries, European Commission, Brussels, 27 November 2018.
13 Interview with Commission Official, DG Maritime Affairs and Fisheries, European Commission, Brussels, 27 November 2018.
14 Action brought on 23 November 2015: European Commission v Council of the European Union (Case C-626/15), *Official Journal of the European Union,* 15 February 2016, C 59/5 and Action brought on 20 December 2016: European Commission v Council of the European Union (Case C-659/16), *Official Journal of the European Union*, 6 February 2017, C 38/20.
15 Interview with Policy Officer, Mission of Norway to the EU, Brussels, 27 November 2018.
16 Interview with Commission Official, DG Maritime Affairs and Fisheries, European Commission, Brussels, 27 November 2018.
17 Interview with Ambassador-at-Large for the Arctic, EEAS, Brussels, 26 November 2018; interview with Policy Officer, Mission of Norway to the EU, Brussels, 27 November 2018; see also *The Last Ocean* website, http://www.thelastoceanfilm.com/sign-the-aoa-petition/.
18 Interview 1 with EEAS Official, European External Action Service, Brussels, 26 November 2018.

References

Attwood, C. G., J. M. Harris and A. J. Williams (1997), 'International Experience of Marine Protected Areas and Their Relevance to South Africa', *South African Journal of Marine Science*, 18 (1): 311–32.

Belschner, T. (2015), 'Not so Green after All? The EU's Role in International Fisheries Management: The Cases of NAFO and ICCAT', *Journal of European Public Policy*, 22 (7): 985–1003.

Bray, D. (2016), 'The Geopolitics of Antarctic Governance: Sovereignty and Strategic Denial in Australia's Antarctic Policy', *Australian Journal of International Affairs*, 70 (3): 256–74.

Bretherton, C. and J. Vogler (2008), 'The European Union as a Sustainable Development Actor: The Case of External Fisheries Policy', *Journal of European Integration*, 30 (3): 401–17.

Brooks, C. M. (2013), 'Competing Values on the Antarctic High Seas: CCAMLR and the Challenge of Marine-Protected Areas', *The Polar Journal*, 3 (2): 277–300.

Brooks, C. M. (2017), 'Why Are Talks over an East Antarctic Marine Park Still Deadlocked?' *The Conversation*, 3 November. https://theconversation.com/why-are-talks-over-an-east-antarctic-marine-park-still-deadlocked-86681.

CBD (2012), 'TARGET 11 – Technical Rationale Extended (Provided in Document COP/10/INF/12/Rev.1)'. https://www.cbd.int/sp/targets/rationale/target-11/.

SC-CAMLR (2009), 'Report of the Twentieth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/system/files/e-sc-xxviii.pdf.

CCAMLR (2018a), 'Report of the Thirty-Seventh Meeting of the Commission'. https://www.ccamlr.org/en/ccamlr-xxxvii.

CCAMLR (2018b), 'Marine Protected Areas (MPAs)', 13 August. https://www.ccamlr.org/en/science/marine-protected-areas-mpas.

CCAMLR (2019a), *CCAMLR Statistical Bulletin*, 31, Table 6: Catch (Tonnes) by Country, Species and Area. https://www.ccamlr.org/en/document/data/ccamlr-statistical-bulletin-vol-31-selected-tables.

CCAMLR (2019b), About CCAMLR, 15 October. https://www.ccamlr.org/en/organisation.

Chaturvedi, S. (2018), 'The Future of Antarctica: Minerals, Bioprospecting and Fisheries', in M. Nuttall, T. R. Christensen and M. J. Siegert (eds), *Routledge Handbook of the Polar Regions*, 403–15, Abingdon: Routledge.

Commission of the European Communities (1979), 'Recommendation for a Council Decision Authorizing the Commission to Negotiate on Behalf of the Community for the Establishment of a Convention on the Conservation of Antarctic Marine Living Resources (COM(79) 20 Final, Brussels, 27 February 1979)'.

Court of Justice of the European Union (2018), Judgement of the Court (Grand Chamber) 20 November 2018 (ECLI:EU:C:2018:925 1).

Daw, T. and T. Gray (2005), 'Fisheries Science and Sustainability in International Policy: A Study of Failure in the European Union's Common Fisheries Policy', *Marine Policy*, 29 (3): 189–97.

European Commission (2013), 'Announcement by Commissioner Maria Damanaki on Joint Statement on Marine Protected Areas in Antarctica (MEMO/13/901), Brussels, 16 October 2013'. https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_901.

European Commission (2018), 'European Union Meets Target of Conserving 10 per cent of Europe's Seas by 2020 (Press Release), Brussels, 29 October 2018'. https://ec.europa.eu/info/news/european-union-meets-target-conserving-10-europes-seas-2020-2018-oct-29_en.

European External Action Service (2017), 'Speech by High Representative/Vice-President Federica Mogherini at the Opening Session of the Our Ocean Conference 2017 (St. Julian's, Malta, 05/ 10/2017)'. https://eeas.europa.eu/headquarters/headquarters-homepage/33322/speech-high-representativevice-president-federica-mogherini-opening-session-our-ocean_en.

European Polar Board (2019), 'European Polar Infrastructure Catalogue'. https://europeanpolarboard.org/infrastructure/european-polar-infrastructure-catalogue/.

Idiens, M. C. (2012), 'Gateway Antarctica: A Route for the EU's Global Political Agenda', University of Canterbury. https://ir.canterbury.ac.nz/handle/10092/8361.
Khalilian, S., R. Froese, A. Proelss and T. Requate (2010), 'Designed for Failure: A Critique of the Common Fisheries Policy of the European Union', *Marine Policy*, 34 (6): 1178–82.
Kovačič, A. (2017), 'European Union and Sustainable Development Indicators', *Management of Sustainable Development*, 9 (2): 19–29.
Kuus, M. (2014), *Geopolitics and Expertise: Knowledge and Authority in European Diplomacy*, Chichester: Wiley-Blackwell.
Langan, M. and S. Price (2017), 'The EU and "pro-Poor" Contributions to Sustainable Development in the Post-2015 Consensus', *Third World Thematics: A TWQ Journal*, 1 (4): 431–36.
Liu, N. (2018), 'The European Union and the Establishment of Marine Protected Areas in Antarctica', *International Environmental Agreements: Politics, Law and Economics*, 18 (6): 861–74.
Lukin, V. V. (2014), 'Russia's Current Antarctic Policy', *The Polar Journal*, 4 (1): 199–222.
Moisio, S., V. Bachmann, L. Bialasiewicz, E. Dell'Agnese, J. Dittmer and V. Mamadouh (2013), 'Mapping the Political Geographies of Europeanization: National Discourses, External Perceptions and the Question of Popular Culture', *Progress in Human Geography*, 37 (6): 737–61.
Molenaar, E. J. (2001), 'CCAMLR and Southern Ocean Fisheries', *International Journal of Marine and Coastal Law*, 16 (3): 465–99.
Neumann, A. and B. Rudloff (2010), 'Impact of EU Policies on the High North: The Cases of Climate Policy and Fisheries', EXPO/B/AFET/FWC/2009-01/Lot 2/01. Brussels: Directorate General for External Policies, European Parliament. https://www.europarl.europa.eu/thinktank/en/document/EXPO-AFETDV(2010)433790.
Parliamentary Questions (2018), 7 August, Answer given by Mr Vella on Behalf of the European Commission, P-003683/2018.
Peñas Lado, E. (2016), *The Common Fisheries Policy: The Quest for Sustainability*, Chichester: Wiley-Blackwell.
Raspotnik, A. (2018), *The European Union and the Geopolitics of the Arctic*, Cheltenham: Edward Elgar.
Rothwell, D. R. (2018), 'The Polar Regions and the Law of the Sea', in M. Nuttall, T. R. Christensen and M. J. Siegert (eds), *Routledge Handbook of the Polar Regions*, 275–83, Abingdon: Routledge.
Vanstappen, N. (2019), 'The Engagement of the European Union in the Governance of Antarctica', Italian Institute for International Political Studies (ISPI), 19 June. https://www.ispionline.it/en/pubblicazione/engagement-european-union-governance-antarctica-23530.
Vanstappen, N. and J. Wouters (2017), 'The EU and the Antarctic: Strange Bedfellows?', in K. Dodds, A. D. Hemmings and P. Roberts (eds), *Handbook on the Politics of Antarctica*, 269–83, Cheltenham: Edward Elgar.
Wehrmann, D. (2019), *Critical Geopolitics of the Polar Regions: An Inter-American Perspective*, Abingdon: Routledge.
Østhagen, A. (2011), 'Utenrikspolitisk entreprenørskap: EU og utviklingen av en Arktis-politikk', *Internasjonal Politikk*, 69 (1): 7–35.
Østhagen, A. and A. Raspotnik (2019), 'Why Is the European Union Challenging Norway over Snow Crab? Svalbard, Special Interests, and Arctic Governance', *Ocean Development & International Law*, 50 (2–3): 190–208.

Part Five

Comparisons and Conclusions

14

Conclusions: Assessing, Comparing and Explaining Institutional Resilience to Climate Change

Olav Schram Stokke

The first chapter of this book posed three questions, which have structured the ensuing chapters.

1. *How do global warming and other environmental changes generate shifts in the abundance, distribution and migratory patterns of commercially and ecologically important marine stocks?* Drawing on Chapters 6 and 11, the first section below summarizes findings regarding selected demersal, benthic and pelagic stocks in polar seas, including Northeast Arctic cod, Barents Sea snow crab, Northeast Atlantic mackerel and Antarctic krill.
2. *To what extent and how do stock-shifts pose challenges to the national, international and transnational management regimes established for the management of commercially and ecologically important fisheries?* Drawing largely on the case studies of international management presented in Chapters 7 through 13, the next section specifies the relationships between stock-shifts and challenges to each of the three management tasks presented in Chapter 1 – the cognitional, the regulatory and the compliance tasks.
3. *To what extent and how have the actors operating these regimes adapted them to the changing circumstances and succeeded in maintaining or improving levels of regime performance – i.e. achieved institutional resilience?* Drawing on all the chapters in this book, the subsequent section in this concluding chapter offers a comparative assessment of the management cases studied here as to their cognitional, regulatory and compliance resilience, and then examines how differences among them can be accounted for by the three risk factors identified in Chapter 3: problem characteristics, broader setting and institutional design. The final section reflects on the merits of disaggregating the analysis of institutional resilience, and on the broader relevance of our findings for other efforts to adapt fisheries management regimes to the impacts of climate change.

Climate change and shifting stocks in polar seas

Although it is not the only driver of change in stock distribution and migration, climate change is clearly affecting the abundance and distribution of commercially and ecologically important stocks in both regions examined in this book: the east Atlantic segment of the Northern Seas – comprising the Nordic (Norwegian, Greenland and Icelandic) Seas and the Barents Sea – and the Southern Ocean.

Northern Seas

More than a century ago, as Stiansen and his colleagues note in Chapter 6, the three Norwegian ocean-science pioneers Bjørn Helland-Hansen, Fridtjof Nansen and Johan Hjort recognized the close relationship between variations in ocean temperature and patterns of recruitment, distribution and abundance of important commercial species in the Northern Seas. Geobiological mechanisms further specified in more recent research include higher primary production due to larger ice-free areas, greater influx of organisms carried by rising inflows of Atlantic water and generally higher biological activity at high temperatures. As Stiansen and colleagues also note, the impacts of temperature on the spatial distribution of fish stocks depend crucially on three other factors as well: bottom topography, stock abundance and food availability, with the relative significance of those factors differing across species.

Topographic conditions are especially important for demersal species like cod and haddock; they serve to constrain the effects of ocean warming on the northward expansion of Northeast Arctic cod (*Gadus morhua*), the world's largest cod stock. Instead of expanding from the relatively shallow Barents Sea into the deep high-seas portion of the Central Arctic Ocean, this stock is more likely to respond to future warming by moving eastwards into the shelf areas of the Kara Sea and around Novaya Zemlya. In these waters, however, persistent winter sea-ice is expected to deter the development of new spawning areas.

Topographic conditions are equally important for benthic stocks. A pertinent example here is the spatially expanding snow crab (*Chionoecetes opilio*) stock now found in most of the Barents Sea northward of a line between Franz Josef Land and central regions of Svalbard: continued ocean warming will enable its further northward expansion on the Barents Sea shelf.

For pelagic species, in contrast, stock abundance and food availability are the key factors determining how ocean warming affects spatial distribution. Scientists agree that the growth of the Northeast Atlantic mackerel (*Scomber scombrus*) stock during the past fifteen years has given rise to a much wider distribution than previously. As Stiansen and associates report, considerably greater uncertainty exists as to whether the future migration route taken by mackerel after spawning will direct any further expansion northwards into the Norwegian Sea or westward toward Icelandic and Greenlandic waters. That uncertainty is deepened by the competition for prey between mackerel and herring.

This scientific uncertainty as to the durability of the currently high occurrence of mackerel in western parts of the Northern Seas has important political implications: it figures centrally in the account given by Østhagen and colleagues in Chapter 7 as to why the user-states have found it so difficult to agree on a new division of quotas for this stock. Thus, performance on the *cognitional* management task of building shared knowledge on the relative importance of factors that influence stock distribution spills over into the *regulatory* management task, as elaborated below.

Southern Ocean

Scientific uncertainty also attends the question of whether and how the spatial distribution of Antarctic krill (*Euphausia superba*) is affected by the ongoing warming of the Southern Ocean. As noted by McBride in Chapter 11, some scholars report evidence of a substantial poleward contraction of this huge crustacean stock, which would concur with broader-based predictions issued by the Intergovernmental Panel on Climate Change (IPCC) and with regional modelling studies of suitable krill habitat under various warming scenarios. However, these reports are contested within the scientific community; and the working group responsible for evaluating such evidence for the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has concluded that lack of long-term information on large-scale krill biomass prevents clear answers thus far.

Compared to the situation in the Northern Seas, the scientific basis for assessing variability and long-term trends for Antarctic krill is relatively weak. Survey activities have been rare or spatially limited, as Stokke notes in Chapter 12; and catch reports provide supplementary information only for the relatively small area where krill fisheries are concentrated, in waters surrounding the Antarctic Peninsula in the Southwest Atlantic. Nevertheless, as McBride points out (Ch. 11), according to what is now known about krill biology and the physical environment of the Southern Ocean, the impacts of a poleward shift of the stock are likely to be negative on several accounts – including significant reduction of habitats suitable for spawning, hatching, larvae survival and juvenile growth.

Similar to the general case in the Northern Seas, other ongoing environmental changes such as ocean acidification, ultraviolet radiation, greater competition from other zooplankton and the recovery of the great whales in the Southern Ocean interact with ocean warming to render the future abundance and spatial distribution of krill more variable and more uncertain.

Challenges to regional management regimes

The generic challenge to fisheries management deriving from these impacts of climate change is hardly new. Variations in ocean conditions and shifts in abundance and spatial distribution of commercial fish stocks, often affecting various harvester groups differently, have long been part and parcel of fisheries management. However, as the chapters in this book bring out, climate change acts to amplify the challenges to the three tasks – cognitional, regulatory and compliance – of resource management.

These three management tasks are explained in Chapter 1 (see also Stokke 2015). The *cognitional* task involves developing and communicating scientific advice on how various levels of harvesting pressure will affect the status of the stocks and their long-term ability to support employment, yield incomes and provide food. The *regulatory* task entails moving from such a shared understanding of means–end relationships into joint commitments among user-states to a set of common or compatible rules. Finally, the behavioural or *compliance* task is to ensure that those rules shape the performance of target groups – the fishing vessels that feed the global seafood value chain. How, then, have shifts in the abundance and spatial distribution of fish stocks examined here affected the performance of each of those management tasks?

Cognitional task challenged

Extensive research on the cognitional management task has identified three factors as particularly important to the persuasiveness of scientific advice: credibility, legitimacy and salience (Cash et al. 2003; Mitchell et al. 2006). Rapid stock-shifts may undermine the credibility and legitimacy of researcher inputs by rendering scientific assessments more uncertain or contested.

Disagreement among scientists on how to interpret observational data is not by itself detrimental to fisheries management: on the contrary, it may indicate vibrant scientific exchange at the frontier of policy-relevant knowledge building. Consider for instance the ongoing methods-oriented debate noted by McBride (Ch. 11) on whether a long-term poleward contraction and decline of the Antarctic krill stock is already underway. Such scientific dissensus can hardly be said to impinge on the cognitional task when, as in this case, the scientific advisory body itself examines and brings out the arguments of both sides and encourages more extensive monitoring and further investigation (SC-CAMLR 2019: 198).

In contrast, Østhagen and colleagues describe in Chapter 7 how scientific disagreement can become intertwined with political controversy among states in ways that undermine the perception among participants and outsiders that inputs are wholly independent of narrow political interests. For instance, a dispute over survey methodologies favoured differently by scientists from the various parties to the polarized mackerel dispute nurtured suspicions that inputs to the scientific advisory process were distorted by political considerations (see also Gänsbauer et al. 2016). Similarly, Young and Stokke note in Chapter 3 that fear of such politicization of science was among the reasons why Norway and the EU terminated the practice of allocating quotas of their shared stock of North Sea herring on the basis of regularly updated model-based estimates of zonal attachment.

In the case of mackerel, the threat to scientific credibility, and thus to the persuasiveness of scientific advice, was compounded by evidence that scientists had systematically underestimated the stock for several years, partly due to its changing distribution (Spijkers and Boonstra 2017: 1842). Earlier studies indicate that low accuracy in the predictions inherent in scientific advice regarding how the stock will respond to harvesting pressure has the effect of reducing the propensity of decision-makers to keep quotas within recommended levels (Stokke 2012).

If stock-shifts can render scientific inputs less credible even in the Northern Seas – where advisory processes centre on the International Council for the Exploration of the Sea (ICES) with its solid reputation for impartiality (Gullestad 1998) and especially advanced peer-review procedures aimed at insulating the advisory process from political pressure (Lassen, Kelly and Sissenwine 2014) – then the challenge may be assumed to be at least equally severe in other regions.

In the mackerel case, as commented by Østhagen and colleagues in Chapter 7, an additional controversy has revolved around how to define zonal attachment. Should one consider only the amount of time that proportions of the stock occur in each zone, or should the calculation also take additional factors into account? In the negotiations as well as in the scientific debate, Icelandic and Faroese participants have held that the weight-gain the mackerel stock achieves while within their exclusive economic zones (EEZs) should figure in the calculations, because that gain occurs at the expense of other ecosystem components within these zones (see also Totland 2020: 159).

Also the salience of scientific advice – its relevance to the specific regulatory issues debated by decision-makers – may suffer if a change in spatial distribution shifts the political attention from issues of conservation to allocation, because scientific advisory bodies typically have much less to say about the latter. In Chapter 8, Jørgensen notes how a working group established under the Joint Norwegian–Russian Fisheries Commission (JNRFC) was unable to agree on the implications of new information they had collected regarding the zonal attachment of Greenland halibut (*Reinhardtius hippoglossoides*). That was partly due to disagreement within the working group on the criteria for determining zonal attachment – but also because the group lacked a firm basis for stating an opinion on how zonal attachment should be weighed against other allocation criteria, notably historical fishing and contributions to research and conservation.

Those criteria and others, including the dependency of coastal fishing communities on the stock in question, are explicitly listed but neither specified nor ranked in the UN Fish Stocks Agreement – today's most authoritative statement of international fisheries law (see also Ch. 2 by Molenaar). As in the JNRFC Greenland halibut case, as Jørgensen notes, a similarly tasked working group on allocation criteria under the North-East Atlantic Fisheries Commission (NEAFC) soon declared itself unable to provide consensual advice on how to specify and weigh the various allocation criteria applied in international law.

In these and other cases, the salience or policy relevance of scientific advice suffers whenever changes in the spatial distribution of stocks serve to shift the focus of management debates from conservation – the level of harvesting pressure – to allocation. Under such circumstances, the indeterminacy of international fisheries law with respect to precise contents, operationalization and relative weight of allocation criteria equips scientists poorly for providing advice on the most pressing issues. As with credibility and legitimacy, low scores on salience mean that decision-makers must proceed with their regulatory task without being able to draw on the advantages of a cognitional task successfully performed, as would be evident in well-substantiated, consensual advice from the regime's scientific body.

Regulatory task challenged

The distinction between allocation and conservation is equally useful when we turn to the challenges deriving from climate change to the regulatory management task of achieving agreement among all or most user-states on rules that constrain the harvesting pressure to levels that are sustainable and do not jeopardize future use.

Instances of allocative challenges amplified by changes in spatial distribution abound in the contributions to his book: in all the management processes examined, stock-shifts have generated international allocation disputes or intensified existing ones. The EU has requested a share of the total allowable catch of snow crab in the Barents Sea, due to the rising occurrence of this species in waters beyond the territorial sea of Norway's Svalbard archipelago – where, according to an EU interpretation rejected by Norway, nationals of other signatories to the Svalbard Treaty are entitled to equal access to natural resources (Ch. 10). Similarly, Russia has requested larger shares of Barents Sea quotas for Greenland halibut, Northeast Arctic saithe (*Pollachius virens*) and redfish (*Sebastes mentella*), on grounds of rising abundance outside Norway's EEZ (Ch. 8). On several occasions, including the period from 2017 to 2020, Norway has set for itself quotas of Norwegian spring-spawning herring (*Clupea harengus*) in the Nordic Seas well above its share in earlier allocation agreements, citing poor alignment with the stock's zonal attachment. Further, Iceland and the Faroe Islands have cited the increased occurrence of mackerel in their own EEZs when demanding recognition as coastal states with respect to management of this stock and corresponding entitlements to shares of the total allowable catch (Chs. 5, 7 and 8). In fisheries diplomacy, the term 'coastal state' denotes also non-state entities with exclusive competence in fisheries – here, the EU and the autonomous territories of the Faroe Islands and Greenland.

For reasons related to contested sovereignty claims to Antarctica, the regime for managing krill fisheries in the Southern Ocean does not employ national quotas, Therefore, climate-related controversies concern not quota allocation but the relationships between fisheries and area-based management (Chs. 12 and 13).

Taken together, then, the chapters in this book leave little doubt that the allocative part of regulation has been rendered more difficult by the impacts of climate change.

In several of the cases examined here, disputes over allocation have involved new entrants to a fishery – typically involving the additional complication that existing members of a regime tend to be averse to recognizing the newcomers as legitimate participants in the management process and unwilling to share part of the total allowable catch. The disputes over mackerel in the Nordic Seas (Ch. 7) and cod in the Barents Sea Loophole (Ch. 9) are obvious cases in point; however, newcomer issues are evident also in the EU–Norway dispute over snow crab in the Barents Sea (Ch. 10). As Molenaar explains in Chapter 2, the rules and practices on participation of many regional fisheries management organizations and arrangements (RFMO/As) raise barriers for new entrants seeking membership, frequently to the extent of granting any existing member the right to veto; this holds true also for the 2018 Central Arctic Oceans Fisheries Agreement. Even when newcomers obtain membership or agree to adhere to an RFMO/A's core rules as a 'cooperating non-contracting party', they have no guarantee of being granted a quota if the stock is fully exploited – which is often the case.

Similar reluctance to acknowledge new entrants is evident in less institutionalized arrangements such as the loosely coupled clusters of annual agreements negotiated bilaterally and multilaterally concerning pelagic species in the Nordic Seas. As Østhagen and colleagues note in Chapter 7, it took more than ten years from Iceland's first request for a status as a coastal state to the mackerel before Norway and the EU were ready to grant it – and that acknowledgement came only after Iceland had demonstrated powerful harvesting ability, also within its own EEZ. Moreover, the initial share offered by Norway in the ensuing negotiations was considerably less than 1 per cent.

Unfortunately, allocative controversies serve to compound also the conservation part of the challenge that climate change poses to regulation – a challenge that has been described in the following terms: 'as climate change potentially introduces a greater level of ecosystem uncertainty, successful ecosystem outcomes potentially mean that management practices may need to be more conservative' (Trathan and Agnew 2010: 338). Allocative controversy can compound that amplified conservation challenge in at least two ways. First, breakdown of quota negotiations often induces each party to set unilateral quotas that add up to a total harvesting pressure well above scientific recommendations. Østhagen and colleagues mention this phenomenon in Chapter 7: when the EU, Norway and the Faroe Islands finally agreed in 2014 on a long-term three-party quota arrangement, they set aside a certain portion of the agreed total quota to non-parties – in practice, to Greenland and Iceland. Given their failure to reach agreement also with Iceland, it is hardly surprising that the subsequent quota set unilaterally by Iceland was much higher than what was set aside for Iceland by the other three. In the ensuing years, the cumulative quotas were 30 to 40 per cent above what the scientists had recommended (ICES 2020a: 5–6): non-agreement on allocation can indeed undermine conservation.

A second way in which allocative controversy compounds the conservation challenge becomes evident when parties manage to obtain agreement on how to share a total quota only by increasing it beyond the bounds of precaution. For instance, Jørgensen notes in Chapter 8 that Norway in practice agreed in 2009 that changes in the zonal attachment of Greenland halibut justified a proportionally higher Russian quota. Nevertheless, total Norwegian catches remained stable, because the two coastal states agreed to increase the total quota fivefold from the previous year: for the first time in a decade, the 2010 catch limit was set above the precautionary level recommended by ICES scientists (ICES 2020b).

In short, whereas lack of agreement on allocation jeopardizes conservation by promoting unilateralism among the user-states, inclusive agreements are sometimes obtained at the expense of conservation. In all cases examined in this book, the impacts of climate change have acted to render one or both of those pathways to regulatory failure more likely.

Compliance task challenged

As to the behavioural or compliance task of fisheries management, climate change can challenge it by reducing the spatial fit between harvesting operations and the jurisdictional basis for essential compliance activities – notably, verification, review and response to rule violations (Hovi, Stokke and Ulfstein 2005).

The verification and review parts of compliance work revolves around monitoring, control and surveillance – key functions of regional fisheries management regimes implemented by means such as observer systems, at-sea inspection, port controls, as well as catch documentation and trade-tracking schemes (see Ch. 2 by Molenaar). Several regional regimes, including CCAMLR and NEAFC, complement information derived from such activities with the operation of satellite-based vessel-monitoring systems, enabling the integration of data from real-time tracking of all vessels flagged by member-states (Stokke 2014).

As Stokke elaborates in Chapter 9, a generic condition for effective verification in fisheries is having access to more than one source of information on harvesting activities, enabling the cross-checking of the reports provided by fishers to their flag states or by states to regional management regimes. Shifts in the spatial distribution of valuable commercial stocks can undermine that condition by constraining at-sea inspection or by removing the basis for comparison of catch- and port-delivery reports. Stokke notes how, in the early 1990s, the co-occurrence of increasing landings of Russian-caught cod in foreign ports and greater availability of this species in the high-seas part of the Barents Sea and in a 'grey zone' – where the two coastal states refrained from inspecting each other's vessels due to a then-unsettled maritime boundary dispute (see also Chs. 3 and 8) – led to very severe overfishing of agreed quotas that proceeded undisclosed for a long time.

The response to perceived rule violations may also be complicated by the impacts of climate change. Under the annual protocols adopted by JNRFC, Norway may license the harvesting of an agreed amount of the total allowable snow-crab catch in the Barents Sea. As Østhagen and Raspotnik discuss in Chapter 10, the westward expansion of that stock has made it available in the high-seas 'Loophole' as well as in Norway's Fisheries Protection Zone (FPZ) around Svalbard. Further, they note that the EU has acknowledged that snow crab is a sedentary species and therefore subject to the continental shelf regime, which grants to the coastal-state management authority beyond 200 nautical miles, provided certain geological and bathometric conditions are met – as they are in the Barents Sea. Norway's right to prohibit foreign crab-catch vessels in the Norwegian part of the 'Loophole' shelf is therefore not disputed. One Norwegian arrest of an EU-licensed vessel has occurred there as well, but the international dispute revolves around another arrest conducted within the FPZ. In that zone, the EU holds that Norway's sovereign rights are to be exercised within the constraints of the 1920 Svalbard Treaty, including the principle that nationals of other signatories shall have equal access to natural resources.

For efforts to enhance compliance with international rules, therefore, as with those targeting the cognitional and the regulatory aspects of management, shifts in the spatial distribution of marine stocks may present additional complications. This is particularly the case when the stock in question becomes available in areas where the jurisdictional basis for verification and enforcement activities are weak or disputed.

Institutional resilience: drivers and impediments

As explained in Chapter 1, 'institutional resilience' denotes the ability of those who operate institutions to adapt them to changing circumstances as necessary for retaining or improving levels of regime performance. This section compares the regional management regimes examined here in terms of resilience to the additional cognitional, regulatory and compliance challenges posed by climate- or otherwise-induced stock-shifts, then seeks to explain variation in such institutional resilience.[1]

Resilience compared

Among the three management tasks, the regulatory one has clearly taken the hardest blow from the stock-shifts examined in this book. All the regimes in question have managed to withstand the additional challenges posed to the cognitional task. In the Northern Seas, ICES plays a central role in this aspect of management and has continued its regular provision of consensual scientific advice on the levels of harvesting pressure deemed compatible with the precautionary approach – also for the highly contested pelagic stocks of herring and mackerel (see Ch. 7; ICES 2020a). The salience of such advice has declined for stocks subject to allocative controversy – but here we should recall that ICES has never requested or been authorized to provide advice on quota sharing. However, even in the politically contested cases of herring and mackerel in the Nordic Seas, the advisory system has produced not only annual total allowable catch advice but also inputs relevant to allocation. On request from the relevant coastal states or their regional management regimes, ICES has prepared survey- and fishery-based reports on changes in a stock's distribution and migration (e.g. on mackerel, ICES 2013; see Ch. 7), sometimes including annual percentage calculations of zonal attachment (as on herring, ICES 2014). Similarly, for the Barents Sea, as Jørgensen details in Chapter 8, the JNRFC has established separate ad hoc expert groups to map changes in the distribution of halibut and redfish to inform the Commission's allocative deliberations. On the whole, then, extensive stock-shifts and considerable quota controversies in the Northern Seas have not disrupted the cognitional performance of the regional fisheries regimes.

As shown by Stokke in Chapter 12, fairly high levels of cognitional resilience are evident also for the Antarctic case, because reports of a rapidly warming Southern Ocean have served to increase political pressure for improving the Scientific Committee's risk-assessment procedure as applied to the krill fisheries. Although the current procedure is clearly inadequate, the causal effect of climate change has been to promote efforts to make multi-scale surveys and stock assessments more regular events than has been the case thus far.

High resilience scores are in order also for the behavioural or compliance task: the overall pattern emerging from the findings reported in this book is a set of compliance systems that have been coping rather well with challenges deriving from climate-change related stock-shifts. As Molenaar explains (Ch. 2), RFMO/As worldwide have developed a broad menu of cooperative measures for detecting and deterring illegal, unreported or unregulated (IUU) fishing, including denial of entry and use of ports. In Chapter 9, Stokke notes how the JNRFC applied a broad range of such measures when combating two waves to IUU fishing in the Barents Sea in the 1990s and early 2000s. Despite the risk of being challenged on the basis of the Svalbard Treaty, as Østhagen and Raspotnik report in Chapter 10, Norway did arrest the EU vessels that fished for the sedentary snow crab on its continental shelf without having obtained a quota from the coastal state. Even in the deeply contested pelagic fisheries for herring and mackerel, compliance with the sum of coastal-state quotas has generally been high (ICES 2020a, 2020c) – partly because those quotas have been set high in order to support competing claims to enlarged shares of the stocks (see Ch. 7). And in the Southern Ocean, as Stokke notes in Chapter 12, CCAMLR has recently stepped up its observer coverage in the krill fishery to 100 per cent, and krill catches have remained far lower than the agreed limit.

Compared to these strong performances on the cognitional and compliance dimensions, regulatory resilience has been far more variable, with complications involving both conservation and allocation. In the Northern Seas, only the JNRFC has regularly managed to deliver quota agreements in line with scientific advice in cases involving shifts in spatial distribution. Thus, Jørgensen shows in Chapter 8 that despite a north- and eastward shift of Northeast Arctic cod (see also Ch. 6), Russia has refrained from requesting any renegotiation of its 50/50 sharing agreement with Norway, and the total allowable catch is typically held within the scientific advice. Moreover, for less-valuable shared stocks, the two coastal states have rather smoothly negotiated new division keys in recent years – and only in the case of Greenland halibut did such reallocation coincide with catch-limit increases somewhat beyond ICES recommendations.

The gap in regulatory performance from the Barents Sea to the Nordic Seas is striking. The states fishing for Norwegian spring-spawning herring have not achieved a comprehensive quota-division accord since 2012; in practically every year since then, the sum of coastal-state quotas has exceeded the scientific advice by more than 10 per cent (ICES 2020c). The situation is even worse for the mackerel stock, as discussed by Østhagen and associates in Chapter 7. Although two of the newcomers, the Faroe Islands and Greenland, in processes involving economic sanctions or threats of such sanctions from the EU and Norway, have decided to join a quota-sharing agreement, the failure to reach a comprehensive agreement dates back to 2009. The cumulative quotas have exceeded the scientific advice by a considerably greater margin than for herring – on average by as much as 40 per cent each year (ICES 2020a).

The longer-term trend in Antarctic krill regulation, as noted by Stokke in Chapter 12, falls somewhere between the successful Barents Sea adaptations and the many failed quota negotiations on large pelagic species in the Nordic Seas. Agreed catch limits for krill ensure a very low harvesting pressure, considering the huge size of the stock. However, the slow pace towards establishing a feedback management system means that CCAMLR remains unable to respond quickly to any rapid changes in the local abundance of krill relative to predator needs in the areas where the fishery is concentrated.

How can we account for these differences in resilience to the challenges that stock-shifts pose to fisheries management in the two regions studied here? The remainder of this section summarizes what the contributions to this book tell us about factors that impede or drive institutional resilience. The comparative part of the argument benefits from the case diversity identified in Chapter 1 – in the number of actors, the extent of the stock shift and the procedural strength of the regime – and is structured by the three types of risk factors that Young and Stokke identify in Chapter 3 as crucial for efforts to avoid failure in environmental governance: *problem characteristics*, *broader setting* and *institutional structure*.

Problem characteristics

One possible explanation for variation in governance performance is that certain characteristics of the social problem addressed by a regime make coping more difficult in some cases than in others – what Underdal (2002) calls 'malignancy', revolving around the severity of collective-action problems associated with free-rider incentives. A core proposition in the study of collective action is that the larger the number of actors that must agree on regulatory constraints, the greater is the risk that one or more of them will seek to avoid being bound or to avoid compliance (Olson 1971). In fisheries management, such problem malignancy can be compounded – for instance, if a stock's rising occurrence on the high seas provides greater opportunities for free-rider behaviour (see Ch. 2 by Molenaar) or by a highly dynamic ecosystem undergoing rapid or nonlinear change (see Ch. 3 by Young and Stokke).

As argued in Chapter 1, the cases presented in this book display analytically helpful diversity with respect to both the number of actors involved and the dynamism of the ecosystem, notably the extent of the spatial shift of the marine stocks under study and their availability on the high seas or in waters involving disputed jurisdiction. Hence, Jørgensen notes in Chapter 8 an important advantage held by the JNRFC over the regimes for managing the pelagic stocks in the Nordic Seas: the most valuable stocks occur more or less exclusively within the EEZs of only two states, rendering the management problem more benign. Problem dynamism too is particularly high in the pelagic sector, as Østhagen and colleagues remind us in Chapter 7: mackerel and herring migrate over greater ocean areas than demersal species do, so the changes in spatial distribution have been more extensive. Moreover, as Stiansen and associates elaborate in Chapter 6, the distribution of pelagic species is closely related to stock size – a factor which also tends to fluctuate more widely for pelagic species than for the major stock managed under the bilateral Barents Sea fisheries regime, Northeast Arctic cod.

Rapid changes in stock distribution draw attention to another problem characteristic which may affect the ability of states to devise effective institutional adaptations: the state of knowledge regarding the expected duration of a stock shift. Even in the contested management processes over the pelagic stocks, the regimes' scientific body has provided consensual advice on the extent of changes in distribution – but the expected duration of that change remains shrouded in scientific uncertainty (see also Ch. 6).

Judging by the cases examined here, such uncertainty has an ambiguous effect on the resilience of management. In Chapter 7, Østhagen and associates show how disagreement as to whether today's wide distribution of mackerel is cyclical or climate-driven (and thus durable), has fostered hardliner policies on both sides of the dispute. In contrast, Jørgensen in Chapter 8 lists scientific uncertainly among the drivers of resilience for the Barents Sea regime, arguing that it may have restrained Russia from requesting a new cod-division key – as that state has done for the less-valuable regional stocks of halibut, redfish and saithe. In the future, Jørgensen argues, the current 50/50 division of cod may again compare favourably (from a Russian perspective) with the stock's zonal attachment.

Jørgensen also notes an important difference between the situations in the Barents Sea and the Nordic Seas that may explain why scientific uncertainty plays out differently. In contrast to Russia with respect to cod, the Faroe Islands and especially Iceland had very little to lose from a confrontational approach towards the regional pelagic heavyweights (the EU and Norway), as their agreed shares in the stocks were initially negligible.

Compared to the Northern Seas situation, the character of the regulatory problem posed in the Southern Ocean is considerably less malign: the value of the krill fishery is far lower, and the allocative dimension is practically absent. Unlike the other regimes examined here, CCAMLR does not allocate quotas among user-states. Thus, the debate recounted by Stokke in Chapter 12 on whether and how to allocate the krill quota over smaller management units revolves around the balance between environmental protection and utilization of a stock with modest commercial significance – it is not a question of allocation among states fiercely competing for long-term shares of quotas valued highly by their respective fishing industries (see also Chs. 7 and 13).

The fact of a relatively benign problem due to the limited commercial value of the fishery may also explain why the EU for several years refrained from pursuing the snow-crab dispute with Norway, as Østhagen and Raspotnik argue in Chapter 10. Although a few small EU member-states and some EU parliamentarians have lobbied for a more assertive stance on the part of the European Commission and the European External Action Service (EEAS), counter-arguments have included the value of maintaining well-functioning cooperation with Norway on the commercially far more important stocks covered in the annual EU–Norway quota agreements. However, Østhagen and Raspotnik also note the limits of that logic, especially in periods of controversy over those more important stocks: the disagreement over snow crab was among the items that featured in the heated diplomatic exchange between the EU and Norway in 2021 over the cut in the EU quota for cod in the FPZ around Svalbard and the subsequent, unilaterally set, EU cod quota (see Stokke 2022).

At the core of a problem-characteristics account for resilience is how the actors involved perceive the costs and benefits of a cooperative arrangement relative to a situation with no external constraints on their behaviour or that of others. As the contributors to this volume bring out, factors that go into such a calculus include the number of states with access to the fishery, the extent of the spatial stock shift and expectations about future ones, the availability of the stock in question on the high seas and whether it is robust enough to withstand the higher harvesting pressure generally associated with unilateral quotas.

Political context

As Young and Stokke elaborate in Chapter 3, a second category of factors that can explain variation in institutional resilience is the broader political or socioeconomic setting for efforts at international governance. An important dimension here is whether the issues at hand are linked to deep-seated partisan differences among the states concerned.

A broader political context marked by intensive rivalry can promote institutional resilience, argues Jørgensen in Chapter 8. She notes how the two coastal states in the Barents Sea during the Cold War – Norway and the Soviet Union – with their opposite placement in the East–West rivalry, had to find practical solutions to their fisheries issues while treading as lightly as possible on several underlying jurisdictional disputes, in order to avoid incidents that might escalate into dangerous situations (see also Ch. 3). It has been argued that this broader setting of geopolitical competition spurred an 'urge to agree' in the Barents Sea fisheries regime that facilitated mutual accommodation on difficult matters such as the adoption of fixed division keys for shared stocks and enforcement in disputed waters (Stokke and Hoel 1991; Hønneland 2006). According to Jørgensen, this urge to agree has gradually been internalized among participants in the JNRFC, generating a 'culture of compromise' that helps to explain the resilience of this institution. She finds evidence of such resilience also in the recent cooperative zonal-attachment studies and subsequent adaptations of several quota-sharing agreements.

The general mechanism that connects the broader political context with accommodation and resilience in the JNRFC case is the concern that disputes over fisheries matters may spill over into larger and potentially more sensitive controversies among the parties. In Chapter 4, Raspotnik and Østhagen refer to the same mechanism when placing the snow-crab row between the EU and Norway in the scholarly debate on EU actorness. Understanding EU external behaviour, they argue, requires keen attention to how actor interests are pursued within a multi-level governance structure distinctive to each issue-area. With respect to marine living resources, internal EU decision-making is shaped by the extensive competence that member-states have ceded to the Commission – which, in the snow-crab case, has a shared interest with the EEAS, another coordinating body involved in the making of EU external policy, in preventing a marginal dispute from impacting negatively on the EU's broader foreign-policy relations with Norway.

Thus, the snow-crab case brings out how the relationship between political context and cooperation depends on the relative institutional clout held by sector agencies and those responsible for coordination. For a long time, as Raspotnik and Østhagen note (see also Ch. 10), the European Commission and the EEAS managed to keep the snow-crab dispute solely a fisheries issue, decoupled from the larger question of whether the equal-access provisions of the Svalbard Treaty apply beyond Svalbard's territorial sea. The latter question would raise the stakes of the dispute considerably, most likely affecting the EU's general foreign-policy relations with Norway as well as its aspirations to play a more prominent role in multilateral processes of Arctic governance.

The cases studied in this book, therefore, reinforce a point made by Young and Stokke in Chapter 3: a conflictual political setting will not necessarily impede cooperative environmental problem solving, provided institutional means can be found for decoupling the issues of conflict, or at least reducing their linkage with the practical tasks of management. Indeed, institutional solutions that have succeed in overcoming geopolitical rivalry or accommodating underlying disputes might even be particularly valuable to those operating the regimes, rendering the solutions more rather than less resilient to external challenges (Stokke 2022).

Socioeconomic environment

Cases displaying diversity in EU actorness, including the ability to pursue a coherent and consistent policy across policy areas, also illustrate the importance of the socioeconomic dimension of the broader setting. As Young and Stokke note in Chapter 3, the socioeconomic environment for governance efforts includes matters such as the prosperity of the countries involved, as well as the mode and extent of attention paid by industry or other non-state actors. As noted in Chapter 1, all the regimes studied in this book have memberships that largely comprise wealthy and technically advanced states – but our management cases differ in interesting ways regarding the roles played by various categories of non-state actors.

Thus, the difference that Raspotnik and Østhagen emphasize in Chapter 13 between the Barents Sea setting and that in the Southern Ocean – the highly limited EU fishing-industry engagement in Antarctic fisheries – can account for the conservation-oriented role assumed by the EU in recent controversies over Antarctic environmental governance. In contrast to the pragmatic conflict-avoidance approach that has gradually prevailed in its snow-crab policy, the EU has taken an active and assertive position in CCAMLR by sponsoring and supporting a string of proposals for marine protected areas (MPAs) throughout the Antarctic, also in harvesting areas, despite increasing resistance from some of the fishing states. With very low economic stakes in the region, the EU Commission has fewer incentives for avoiding open disagreement with harvesting interests. And, as Raspotnik and Østhagen add, the Antarctic stands out as a particularly attractive location for implementing EU commitments to the Aichi Target under the Convention on Biological Diversity as regards providing area protection status or area-based conservation measures to 10 per cent of the world's coastal and marine areas.

Among the arguments for Antarctic MPAs, which may include areas where krill harvesting is prohibited or subject to particularly stringent regulations, is that they can support scientific research on the ecosystem effects of krill harvesting by providing reference data from otherwise comparable no-fishing areas. Accordingly, adoption and implementation of MPA measures could provide evidence of institutional resilience. Within CCAMLR, however, as Stokke argues in Chapter 12, such resilience is instead evident in the pragmatic decoupling of the crucial process of improving the krill management procedure from the increasingly contested MPA initiatives. Since around

2012, the MPA issue has become entangled in a larger controversy among CCAMLR members on how to balance the utilization and protection elements of the regime's conservation objective. One indication of how this controversy has constrained decision-making capacity: since 2015, CCAMLR has been unable to agree even on a Climate Change Response Work Plan proposed by the Scientific Committee as part of its efforts to integrate the impacts of climate change into its research coordination and advisory efforts. As in the Barents Sea cases combining fisheries and jurisdictional disputes between Norway and Russia or the EU, decoupling the process of revising the management procedure for Antarctic krill from the broader controversies over MPAs is a means for enhancing CCAMLR's resilience to the impacts of a warming Southern Ocean.

A noteworthy change in the socioeconomic environment for all the management processes examined in this book is the strengthening of private sustainability certification schemes, operating alongside the intergovernmental management regimes. In Chapter 5, Hønneland describes and assesses the operation of the most significant scheme, the Marine Stewardship Council (MSC), which originated in a partnership between a major transnational food company and the global environmental organization WWF. Today, the MSC certifies more than 10 per cent of the world's capture fisheries, including several of those for Antarctic krill, Barents Sea cod, herring in the Nordic Seas and, until 2019, mackerel.

As Hønneland shows, the MSC has played a role in the mackerel dispute from the outset, because the certificates awarded to several of the regional mackerel fisheries, initially in 2009, were made conditional on reducing quota overfishing and ensuring international agreement on a new harvest-control rule. The risk of having their certificates withdrawn was among the motivations for a loosely coupled group of pelagic industry associations in the Northeast Atlantic, the Mackerel Industry Northern Sustainable Alliance (MINSA), to engage with management bodies, scientists and the media in favour of an inclusive quota-sharing agreement.

From a resilience perspective, industry incentives pressing for mutual accommodation on the part of their respective governments are particularly welcome in disputes characterized by rigid positions among the states involved, as in the mackerel case. In Chapter 7, Østhagen and associates relate that rigidity to the political clout of the pelagic fishery associations when engaging in domestic decision-making – especially in Iceland and the Faroe Islands, but also in Norway. On this matter, the limits of what private governance initiatives can achieve are made clear by Hønneland in Chapter 5: MINSA has failed to recruit the Icelandic pelagic association, and any flexibility that its lobbying activities may have incited in other delegations has thus far been insufficient to overcome the differences.

More tangible outcomes of private governance are evident in the Southern Ocean. The MSC certifies most of the Antarctic krill fisheries. As Hønneland brings out in Chapter 5, stakeholder submissions, objections and conditions set by the MSC assessment teams have revolved around inadequate knowledge regarding the population dynamics of target stocks and their interaction with other ecosystem components. Keen to retain their certificates, fishery clients have therefore introduced sampling programmes in their own fishing activities and provided various financial and in-kind support to research. As Stokke points out in Chapter 12, MSC-certified members of the Association of Responsible Krill Harvesting Companies (ARK) take by far the greatest share of the Antarctic krill catch; and they regularly provide vessel capacity for survey purposes, free of charge, as with the ambitious 2019 synoptic krill survey which covered all areas where krill fisheries occur. Moreover, ARK has used its observer status in CCAMLR to encourage parties to move forward on improving the risk-assessment procedure and developing a krill management system sensitive to updated information about the ecosystem. As Stokke adds, this association has also assumed voluntary restrictions more stringent than CCAMLR conservation measures, including the pledge to avoid krill-fishing grounds located close to breeding grounds and foraging areas for land-based predators.

Therefore, paying attention to the socioeconomic setting for international governance efforts is important for understanding variation in institutional resilience. As with the prosperity of the states involved, the relative clout of various categories of non-state actors involved is likely to influence the configuration of interests among regime participants and the resources available for overcoming differences.

Institutional design and interplay management

The third set of generic factors important for effective governance pinpointed by Young and Stokke in Chapter 3, besides problem structure and broader setting, concerns attributes of the management institutions themselves and their interplay. We noted in Chapter 1 that the regimes studied in this book display considerable diversity with respect to *procedural strength*, i.e. the means an institution provides for enabling the adoption of binding decisions on substantively controversial matters. The cases studied in this book have brought out the relevance of such strength for institutional resilience, notably the existence of firm procedures for protecting the integrity of scientific advisory bodies and decision-making arenas allowing regular negotiations among all the states involved in the fishery. Also conducive to institutional resilience are certain substantive norms on conservation and allocation as well as dynamism within a steadily wider complex of institutions relevant to fisher compliance, including trade rules and private governance schemes.

A relevant feature of most of the management processes examined in this book is that adaptations to stock-shifts have involved interplay within the larger complexes of institutions that co-govern various activities occurring within a geographic area. Such institutional interplay, in which one institution affects the contents, operations or consequences of another institution, has been the subject of growing interest in studies of international governance in realms ranging from fisheries (Stokke 2001), to genetic resources (Raustiala and Victor 2004), and climate change (Keohane and Victor 2011). Various terms are employed for such institutional complexes, but the core conceptual components are the same: plurality of institutions that are distinctive in terms of decision-making and participation, yet deal with the same activity, or aspects of the same activity, usually in a non-hierarchical manner (Oberthür and Stokke 2011).

As shown in Chapters 7 to 9, conducive institutional interplay is central to the cognitional resilience that has marked the management regimes in the Northern

Seas, each centred on a decision-making procedure that includes written advice from ICES. The institutional features that make this organization particularly well suited for solving the cognitional problem in Northeast Atlantic fisheries management are its membership, comprising national fisheries research institutions in all coastal states, and a set of procedures that can balance the salience or policy relevance of the advice with insulation from political pressure that may be exercised by industry or governments (Stokke 2019).

On the salience side of that balance, ICES receives annual requests for advice on the total allowable catch of specified stocks from the management bodies or their members, often identifying particular issues in need of scientific elucidation (ICES 2017). In responding to such requests, ICES calls first upon a working group typically dominated by experts from the members involved in the fisheries (and therefore with incentives to finance research activities). This working group compiles available data and conducts the necessary analyses.

Insulation from political pressure is among the aims of the subsequent step in the ICES advisory procedure: a review group or process involving experts from members without any stakes in the fishery who are asked to examine the analysis against the benchmark of 'best available science' and to develop draft advice. Next, the ICES Advisory Committee reviews that draft, modifies it as appropriate and adopts the official advice. Thus, most of the underlying work is typically carried out by researchers from the main harvesting states – whereas the development, quality control and provision of the advice is placed in a multilateral setting centred on third-party peer review.

In the Southern Ocean, the Scientific Committee that advises CCAMLR on conservation measures is less shielded from political controversy than its Northern Seas counterpart, because the advice must be adopted by consensus among committee members. Nevertheless, as Stokke argues in Chapter 12, the high degree of transparency that characterizes the Scientific Committee, based on the requirement in its Rules of Procedure that it shall report 'all the views' expressed in the deliberations, implies that also in CCAMLR decision-making proceeds on the basis of broad scientific input, also in matters marked by controversy.

Institutional characteristics important for regulatory resilience include, beyond those promoting scientific integrity, two types of rules that shape the ability of states to obtain agreement on conservation and allocation on a regular basis – procedural and substantive.

In practice, the procedural rule of consensus predominates in all the management regimes examined here. For CCAMLR and the JNRFC, this rule is formalized in the constitutive documents. In the considerably shallower and more loosely coupled 'coastal states' regimes that emerged in the 1990s with the recovery of the large pelagic stocks in the Nordic Seas, each member may de facto veto an inclusive agreement by refusing to join it – which each member has indeed done at one time or another. As elaborated in Chapter 1, regulatory negotiations on the pelagic stocks proceed by two rounds of multilateral negotiations and numerous bilateral negotiations between coastal states concerning quota exchange and reciprocal access to each other's zones. Thus, although NEAFC procedures allow for qualified-majority decisions, the ramifications for those decisions have already been set in less formalized processes, jointly providing ample opportunity for exit. And as Molenaar notes in Chapter 2, the provisions on decision-making in the Central Arctic Ocean Fisheries Agreement indicate that a consensus requirement will prevail there as well. The formal or de facto consensus rule applied in all the regimes examined here places obvious limits on their ability to respond rapidly and effectively to change whenever members disagree on how to respond.

Preventing or handling regulatory disagreement is precisely the role intended for the substantive decision rules on conservation and allocation which more and more fisheries management regimes have adopted, encouraged by the development and diffusion of the precautionary approach to fisheries management during the 1990s (Stokke 2001). As Jørgensen notes in Chapter 8, some time ago the JNRFC adopted long-term management plans with specific harvest-control rules for all the shared stocks (see also Hønneland 2006; Kvamsdal et al. 2016). When combined with fixed quota-allocation keys, these harvest-control rules – based on biological reference points and, in the case of the valuable Northeast Arctic cod, an inter-annual quota stability clause – have greatly facilitated reaching agreement on management responses to any changes in the stock. In the Barents Sea fisheries regime, annual decisions on conservation as well as allocation are normally obtained more by calculation than by negotiation.

CCAMLR has adopted a preliminary decision rule for Antarctic krill which facilitates the setting of catch limits – but a main limitation of that rule is its arbitrary nature and its disjunction from updated information on the state of this stock and the needs of its predators (see Ch. 12). The inclusively agreed harvesting-pressure rules in place for herring and blue whiting (but not mackerel) in the Nordic Seas (ICES 2019) are superior in that respect, but disagreements over how to allocate the corresponding total allowable catch have reduced their practical value considerably. A substantive decision rule on conservation facilitates regulatory resilience – but cannot deliver it reliably unless supported by a legitimate allocative rule or procedure.

The legitimacy of such allocative rules or procedures – argue Young and Stokke in Chapter 3, after reviewing a string of regulatory successes and failures – can be upheld in several ways. A fixed allocation key with a long duration (Franck 1990), like the more than forty-year old 50/50 sharing agreement on Northeast Arctic cod, is likely to be more robust than one adopted recently. However, an explicitly temporary division key may be perceived as more legitimate for stocks that fluctuate widely in abundance and distribution, such as Icelandic capelin in the Nordic Seas (also Kvamsdal et al. 2016). And whether fixed or temporary, allocation keys accompanied by a flexibility mechanism whereby the parties may exchange part of their respective quotas for access to other species in the region are likely to remain acceptable to all parties over time, as they allow states to buffer changes and capitalize on differences in how they value the species in question (also Chs. 7 and 8).

As with the cognitional management task, certain institutional characteristics have proved important for the high resilience displayed on the compliance side of management in the fisheries regimes examined here. As Molenaar points out in Chapter 2, the 1995 UN Fish Stocks Agreement operationalized the general duty which states have under the UN Convention on the Law of the Sea (UNCLOS) to cooperate on fisheries management by linking it to RFMO/As. In the realm of compliance, regional organizations such as CCAMLR and NEAFC have pioneered various cooperative measures for detecting and deterring harvesting not authorized by regime members – including vessel-monitoring schemes, catch documentation requirements and IUU vessel lists. As Molenaar notes, the RFMO/As have generally designed the trade-restrictive part of their IUU measures in ways that target vessels rather than states, thus reducing the risk of challenge under the dispute settlement procedure of the World Trade Organization.

The relationship between fisheries compliance measures and international trade rules is also central in Stokke's account in Chapter 9 of how the coastal states in the Barents Sea have gradually expanded their compliance systems to ensure continued effectiveness. A first step was taken in the 1990s with the establishment of the Permanent Committee on Compliance and Control under the JNRFC, enabling deeper cooperation among the enforcement agencies of the two states (see also Ch. 8). One decade later, when Russian fishing companies began delivering their catches in various European ports beyond the reach of their home governments, cross-regime adaptations were necessary – primarily involving the mobilization of the multilateral compliance system operated by NEAFC.

In short, important institutional attributes conducive to the resilience of resource management regimes can be observed at the micro-level: procedural or substantive means for supporting the cognitional, regulatory and compliance tasks of management. As this section shows, such conduciveness may also derive from institutional characteristics observable at the macro-level, including the interplay among several institutions with different memberships and capacities. One important such macro-level characteristic is the extent to which the interplay makes good use of the institutions' respective strengths, as it does in the cases involving dynamic interplay between bilateral and multilateral levels of governance or between international resource-management and trade regimes.

Disaggregate analysis, case diversity and broader lessons

In this book we have examined the resilience of fisheries management regimes by focusing on how climate-related stock-shifts have affected the cognitional, regulatory and compliance management tasks in cases involving four major marine stocks, attentive to processes of institutional adaptation. Among the advantages of such tripartite disaggregation of resilience analysis is to facilitate comparison across cases of fisheries management. Such disaggregation ensures that the study of institutional adaptation attends, in operational detail, to the three core activities that participants and sub-bodies in most international fisheries regimes actually engage in – generating knowledge and providing advice, negotiating agreed regulations and taking steps to enhance compliance (Stokke 2012).

Another advantage of the disaggregate approach to governance analysis, besides promoting comparability, is to facilitate a more nuanced assessment of adaptation and performance one that is sensitive to successes and failures concerning each part of the larger management challenge, whatever the overall performance of the regimes in questions. Moreover, as the preceding section shows, the specific combination of problem structure, political and socioeconomic setting and institutional characteristics that best explain variation in resilience regarding *one* governance task does not necessarily provide the most compelling account for the other two.

What lessons, then, can be derived from our case studies? And what of their applicability to broader sets of efforts to adapt fisheries management to the impacts of climate change in other parts of the world?

One finding that cuts across the cases examined here is that institutional resilience is especially important, but unfortunately also especially difficult to obtain, when problem malignancy is high. Rising malignancy may be due to an increase in the number of actors involved in the fishery, a more extensive spatial stock shift or one implying greater availability on the high seas or in areas where jurisdiction is disputed, or it may derive from a rise in economic value of the fishery. All these external perturbations tend to make the non-cooperative option relatively more attractive to the actors involved in management, thus raising the risk of management failure.

On the cognitional dimension, non-cooperation shows up as suspicion among the scientists involved that inputs from others are politically motivated and as perceptions among decision-makers that the scientific advice is unreliable. Our case studies indicate that maintaining cognitive problem solving under such circumstances is well served by a strong transnational network of experts firmly committed to shared standards of scientific inquiry and validation – which in the broader study of environmental governance is often referred to as an *epistemic community* (Haas 1992).

As all the cases examined here include such networks, although they vary in cohesiveness, our study does not put to test the proposition that the existence of an epistemic community is necessary for cognitional resilience – but the fact that the networks examined here continued to perform well also under the least-likely circumstances of highly disputed allocation, indicates that the scientific-cooperation lesson is broadly applicable (see Levy 2008). Moreover, the processes traced in our case studies indicate that such resilience is supported by peer-review procedures that can serve to counteract any political pressure on the advisory process, by the creation of special working groups tasked with establishing a shared factual basis on those parts of allocative questions that are scientific in nature, and by private governance schemes that incentivize industry contributions to research activities.

On the regulatory dimension of management, non-cooperation may involve harvesting quotas set up unilaterally by states or other entities, typically adding up to total allowable catches in considerable excess of what the scientists recommend. Our case studies indicate that in situations involving strong power-asymmetries, coercive means such as economic sanctions may prove relevant for inducing cooperation – although such means have not succeeded in generating comprehensive allocation agreements in the cases studied here. Processes traced in our cases as well as the comparative analysis indicate that a well-functioning scientific advisory body and pressure from private governance bodies are conducive, but not sufficient, for regulatory resilience.

Similar comments apply regarding substantive decision rules that facilitate annual negotiations over conservation and allocation issues, notably harvest-control rules and fixed or adjustable quota-division keys. Such substantive decision rules appear to be conducive for regulatory resilience in the cases examined here, but only if both kinds are present. Moreover, the single case in which both kinds of rules are present involves relatively low malignancy and relatively high procedural strength. By implication, the high score on regulatory resilience in that case is probably explained in part by those favourable circumstances. Since favourable circumstances also make that case a most-likely success story from a methodological point of view (Levy 2008), any claim concerning broader applicability of such substantive decision rules as an effective means for obtaining regulatory resilience should be stated with caution.

On the compliance dimension of management, non-cooperation shows up as opportunistic reporting practices among fishers and inadequate effort or ability by states or other relevant entities to cross-check such reports with complementary sources of information, such as inspections and satellite monitoring. Our case studies indicate that providing international management regimes with strong compliance systems which commit members to procedures that enable review of their compliance performance and joint development of measures for raising the cost of rule violation among fishers can work effectively – also under malign circumstances when the availability of a stock is high relative to the total allowable catch and corrupt practices are well established in the value chain. Also the diffusion of many such means for monitoring, control and surveillance among RFMO/As during the 2010s testifies to the broad applicability of that finding, although parts of the menu of compliance measures may prove more difficult to implement if regime members are less wealthy and/or technically advanced than in the cases studied here. Further, because fishers and fishing companies that are prepared to take more fish than their entitlement will constantly search for new ways to evade control, our studies show how decision-making on such compliance systems should be flexible enough to allow adaptation, also by involving new actors and institutions that can be relevant for combating illegal, unregulated and unreported fishing.

Summing up, then: the separate analyses of challenges, adaptations and performance on the cognitional, the regulatory and the compliance sides of management offered in this volume have meant that lessons regarding the conditions for institutional resilience, including the strategies for avoiding institutional failure, have been substantively richer and also more precise than would otherwise have been the case.

Note

1 Parts of this section draw on material published in Stokke (2022).

References

Cash, D. W., W. C. Clark, F. Alcock, N. M. Dickson, N. Eckley, D. H. Guston, J. Jäger and R. B. Mitchell (2003), 'Knowledge Systems for Sustainable Development', *Proceedings of the National Academy of Sciences of the United States of America*, 100 (14): 8086–91.

Franck, T. M. (1990), *The Power of Legitimacy among Nations*, Oxford: Oxford University Press.

Gullestad, P. (1998), 'The Scope for Research in Practical Fishery Management', *Fisheries Research*, 37 (1): 251–58.

Haas, P. M. (1992), 'Introduction: Epistemic Communities and International Policy Coordination', *International Organization*, 46: 1–35.

Hønneland, G. (2006), *Kvotekamp og kyststatssolidaritet. Norsk-russisk fiskeriforvaltning gjennom 30 år* (Quota struggles and coastal state solidarity: Norwegian–Russian fisheries management through 30 years), Bergen: Fagbokforlaget.

Hovi, J., O. S. Stokke and G. Ulfstein (2005), 'Introduction and Main Findings', in O. S. Stokke, J. Hovi and G. Ulfstein (eds), *Implementing the Climate Regime: International Compliance*, 1–14, London: Earthscan.

ICES (2013), 'Report of the Ad hoc Group on the Distribution and Migration of Northeast Atlantic Mackerel (AGDMM)', *ICES CM 2013/ACOM:58*. http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2013/AGDMM/AGDMM%202013.pdf.

ICES (2014), *Report of the Coastal States Working Group on the Distribution of Norwegian Spring Spawning Herring in the North-East Altantic and the Barents Sea*, Copenhagen: International Council for the Exploration of the Sea.

ICES (2017), 'EU Request on Distributional Shifts in Fish Stocks', *ICES Advice*. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/eu.2017.05.pdf.

ICES (2019), 'Working Group on Widely Distributed Stocks (WGWIDE)', *ICES Scientific Reports* 1. http://doi.org/10.17895/ices.pub.5574.

ICES (2020a), 'Mackerel *(Scomber scombrus)* in Subareas 1–8 and 14, and in Division 9.a (the Northeast Atlantic and adjacent waters)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/mac.27.nea.pdf.

ICES (2020b), 'Blue Whiting *(Micromesistius poutassou)* in Subareas 1–9, 12, and 14 (Northeast Atlantic and adjacent waters)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/whb.27.1-91214.pdf.

ICES (2020c), 'Herring *(Clupea harengus)* in Subareas 1, 2, and 5, and in Divisions 4.a and 14.a, Norwegian Spring-spawning Herring (the Northeast Atlantic and the Arctic Ocean)', *ICES Advice*. https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/her.27.1-24a514a.pdf.

Keohane, R. O. and D. G. Victor (2011), 'The Regime Complex for Climate Change', *Perspectives on Politics*, 9 (1): 7–23.

Kvamsdal, S. F., A. Eide, N. A. Ekerhovd, K. Enberg, A. Gudmundsdottir, A. H. Hoel, K. E. Mills, F. J. Mueter, L. Ravn-Jonsen, L. K. Sandal, J. E. Stiansen and N. Vestergaard (2016), 'Harvest Control Rules in Modern Fisheries Management', *Elementa*. doi: 10.12952/journal.elementa.000114.

Lassen, H., C. Kelly and M. Sissenwine (2014), 'ICES Advisory Framework 1977–2012: From Fmax to Precautionary Approach and Beyond', *ICES Journal of Marine Science*, 71 (2): 166–72.

Levy, J. S. (2008), 'Case Studies: Types, Designs, and Logics of Inference', *Conflict Management and Peace Science*, 25: 1–18.

Mitchell, R. B., W. C. Clark, D. W. Cash and N. M. Dickson (2006), *Global Environmental Assessments: Information and Influence*, Cambridge, MA: MIT Press.

Oberthür, S. and O. S. Stokke (2011), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change*, Cambridge, MA: MIT Press.

Olson, M. (1971), *The Logic of Collective Action: Public Goods and the Theory of Groups*, Cambridge, MA: Harvard University Press.
Raustiala, K. and D. G. Victor (2004), 'The Regime Complex for Plant Genetic Resources', *International Organization*, 58 (2): 277–309.
SC-CAMLR (2019), 'Report of the Thirty-Eighth Meeting of the Scientific Committee'. https://www.ccamlr.org/en/sc-camlr-38.
Spijkers, J. and W. J. Boonstra (2017), 'Environmental Change and Social Conflict: The Northeast Atlantic Mackerel Dispute', *Regional Environmental Change*, 17 (6): 1835–51.
Stokke, O. S. (2001), *Governing High Seas Fisheries: The Interplay of Global and Regional Regimes*, Oxford: Oxford University Press.
Stokke, O. S. (2012), *Disaggregating International Regimes: A New Approach to Evaluation and Comparison*, Cambridge, MA: MIT Press.
Stokke, O. S. (2014), 'Actor Configurations and Compliance Tasks in International Environmental Governance', in N. Kanie, S. Andresen and P. M. Haas (eds), *Improving Global Environmental Governance: Best Practices for Architecture and Agency*, 83–107, London: Routledge.
Stokke, O. S. (2015), 'Fisheries and Whaling', in P. H. Pattberg and F. Zelli (eds), *Encyclopedia of Global Environmental Governance and Politics*, 364–73, Cheltenham: Edward Elgar.
Stokke, O. S. (2019), 'Management Options for High Seas Fisheries: Making Regime Complexes More Effective', in J. R. Caddell and E. J. Molenaar (eds), *Strengthening International Fisheries Law in an Era of Changing Oceans*, 51–78, London: Hart.
Stokke, O. S. (2022), 'Arctic Geopolitics, Climate Change, and Resilient Fisheries Management', *Ocean Yearbook*, 36.
Stokke, O. S. and A. H. Hoel (1991), 'Splitting the Gains: Political Economy of the Barents Sea Fisheries', *Cooperation and Conflict*, 26 (2): 49–65.
Totland, O. A. (2020), 'Makrellkonflikten og dtrategisk klimafornekting', *Internasjonal politikk*, 78: 142–66.
Trathan, P. N. and D. Agnew (2010), 'Climate Change and the Antarctic Marine Ecosystem: An Essay on Management Implications', *Antarctic Science*, 22 (4): 387–98.
Underdal, A. (2002), 'One Question, Two Answers', in E. L. Miles, S. Andresen, E. M. Carlin, J. B. Skjærseth, A. Underdal and J. Wettestad (eds), *Environmental Regime Effectiveness: Confronting Theory with Evidence*, 3–45, Cambridge, MA: MIT Press.

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