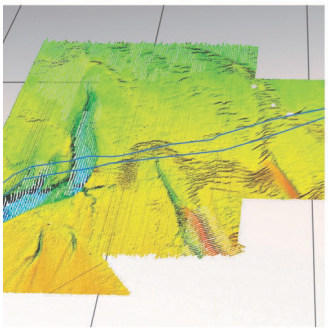
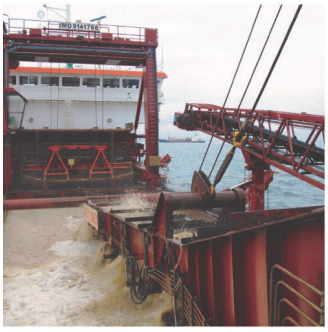
Environmental Defense Fund

Building Resilience of Fisheries Governance in the North East Atlantic

Final Report

January 2018

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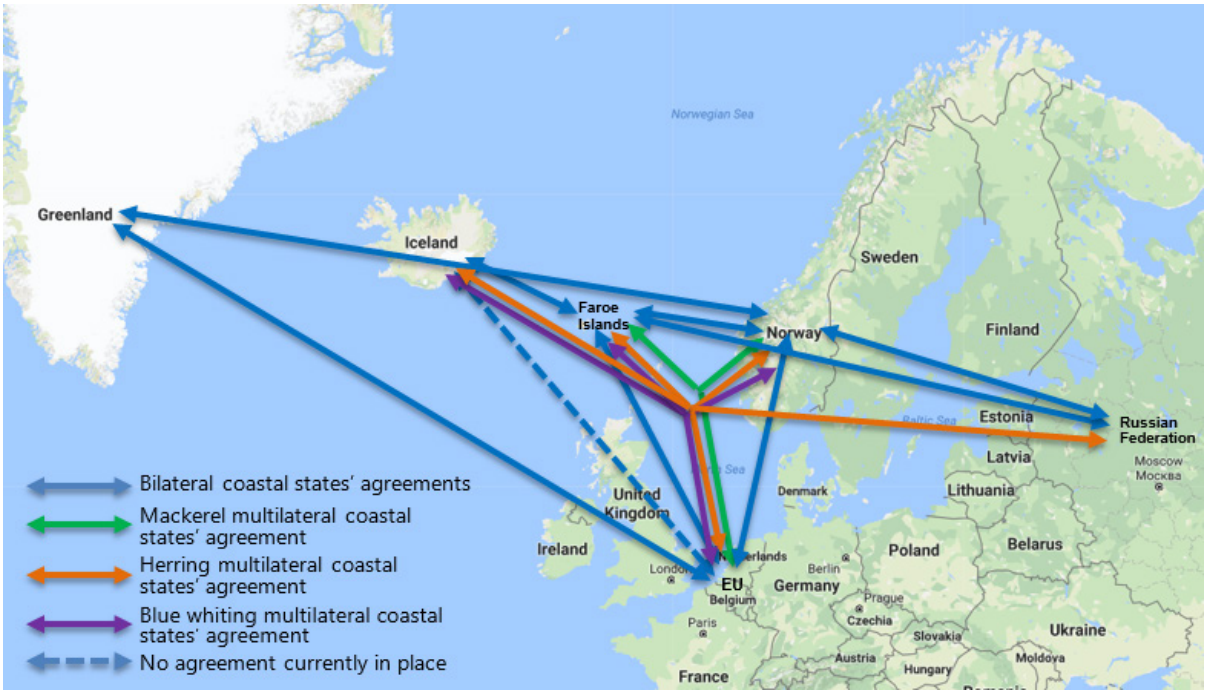

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Notice

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Executive Summary

Climate-related impacts on the range and distribution of commercial fish stocks are likely to intensify in coming decades and will increasingly challenge existing institutions and governance arrangements that are in place to manage associated fisheries. As a result, fisheries science and management face new challenges in meeting the needs of a dynamic ecosystem. Governance arrangements must be flexible and adaptable to provide resilience in the face of climate-related impacts, so that relevant coastal states are able to anticipate and avert conflict that may arise from stock-related disputes.

This report analyses fisheries governance in the North East Atlantic region and draws on case studies from around the world in order to identify the key features required to build an adaptive, flexible fisheries governance framework that can respond to climate-related impacts, such as changes to stock abundance and distribution. Political pressures, such as Brexit, and conservation mandates, such as the Landing Obligation required by the Common Fisheries Policy, are converging under changing environmental conditions to create an increasingly challenging picture for fisheries governance in the region. Regional governance systems need to be able to respond to these environmental and political fluctuations by building resilience into the system. This period of change represents a rare opportunity for institutions and nations to evaluate the existing governance landscape and develop climate-proofing policies that support a responsive, adaptive system. With lessons learned from the herring and mackerel 'wars', the risks of continuing with 'business as usual', particularly under accelerated climate change impacts, must not be ignored.

Opportunities already exist within the current landscape, and these can be built upon. The North East Atlantic Fisheries Commission (NEAFC), the regional fisheries management organisation (RFMO) with international legal competence for the region, is identified as collaborative and forwards-looking. An increasingly ecosystem-based approach to fisheries management, joint work with OSPAR (a regional body focused on the conservation of biodiversity), and recent work on allocation criteria for shared and straddling stocks and developing a framework for coastal state negotiations, all point towards an institution with the potential to play a greater overarching role in addressing the governance challenges in the region.

As stocks shift under climate change, 'winners and losers' are created amongst coastal states, requiring effective governance systems to ensure that individual interests in stock exploitation do not see a return to over-fishing. The unilateral quota-setting seen under the fish 'wars' (resulting in fishing well over 100% of the recommended Total Allowable Catch (TAC) for a given species) must not be an option under future arrangements. Ultimately, governance needs to be developed to ensure that the benefits of being part of an agreement outweigh the risks — or penalties — of withdrawing from such an agreement. With this in mind, global best practice in regional, cooperative governance has been reviewed to highlight strengths and strategies which could be applied in climate-proofing Europe's sustainable fisheries. The main findings and recommendations from the review of case studies from Europe and around the world are summarised below.

An over-arching framework, with all relevant parties involved, is needed to coordinate setting catch limits, management measures and allocation agreements across the North East Atlantic region for widely-distributed stocks. This should ensure that TACs and their allocation effectively restrict total catches to levels consistent with scientific advice, and unilateral quota-setting must not be an option. NEAFC could play a key role in the development and implementation of this framework.

A long-term agreement for cooperation in the management of shared stocks, with periodic revisiting and review, can provide stability with appropriate flexibility. Changes in stock distribution under climate change can lead to perceived injustice within a stock management and sharing arrangement. Building in explicit periodic review of the allocation of resources can help to generate stability, allowing arrangements to be revised without parties withdrawing from the agreement. Allocation keys can incorporate various criteria, with different weightings, including both resource distribution and historical participation in the fishery. For example, the distribution of the TAC in the Pacific Halibut Convention automatically adjusts to changes in resource distribution, and resource distribution forms part of the allocation formula in the Vessel Day Scheme of the Parties to the Nauru Agreement (PNA) tuna fishery.

The benefits of being part of a cooperative arrangement must out-weigh the possible benefits of withdrawing. All other ingredients to successful cooperative governance of fishery resources must play in to this one, overriding goal. Having an over-arching framework that governs the management of shared and straddling stocks will form a key part of this.

Agreements with fewer parties tend to be more stable. This is a key tenet of Game Theory, and is borne out by the stability of bilateral agreements such as EU–Norway compared to the multilateral agreements for widely-distributed stocks. Stable agreements generate the foundational resilience necessary to absorb environmental shocks, and adapt to a changing fisheries landscape.

An agreement with more parties that encompasses multiple stocks may provide increased resilience compared to a series of single-stock agreements. Agreements covering multiple stocks allow benefits to be traded off between stocks and with other associated benefits such as access to waters, helping to discourage withdrawal from an agreement. Achieving such an agreement is likely to be a challenging endeavour that will require political will and commitment from all sides.

Transferability and flexibility in fishing opportunities, such as through quota swaps and leasing arrangements, can help to match fishing opportunities with fish availability on the ground, and for industry to access quota of interest even if international allocations change. Transferability of fishing opportunities form a key part of the Vessel Day Scheme in the PNA tuna fishery, ensuring all parties benefit from the agreement, including those whose waters are not in 'prime' fishing grounds. In Europe, greater transparency and flexibility in the transfer of quota could help to alleviate some of the pressure resulting from shifting stocks, particularly under full implementation of the Landing Obligation and continued fixed quota allocation under the EU's relative stability key.

Future fisheries governance will require effective, active, mechanisms for dispute-resolution. Whilst NEAFC has developed a fast-track dispute resolution tool, this has not been applied in a 'fish war' context. Such tools — proactively applied — will be necessary to avoid conflicts over shifting stocks that result from unilateral quota-setting and over-fishing.

Climate resilience will be underpinned by responsive, robust science. The need for scientific evidence to inform policy will continue to grow as climate impacts are felt more acutely in commercial fisheries. Institutions must seek to anticipate future fluctuations in the ecosystem and stock assessment models will provide a means to anticipate future -related impacts, as well as help bridge the interface between science, management and policy. Real-time data and alternative data streams need to be more actively integrated into the science and management decision-making process; technological developments will increase opportunities for these to inform the scientific process

There are demonstrable challenges ahead for the North East Atlantic region, particularly in EU waters. However, the region has many positive attributes that must also be considered. The improving status of many stocks in the region, common agreement on the goal of sustainability, relatively data-rich

fisheries, the small number of key players with a high level of economic development, and significant scientific resources upon which to draw, make it an excellent candidate to set a world class example for climate-resilient management.

The International Council for the Exploration of the Sea (ICES), NEAFC, relevant coastal states, European Member States, and fishing industries and other stakeholders need to come together to discuss and agree on alternative approaches to fisheries management and governance that can respond to the challenges posed by climate change. Resilience in the governance system will be founded on cooperation, with agreed processes and procedures for TAC-setting and quota allocation that can respond to shifts in stock distribution and biomass, coupled with quota trading and exchange mechanisms to balance quota availability with need (with built-in review periods), strong implementation and enforcement of regulations, an effective and responsive dispute resolution procedure, and supported by a strong science–policy interface.

The North East Atlantic region has the incentive, scientific knowledge and capability to successfully address these issues. With the UK's impending exit from the EU, the UK Government has the potential to become a new and significant player in the region, which is likely to require a reimagining of the existing governance frameworks, together with vision and ambition to adjust them to ensure management is responsive, resilient and able to cope with shifts in the system as a result of climate change. With the right level of cooperation, willingness, and ambition from leaders of the North East Atlantic, this region can set a benchmark for fisheries governance in Europe and around the world.

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1 Introduction

> *Changes in fish stock location and abundance presents major challenges…There will be significant issues with respect to access and allocation between affected States and their commercial stakeholders.*
>
> John C. Davis in OECD. 2010

Climate-related impacts on the range and distribution of commercial fish stocks are likely to intensify in coming decades and will increasingly challenge existing institutions and governance arrangements that are in place to manage associated fisheries. This report analyses fisheries governance in the North East Atlantic region and draws on case studies from around the world. The aim is to identify the key features necessary for fisheries governance systems to be able to respond and adapt to climate-related changes in fish stock abundance and distribution, and how to support adaptation of fisheries governance in the North East Atlantic.

This report draws on research that was conducted to contribute to a workshop organised by the Environmental Defense Fund (EDF) and hosted by the International Council for the Exploration of the Sea (ICES), and the considerations resulting from that workshop. It intends to stimulate discussion and debate and contribute to the development of potential options for building a robust and resilient fisheries governance framework in the North East Atlantic region.

1.1 Defining governance

Effective governance of capture fisheries is vital for the optimal and long-term use of marine fisheries resources. Fisheries governance is the sum of the legal, social, economic and political arrangements used to manage fisheries. It has international, national and local dimensions and includes legally binding rules as well as customary social arrangements (FAO, 2001).

The United Nations Food and Agriculture Organization (FAO) defines modern fishery governance as a systemic concept relating to the exercise of economic, political and administrative authority. It is characterised by[1]:

- Guiding principles and goals, both conceptual and operational;
- The ways and means of organisation and coordination;
- The infrastructure of socio-political, economic and legal institutions and instruments;
- The nature and *modus operandi* of the processes;
- The actors and their roles;
- The policies, plans and measures that are produced; as well as
- The outcomes of the exercise.

FAO goes on to explain:

> *'Fishery governance establishes the overriding principles and objectives of the sector. It develops the policy and regulatory frameworks. It connects government with civil society, harmonising individual, sectoral and societal perspectives and maintaining social order and productive socio-ecological systems. It legitimates and balances stakeholders' interaction, enforces decisions and regulations and maintains coherence across jurisdictional, space and time scales. Finally, it conditions the allocation of power, resources and benefits and maintains the governance system capacity to learn and change.'*

[1] http://www.fao.org/fishery/governance/en

Fishery governance needs to coordinate institutional rules and individual actions to incorporate multiple objectives representing both conservation and use. It must reconcile the short-term horizons of individuals with the intergenerational time horizons of society. Under conditions of climate change, governance needs to be able to function in an environment of uncertainty, and needs to be able to adapt as conditions change (Hanna, 2011). Strengthening the adaptability, flexibility and resilience of fishery governance would therefore support its effectiveness under conditions of climate change.

This report focuses on the international dimension of fishery governance rather than on local fleet- or country-specific issues, given the regional focus on the North East Atlantic. Due to the scope of European Union (EU) waters and the multiple individual countries that the Common Fisheries Policy (CFP) encompasses, internal EU issues are also considered. At the international and EU levels, arrangements for the determination and allocation of Total Allowable Catches (TACs) and quotas, and their subsequent exchange, are a key issue in fishery governance and therefore form the primary focus of this report. Institutional issues linked to quota allocation are also considered.

1.2 Climate change and resilience of governance systems

Climate change is expected to affect fish productivity and distribution through changes in recruitment, growth rates and mortality rates, as well as in the migratory patterns of some stocks. These changes may result in winners and losers, between regions or countries as well as within national jurisdictions (OECD, 2010).

Hanna (2011) summarises the climate-induced physical changes that can create a range of biological effects that can impact on fisheries:

- Physical changes: temperature, stratification, changes to coastal upwelling, sea level rise and ocean acidification; and
- Biological effects: changes in primary productivity, stock productivity, distribution, life history strategies, behaviour, ecosystem composition, interactive effects, invasive species, substitution effects, habitat availability, larval dispersal and viability.

The two main types of changes that fisheries management and governance may need to address are changes in fish stock productivity, and changes in fish migrations or the location of their habitats (Hannesson, 2011). Science and management therefore need to be able to respond to these changes, with flexible management systems that account for the increase in variability and uncertainty that may arise. The changes in biological productivity in turn may cause economic impacts on fisheries, notably in terms of the value of the catch, changes to the costs of production, profitability of fishing, employment in fisheries, and the (re)distribution of benefits and costs among stakeholders. Adaptation of fishing capacity and infrastructure may also be required (McIlgorm, 2008).

Where there are changes to fish migrations and stock distribution, individual countries might be affected differently (some positively, some negatively), and this can put existing governance and management arrangements under strain, or make it more difficult to reach agreement where none is in place (Hannesson, 2011). Changes in fish stock distribution will likely affect fish stock sharing arrangements between countries regarding straddling or migratory stocks.

1.3 Structure of this report

The existing fisheries governance arrangements in the North East Atlantic region are outlined in Section 2 and background on international TAC setting and quota allocation mechanisms is provided in Section 3. Section 4 provides a series of case studies from around the world, which offer examples of how fisheries governance has been affected by and adapted to changes in fish stock abundance and distribution. Based on this, and a review of other literature, Section 4.2 identifies the key features of governance systems for being adaptable, robust and resilient in the face of climate change. Section 5 considers how these attributes could be developed in the North East Atlantic region, and conclusions are provided in Section 6.

2 Existing Governance Arrangements in the North East Atlantic

2.1 International

2.1.1 International legal framework

At the international level, multilateral and bilateral treaties and other non-binding instruments form the overarching framework for fisheries governance. Key agreements are:

- 1982 United Nations Convention on the Law of the Sea (UNCLOS), which establishes the jurisdiction of coastal states to manage and exploit sustainably the living and non-living marine resources in their Exclusive Economic Zone (EEZ), to make any surplus available to other states, and to cooperate in the management of shared stocks. It also establishes the right to fish on the high seas, and the duty to take or cooperate in taking conservation measures (Ásmundsson, 2014).
- 1995 United Nations Fish Stocks Agreement (UNFSA), which provides a legal framework for the conservation and management of straddling and highly migratory fish stocks, based on an ecosystem approach and the precautionary approach (UN, 2010). It establishes the matters on which states are expected to agree in order to attain sustainable fisheries management, including management measures, agreement on participatory rights (e.g. allocation of allowable catch and/or effort), decision-making rules, and mechanisms to acquire scientific advice and ensuring compliance with management measures (see Box 1). Furthermore, for states fishing for straddling fish stocks or highly migratory fish stocks, it establishes the duty to cooperate by becoming members of a relevant subregional or regional fisheries management organisation, or by applying the conservation and management measures established (Ásmundsson, 2014).
- 1995 FAO Code of Conduct for Responsible Fisheries, which is a voluntary instrument that establishes principles and standards for the conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity.

Many of the stocks targeted in the North-East Atlantic are shared stocks that are jointly managed between the coastal states (EU, the Faroe Islands, Iceland, Norway and the Russian Federation) through coastal states' agreements, or managed under the inter-governmental North East Atlantic Fisheries Convention[2].

UNFSA explicitly allows for cooperation between States for achieving the sustainable management of fisheries to be carried out through Regional Fisheries Management Organisations (RFMOs) *or* other 'arrangements'. An arrangement can include a cooperative mechanism by two or more States. In the North East Atlantic region, due to the majority of the area being within EEZs, such cooperative arrangements predominate in the mechanisms for managing shared, straddling and highly migratory fish stocks; the North East Atlantic Fisheries Commission (NEAFC) is the regional fisheries management organisation (RFMO) that currently serves as the management body for a small number of stocks that are fished in international waters (see Section 2.1.3 on NEAFC).

[2] The Convention is implemented by the North Atlantic Fisheries Commission (NEAFC), a body with legal status. The Commission is managed by the Secretariat in London. http://www.neafc.org/system/files/Text-of-NEAFC-Convention-04.pdf

Box 1: UNFSA principles

The principles provide by UNFSA in relation to the precautionary approach and conservation and management measures stipulate the requirement to:

- Adopt measures to ensure long-term sustainability;
- Ensure that such measures are based on the best scientific evidence available and are designed to maintain or restore stocks at levels capable of producing maximum sustainable yield;
- Apply the precautionary approach;
- Assess the impacts of fishing on target stocks and species belonging to the same ecosystem;
- Adopt conservation and management measures for species belonging to the same ecosystem;
- Protect marine biodiversity;
- Ensure that levels of fishing capacity and fishing effort do not exceed those commensurate with the sustainable use of fishery resources;
- Collect and share in a timely manner complete and accurate data concerning fishing activities;
- Promote and conduct scientific research in support of conservation and management; and
- Implement and enforce conservation and management measures through effective monitoring, control and surveillance.

Source: Lodge *et al.*, 2007

2.1.2 ICES

ICES is an intergovernmental organisation whose main objective is to increase the scientific knowledge of the marine environment and its living resources and to use this knowledge to provide unbiased, non-political advice to competent authorities[3]. It comprises a network of more than 5,000 scientists from over 690 marine institutes in 20 member countries and beyond. ICES scientific activities focus on the North Atlantic and adjacent European seas (e.g. the Baltic Sea), as well as the Arctic Ocean. The work of ICES is complemented by strategic partnerships, e.g. in the North Pacific and in the Mediterranean Sea (ICES, 2014).

ICES delivers scientific publications, information and management advice requested by member countries and international organisations and commissions such as the Oslo–Paris Commission (OSPAR), the Helsinki Commission – Baltic Marine Environment Protection Commission (HELCOM), NEAFC, the North Atlantic Salmon Conservation Organization (NASCO), and the European Commission (EC). Scientific advice provided includes advice on around 200 stocks in the Baltic Sea and North East Atlantic Ocean, including the overall level of TAC and general technical measures (such as mesh sizes, closed areas for juveniles, spawning etc.) in line with policy objectives and management plans.

Source: ICES website

Figure 1. ICES member countries

ICES has 20 member countries from across the North Atlantic: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Russian Federation, Spain, Sweden, United Kingdom, and the United States of America (USA) (Figure 1).

[3] ICES website, www.ices.dk.

Research on climate change and variability has been part of ICES' work since it was established more than one hundred years ago, but during the past two decades, there has been a growing awareness of the importance of climate change among the marine science community, and a growing focus of ICES' work on climate change.

An External Panel Review of ICES Advisory Services in 2011–2012 found that ICES' advice was relevant and credible, although the communication of the advice could be improved (Hoydal, 2014). In addition, the Panel recommended widening the scope of the ICES advice to include social and economic considerations (e.g. descriptions of the various industry sectors having an impact on the oceans, their economies, and the social conditions of dependent communities, including data on fleet activity and economy, and the dependence of fishing communities on these activities).

2.1.3 NEAFC

NEAFC is a regional fisheries management organisation (RFMO) with international legal competence to manage fisheries in the North East Atlantic. Its management role is mainly on the high seas, but measures can apply to areas within national jurisdiction where the relevant coastal state suggests such an arrangement (Ásmundsson & Corcoran, 2016). The Contracting Parties to NEAFC are Denmark (with respect to the Faroe Islands and Greenland), the EU, Iceland, Norway and the Russian Federation. Cooperating non-contracting parties are Bahamas, Canada, Liberia, New Zealand and St Kitts and St Nevis[4].

Most of the waters within the NEAFC Convention Area are under the fisheries jurisdiction of the Contracting Parties, but there are four large areas of international waters, which make up the NEAFC Regulatory Area (Figure 2). The main fisheries are redfish, mackerel, haddock, herring, blue whiting and deep-sea species. Herring, blue whiting and mackerel are commercially the most significant stocks.

NEAFC has introduced a number of measures to improve management and control illegal, unreported and unregulated (IUU) fishing, including the port control system. Additionally, fisheries management in NEAFC has increasingly been considering the wider ecosystem impacts of fisheries (e.g. bycatch, vulnerable marine ecosystems), and in 2014 NEAFC and OSPAR[5] adopted a Collective Arrangement regarding cooperation and coordination in selected areas beyond national jurisdiction within their convention areas (NEAFC & OSPAR, 2014). It contributes to establishing a more comprehensive approach to the management of human activities in the high seas, by fostering collaboration between NEAFC (responsible for fisheries management) and OSPAR (responsible for biodiversity conservation), and demonstrates the collaborative, cross-sectoral and forward-looking approach of these two regional organisations.

[4] NEAFC website, https://www.neafc.org/managing_fisheries/measures/ra_map, 5 October 2017.

[5] Oslo-Paris Commission for the Protection of the Marine Environment in the North East Atlantic (OSPAR) is a regional mechanism for cooperation to protect the marine environment both within and outside areas of national jurisdiction in the North East Atlantic.

Areas shaded orange are the NEAFC Regulatory Area

Source: NEAFC

Figure 2. The NEAFC area

Management and allocation arrangements

Fish stocks in the NEAFC area fall into three different categories, which affects the management arrangements for each (Table 1). Most of the stocks that NEAFC has jurisdiction over are shared between the NEAFC Regulatory Area and the EEZ of one or several states. NEAFC takes management measures for the whole stock only for pelagic redfish and deep-sea species, which are primarily inside the NEAFC Regulatory Area. For the main stocks (blue whiting, Norwegian spring-spawning herring, mackerel), which predominantly occur within coastal states' waters, first the coastal states agree on TACs and allocations outside of NEAFC through the coastal state agreements (see Section 2.1.4), with scientific advice provided by ICES. Subsequently, NEAFC takes management measures for the part of

the stock that occurs within the Regulatory Area (with the quota for this area being agreed upon by the coastal states).

Table 1. Categories of fish stocks in NEAFC and management arrangements

Category	Management Arrangements
Primarily inside the NEAFC Regulatory Area (pelagic redfish, deep-sea species)	NEAFC takes management measures for the whole stock.
Both inside the Regulatory Area and the EEZ of a single coastal state (Rockall haddock)	NEAFC takes management measures for the part of the stock that occurs within the Regulatory Area.
Both inside the Regulatory Area and the EEZs of several coastal states (blue whiting, Norwegian spring-spawning (Atlanto-scandian) herring, mackerel)	NEAFC takes management measures for the part of the stock that occurs within the Regulatory Area, but only after the relevant coastal states have agreed on TACs and allocations outside of NEAFC. Where there is no coastal state agreement, each coastal state determines its own management plan, including TAC.

Source: OECD, 2009.

The result is that NEAFC's current role is relatively constrained. Rather than NEAFC being the main conduit for negotiations and agreements over management and allocation of shared stocks, the coastal states take the main decisions (often on a stock-by-stock basis, with different coastal states involved in the negotiations for the different stocks). NEAFC fisheries conservation and management measures only apply to the portion of the stock within the NEAFC Regulatory Area (unless parties agree that NEAFC measures should also apply to areas within national jurisdiction). This is explored further in Section 2.1.4 on coastal states' arrangements. The NEAFC Performance Review highlighted that "NEAFC currently operates on the assumption that conservation as well as optimal utilization objectives are being met in the management plans developed by coastal States, where such plans exist. … When there is not coastal State agreement, each coastal State determines its own management plan including TAC. In these situations, NEAFC has limited to no scope for management within its Regulatory Area" (FAO, 2015).

Repeated and frequent failures of coastal states to agree on allocation of the major stocks were highlighted by the First (2006) and Second (2014) NEAFC Performance Reviews as a key issue (Molenar, 2017), and others have previously raised the question of whether NEAFC should have a greater role in the management of widely distributed stocks that migrate through the various coastal states' economic zones (Standal, 2006). The reasons for the inability to reach consensus allocations for stocks are complex (NEAFC, 2014). In some cases, the lack of agreement relates to widely distributed stocks, where the current resource distribution differs from historical distribution and participation in the fishery (e.g. mackerel) (and for which management is dependent on the coastal states' negotiations outside of NEAFC). In other cases, it relates to stocks managed by NEAFC, where disputes remain about the productivity and stock structure in various areas and depths (e.g. redfish stocks).

Prior to the mid-1990s, the introduction of TACs in NEAFC required a two-thirds majority and the consent of all Contracting Parties — an objection by a single party was sufficient to invalidate the recommendation. Proposed recommendations could also be objected to by Contracting Parties, in which case they were not binding for that party. The introduction of a fast-track dispute settlement mechanism in 2004 strengthened decision-making, making it more difficult for objections to be raised. However, the dispute settlement mechanism has not been used to arbitrate in matters relating to TAC setting and quota allocations (Dankel *et al.*, 2015).

The second Performance Review (NEAFC, 2014) found that the current annual ad hoc negotiations between coastal states were not the best approach to setting TACs and determining allocations. Disputes over TACs and allocations result in overall catches exceeding scientific advice, potentially undermining the health of stocks or creating risks of stock depletion, which is inconsistent with the precautionary approach. The Performance Review recommended that NEAFC agrees on and applies objective criteria for determining allocations. It was highlighted that criteria-based allocation keys should allow allocations to respond to changes, and would be likely to include both historical levels of participation and the distribution of the stock under consideration. As a result, two Working Groups were established at the 34th Annual Meeting of NEAFC in 2015:

- Working Group on Allocation Criteria; and
- Working Group on a Framework for Coastal State Negotiations.

The Working Group on Allocation Criteria agreed that a major criterion[6] in allocation exercises should be zonal attachment (see Box 2), based on the biomass in each zone, integrated over the whole year. Other criteria were discussed but there was no consensus on the definition or description of criteria, nor on explicit weighting of the different criteria (NEAFC, 2016). The Working Group on a Framework for Coastal State Negotiations aims to develop principles, guidelines and good practice aimed at enhancing predictability and cost-effectiveness of negotiations, reducing uncertainty and promoting an atmosphere of trust. The 2016 Annual Meeting recognised the progress that the groups have made and mandated them to continue their work in 2017 with the aim of presenting formal proposals to the 2017 Annual Meeting. The outcomes of the 2017 Annual Meeting were not available at the time of this report going to press.

Box 2: Zonal attachment

Zonal attachment is a way of defining how the amount of fish to be caught from a shared stock should be divided amongst the coastal states in whose waters the stock occurs. The zonal attachment of a stock is the share of the stock residing within a particular country's EEZ, weighted by the time it spends in a country's zone over a year, if necessary (Engesæter, 1993, cited in Hannesson, 2011). Different approaches, formulae and data sources can be used for calculating zonal attachment. Further details are provided in Section 3.

2.1.4 Coastal states' arrangements

A number of bilateral and multilateral coastal states' arrangements are in place in the North East Atlantic for the management of shared stocks, including arrangements for access to waters, sharing of TACs, and sometimes (in the bilateral agreements) exchange of quotas. These form a complex picture of complementary and overlapping arrangements (see Figure 3).

Bilateral agreements

Bilateral agreements exist between most of the coastal states in the North East Atlantic region. The bilateral agreements are:

- EU–Faroe Islands;
- EU–Greenland;
- EU–Iceland (currently suspended due to the mackerel dispute);
- EU–Norway;

[6] Allocation criteria are discussed further in Section 3.

- Faroe Islands–Iceland;
- Faroe Islands–Norway;
- Faroe Islands–Russian Federation;
- Norway–Greenland;
- Norway–Russian Federation.

The EU's agreements, and specifically the EU-Norway agreement, are explored in more detail below as an example of the bilateral coastal states' agreements. Bilateral agreements often cover multiple stocks that are shared between the two parties. They may include agreed management plans for the stocks in question, the sharing of TACs between the parties, quota transfers (exchanges or swaps) between the parties, and reciprocal access to waters for fishing vessels of the two parties.

The EU has bilateral 'northern' fishing agreements with Norway, Iceland and the Faroe Islands, which are based on the reciprocal exchange of quotas. The EU also has a sustainable fisheries partnership agreement with Greenland, which provides fishing opportunities for EU vessels in exchange for a financial contribution for access and the support and implementation of Greenlandic sectoral fisheries policy.

Where stocks are jointly managed, the parties to the agreement establish the TAC based on scientific advice and the agreed management plan. The TAC is then divided between the parties according to an agreed formula, which may be based, *inter alia,* on historical fishing patterns or zonal attachment (see Section 3). Adjustments to quota allocation within each year can take place through mutually-agreed quota exchanges. These are based on each party's current interest in fishing the stocks in question, with the fishing industry involved in identifying fishing opportunities of interest under the agreements. Quota exchanges are usually agreed at the beginning of the year; further exchanges can take place during the year but are unusual and require a further exchange of letters between the delegations.

Agreements encompassing multiple stocks may be more resilient than agreements for a single stock (Hannesson, 2013; Niemmenen *et al.*, 2016), and the EU–Norway agreement seems to bear this out. The agreement has been in place since the 1970s, and although there have been some years when agreement has been difficult to reach, geography and biology mean that there is no realistic alternative to cooperation on the management of shared stocks[7]. The exchange of quotas and provision of reciprocal access to waters also play a role in making the agreement important for both sides. The division of quotas for shared North Sea stocks between Norway and the EU is based on an investigation carried out in the early 1980s and has withstood the test of time (with the exception of North Sea herring, for which zonal attachment percentages were subsequently agreed in the 1990s (Hannesson, 2011)). Additionally, the same 'cod equivalents' key has been used to determine relative values of different species for quota swaps, despite changes in the market prices for these species.

The durability of the agreement (and the zonal attachment and cod equivalents keys in place) may be partly due to there being only two parties involved — game theory shows that cooperative arrangements between fewer players are more stable than those with more players — but also a recognition that if changes were to be made to the allocations, there would be winners and losers on both sides, so it may be prudent to maintain the accepted divisions of each stock and quota exchange arrangements. Therefore, in the absence of an agreed-upon process and periodicity regarding how and when to update the key, the original key remains in place. However, over the long term, it may be that gains and losses for each party balance each other out across the mix of species covered by the agreement (Walmsley, 2014).

[7] http://nffo.org.uk/news/eunorway-negotiations.html

Multilateral agreements

In addition to the bilateral coastal states' agreements, there are multilateral arrangements for the management of specific stocks. For example, there is:

- A tripartite agreement for Atlantic mackerel between the EU, the Faroe Islands and Norway from 2014–2018, which also provides an allocation to Russia (Iceland is not party to the agreement, although they establish their own quota to fish Atlantic mackerel, see further detail in Section 4.1.1);
- An agreement between the EU, the Faroe Islands, Iceland, Norway and the Russian Federation for Norwegian spring-spawning herring;
- An agreement between the EU, the Faroe Islands, Iceland and Norway for blue whiting, which also provides an allocation to NEAFC for Greenland and Russia.

While these multilateral agreements improve the management of shared stocks in the respective coastal state areas, their existence masks the fact that there is a lack of overarching, comprehensive agreement (including all interested parties/coastal states) for any of these stocks: Iceland is not party to the agreement on mackerel, setting its own unilateral quotas; coastal states agree on the total catch limit for blue whiting, but a lack of agreement over allocation means that they set unilateral quotas that exceed the scientific advice (see Box 3); there have been difficulties in reaching agreement on allocation among the coastal states for herring in recent years, resulting in conservation and management measures not being comprehensive (FAO, 2017) and catches exceeding scientific advice (ICES, 2016).

The majority of the stocks in the North East Atlantic area fall within coastal states' waters. Consultations on conservation and management are held between delegations from the relevant coastal states for areas under national jurisdiction, to agree on TACs and their allocation between the parties, with a portion of the agreed TAC being allocated to NEAFC (to be fished against by non-coastal states).

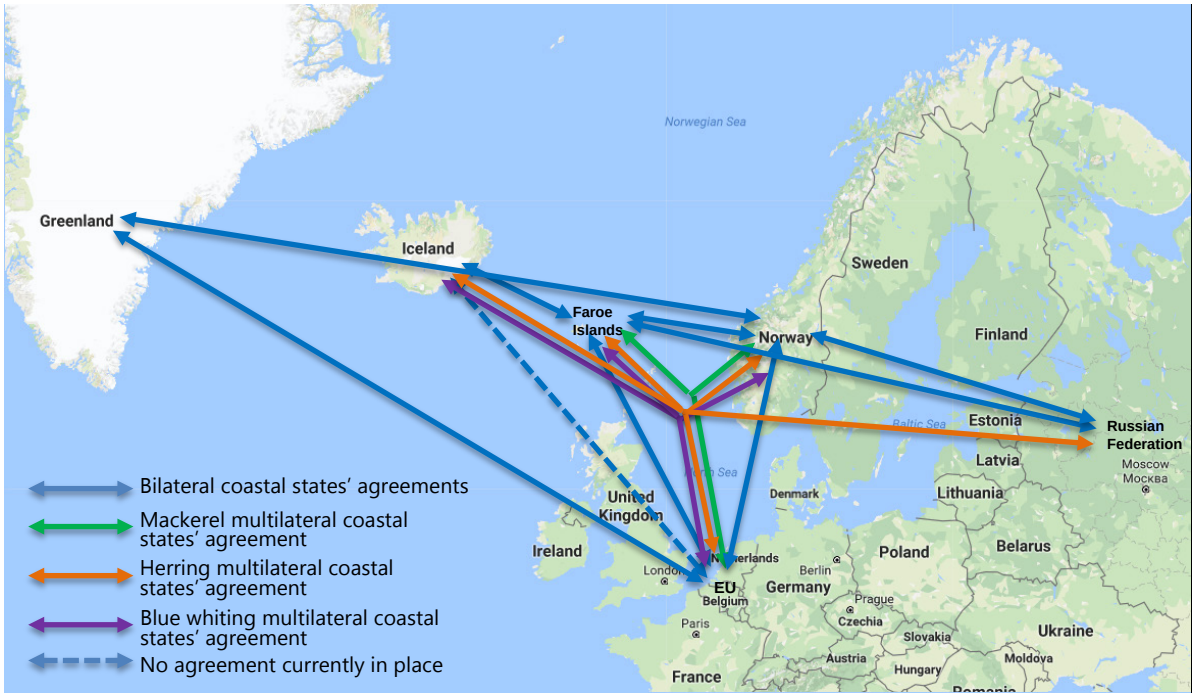
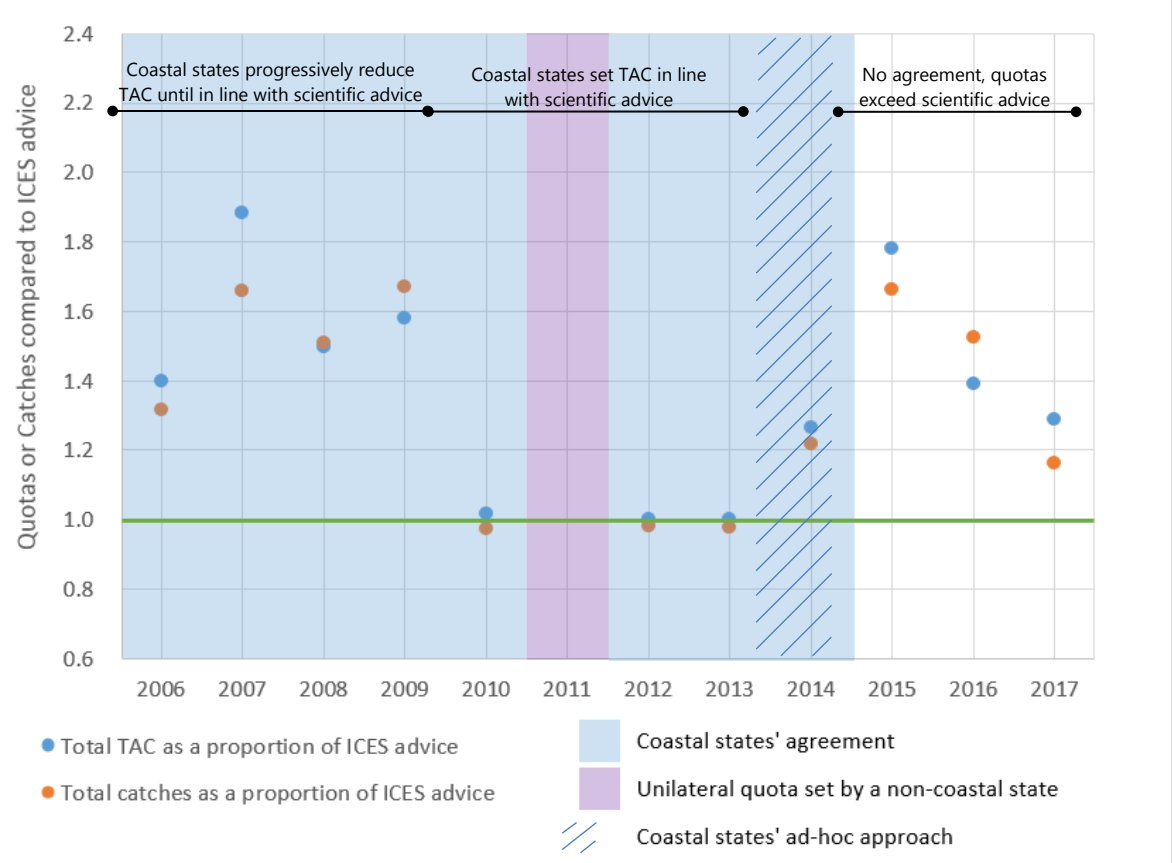


Figure 3. Bilateral coastal states' agreements and multilateral herring, mackerel and blue whiting agreements in the North East Atlantic

Box 3: Blue whiting

In the 1990s, fishing nations agreed that a cooperative sharing scheme was necessary to prevent overexploitation of blue whiting, but could not agree on how to share the TAC. Countries often set their own quotas, which greatly exceeded the recommended TAC.

Between 2002 and 2006, coastal states were unable to agree to a management regime for the blue whiting stock. Catches had been exceeding the TACs and the stock was being harvested outside of safe biological limits. Norway claimed that the stock should be managed according to the 'zone appurtenance' or zonal attachment (TACs shared according to the proportion of the stock located in each nation's waters) and claimed 37% of the TAC. The EU claimed that TAC allocation should be on the basis of recorded catches from each state's exclusive zones (irrespective of which nation carries out the catching), demanding 58% of the TAC. The Faroe Islands and Iceland also followed the EU approach, claiming 31% and 22% respectively. Economic dependency was also included as an argument in some cases. Historical fishing rights were also used in arguments of all sides to support their position or invalidate others. The sum of the TAC claims totalled 160% (OECD, 2009, Bailey *et al.*, no date.).



Source: ICES (2017a), Agreed records of conclusions of fisheries negotiations between coastal states

Note: TAC and catches compared to ICES advice are not shown for 2011, when ICES advice was for a range (40,100–223,333t), due to uncertainty in the assessment and the transition to an MSY approach, and was greatly reduced from previous years. The coastal states set their TAC below the lowest recommended TAC (40,100t). Russia (not a coastal state but a fishing party within NEAFC areas) set its own quota consistent with the level for previous years (45,000t), resulting in overall quotas that exceeded the lowest level of scientific advice by 100%, but that were only 40% of the upper level of scientific advice.

From 2006, the four coastal states (EU, Faroe Islands, Iceland and Norway) agreed a long-term management plan, maximum catch limits and allocation based on fixed percentages (EU 30.5%, Faroe Islands 26.1%, Iceland 17.6%, Norway 25.7%). The multi-annual management plan would progressively reduce the TAC until fishing mortality reached the target level[8]. This arrangement was successful in reducing the total catch limits and catches, and over the years 2010–2013 these were broadly in line with scientific advice (see table below). This arrangement persisted until 2014, when an 'ad hoc arrangement' was agreed (which did not follow the agreed management plan, due to changes in the stock assessment methodology and data issues), but in 2015–2017, no agreement was reached. Although nominally the coastal states agreed on the overall TAC in line with ICES' advice, each party set its own unilateral quotas, the total of which exceeded the scientific advice. On average, quotas were set 1.5 times the level of scientific advice over the period 2015–2017. The breakdown in the arrangements followed the report of a NEAFC Working Group (which had been convened on request of the coastal states) to collate information on the distribution of blue whiting in the North East Atlantic (NEAFC, 2013), which indicated that the quota allocation percentages might not be in line with the spatial distribution of the stock. For 2018, no coastal states agreement has yet been reached.

2.2 Domestic policies

Each coastal state in the region has its own policy for managing fisheries and allocating quota to fleets. In Norway, quota is reserved by the state for research purposes and for exchange with other countries under bilateral agreements (e.g. with the EU), and the remainder is allocated to different fleet segments. The allocation to fleets can be through individual quotas or quota pools, depending on the fleet segment (Walmsley, 2014). Iceland manages its fisheries through a system of individual transferable quotas (ITQs) (Arnason, 2005), whereas the Faroe Islands use a system of total allowable effort in mixed fisheries for cod, haddock and saithe, controlled through licensing, days-at-sea and closed areas (Hegland & Hopkins, 2014). The EU's Common Fisheries Policy (CFP) uses a system based on the setting of TACs and quotas for the majority of stocks. The quotas are allocated to individual Member States through the principle of Relative Stability, which seeks to guarantee the same proportion of the EU's quota each year for a Member State, in relation to a species in a fishing area. Individual Member States then allocate national quota to their domestic fleets. The CFP is analysed in greater detail below given it is a key policy to consider when evaluating the overarching governance regime for fisheries in the North East Atlantic region.

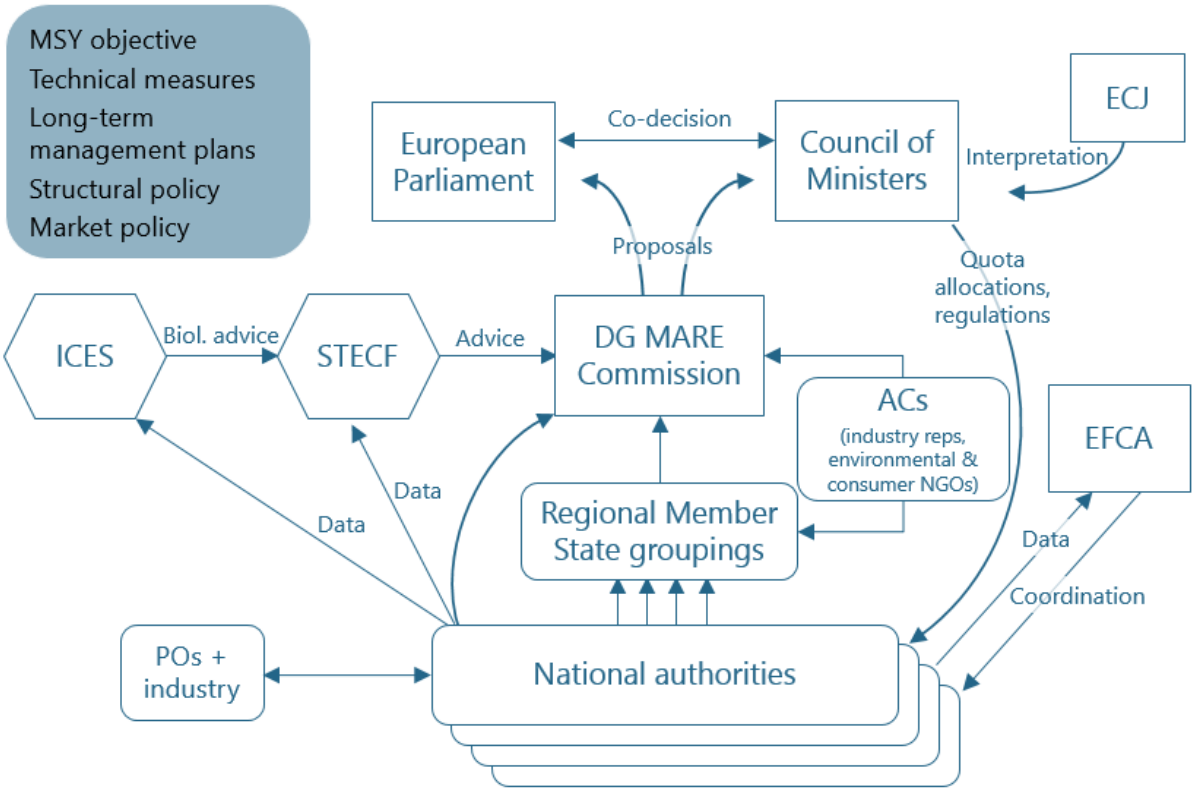
2.2.1 EU Common Fisheries Policy

The EU's CFP was first introduced in the 1970s and provides equal access to European fishing fleets to EU waters (subject to holding rights or quota to fish). The CFP sets the rules for fishing to ensure sustainability, including setting TACs and technical regulations, monitoring the size of the European fishing fleet, the common organisation of the market, providing funding for the fisheries and aquaculture sectors, scientific research and data collection, and international aspects. The CFP is revised every ten years, and the most recent reform came into force on 1 January 2014, introducing more regionalised decision-making and an obligation to land all catches of species managed through TACs.

[8] https://www.regjeringen.no/globalassets/upload/kilde/fkd/prm/2005/0107/ddd/pdfv/267638-2006_agreed_record_coastal_states.pdf Accessed 11 October 2017.

Institutional structures, co-decision and regionalisation

The institutional structures of the CFP are shown in Figure 4. Member State national authorities and industry provide data to institutions such as ICES, the Scientific, Technical and Economic Committee for Fisheries (STECF), and the European Commission and European Fisheries Control Agency (EFCA).



Note: Excludes the external dimension of the CFP.

Figure 4. Institutional structures of the CFP for internal policy

A number of instruments and measures are pursued through regionalisation under the CFP: multiannual plans, discard plans, establishment of fish stock recovery areas, and conservation measures necessary for compliance with obligations under EU environmental legislation.[9] In these instances, Member States with a direct management interest may submit a joint recommendation to the European Commission. For this purpose, regional 'High-Level Groups' (HLGs) comprising the fisheries directors of the Member States in question, have been formed in order to develop joint recommendations[10]. Advisory Councils (ACs) must be consulted on these recommendations. ACs are stakeholder-led organisations, with a membership of 60% industry representatives and 40% other interest groups (e.g. environmental and consumer NGOs), that provide recommendations on management issues to the Commission and to Member States. They are not involved directly in decision-making, but attend the HLG meetings to present AC advice. The increasingly regionalised decision-making processes in the EU have also been highlighted as representing an obstacle to cooperation with interests outside the EU, such as Norway (House of Lords, 2016).

[9] https://ec.europa.eu/fisheries/cfp/fishing_rules/regionalisation.

[10] Notably, 'Baltfish' comprising Denmark, Estonia, Finland, Germany Latvia, Lithuania, Poland and Sweden; and the 'Scheveningen Group' comprising Belgium, Denmark, Germany, France, the Netherlands, Sweden and the United Kingdom.

The European Commission (Directorate-General for Maritime and Fisheries, DG MARE) makes proposals for legislation, which are passed to the Council of Ministers and the European Parliament under the Co-decision process. The exception is the annual setting of TACs and quotas, which is implemented by the Council of Ministers.

EU TACs, quotas and relative stability

Many fish stocks in the North Sea and North East Atlantic are managed through the setting of TACs, with quotas shared amongst Member States. The EU's overall quota is allocated to individual Member States according to the principle of 'Relative Stability', which was established on the basis of historic reported landings over a five-year reference period (1973–1978), and was the subject of intense political negotiation. The original allocation took into account the needs of coastal areas heavily dependent on fisheries, lost fishing opportunities arising from the declaration of 200-mile limits by third countries[11], and national priorities in terms of target stocks (FAO, 2000). Though rare, because of the difficulty of re-negotiating hard-won agreements, from time to time adjustments have been made to the Relative Stability key, such as when necessary to accommodate the accession of new Member States (Peñas-Lado, 2016).

Individual Member States have responsibility for the way in which the national quota allocation is allocated to their fishing vessels, and the way it is managed. As a result, a variety of different approaches have emerged in different Member States and for different fisheries and fleet segments, from community quota pools, individual quotas and individual transferable quotas (MRAG *et al.,* 2009). Article 17 of the current CFP (Regulation (EU) No 1380/2013) introduced a requirement for the allocation of fishing opportunities by Member States to be based on 'transparent and objective criteria including those of an environmental, social and economic nature'.

Where the fishing fleet of a Member State requires more quota of a stock than its national allocation, Member States can agree to in-year quota swaps. These are negotiated and agreed between the Member States throughout the year (often on the basis of requests from industry), and the quota subsequently distributed to the fishing industry. To some extent, quota swaps can be used to address some situations where there is insufficient quota, but this depends on the availability of other quota to swap out, and the willingness of other Member States to swap the quota of interest.

Where stocks have changed distribution, and have increased or decreased the amount of biomass in some areas, this can result in a mis-match between the amount of quota that a Member State receives for that stock, and the available fish biomass on the fishing grounds. For example, European hake (*Merluccius merluccius*) has increased in biomass between 2004 and 2011 and expanded its range and distribution, particularly in the North Sea (Baudron & Fernandes, 2014). Because it was not historically fished in that area,, countries bordering the North Sea receive very little quota for this species under the Relative Stability key, yet hake are becoming significantly more abundant on the fishing grounds.

The current EU quota system means that in order to pursue a species that has become newly abundant in a particular fishing area, fishers must have a means to access quota for the species to cover their catch. While many Member States' quota management systems have some degree of transferability of quota on a permanent or temporary (leasing) basis, a mismatch between quota availability and need for quota is occurring between Member States under the existing Relative Stability key. For example, Denmark holds much of the quota for North Sea whiting, yet in recent years large numbers of the species have been found off the UK's east coast. There is insufficient UK quota for whiting and therefore the UK catches much of its whiting as by-catch, which is currently discarded. This occurs despite much of the Danish quota going unused (Inglis & MacLennan, 2011).

[11] i.e. countries that are not members of the European Union (or, in the 1970s, of the European Economic Community).

The 2011 Proposal for the Reform of the CFP (COM(2011) 425 final) promulgated the use of mandatory transferable rights (called transferable fishing concessions or TFCs in the proposal) on fishing opportunities for regulated stocks for all vessels with the exception of vessels under 12 metres with passive gear, with the aim of better balancing fishing capacity with available fishing opportunities. TFCs were also considered as a mechanism to help facilitate the acquisition of an appropriate quota mix for vessels in different areas. However, despite the fact that many Member States already employ such systems voluntarily, there was significant opposition to the introduction of this mandatory scheme, which was seen as impinging on an area of Member State competence, creating concerns that it would result in the over-concentration of quota. Ultimately the proposal for mandatory TFCs was dropped from the reform, although the legislation authorises (rather than requires) the use of TFCs, as well as the use of European Maritime and Fisheries Fund (EMFF) financing to create or support such systems.

The introduction of a Landing Obligation aims to end the discarding of species that are managed under TACs and quotas. It is being introduced in a phased approach, and took effect on pelagic species on 1 January 2015, and for demersal species in subsequent years, until all TAC species will be included by 1 January 2019.

Whereas previously fishers may have discarded catches for which they did not have quota, the introduction of the Landing Obligation places further constraints on fishing. Coupled with the increasing mismatch between quota allocations and the distribution of species biomass, a vessel without enough quota to catch a particularly abundant species runs the risk of running out of quota for that species, whilst still holding quota for other species, resulting in an early end to fishing. This occurrence, known as a 'choke', is likely to become an increasingly prevalent issue as more species and fishing segments are brought under the Landing Obligation.

In sum, this combination of a fixed quota allocation key (Relative Stability), restrictions on quota trading and swaps (which is typically taken forward at the Member State level rather than between fishing businesses or producer organisations), changes to stock distributions as a result of climate change and recovering stock biomass due to management intervention, and the constraints of the Landing Obligation, are resulting in a 'perfect storm' of conditions that is proving very challenging, but which needs to be addressed (Penas-Lado, *pers. comm.*).

Other CFP measures

While outside the purview of this report, other CFP measures include technical conservation, management of fleet sizes, financial support for fisheries and management of fishing practices in international waters.

3 International TAC and Quota Allocation Mechanisms

For shared stocks, relevant parties need to agree on a TAC, as well as an allocation agreement on how to divide the TAC. The lack of an agreed allocation key means that even if the parties agree on the overall TAC, each party may set its own unilateral quota for the portion of the TAC that they believe is 'theirs'. In the absence of an allocation agreement, the sum of these unilateral quotas is likely to exceed the TAC.

Several principles have been invoked in the resolution of the question of how the amount of fish to be caught from a stock should be divided among the parties. The key principles that have been used internationally are:

- Historic track record (of, for example, fishing effort or recorded landings); and
- Zonal attachment.

Other criteria may also be used (see Section 3.1.3). The preference for one type of approach or another depends on the party's interest. For example, in fisheries for widely ranging stocks, fishing nations often prefer the historic track record approach, as it guarantees them a share of the TAC that is in line with their past participation in the fishery. Countries that are coastal states (where the resource distribution overlaps their EEZ), and have not previously participated in the fishery, may prefer zonal attachment, which would provide them with a portion of the TAC despite not having previously participated in the fishery.

At the international level, quota allocations are discussed within NEAFC for stocks that do not straddle EEZs (i.e. redfish and deep-sea species). For other stocks, quota allocations are agreed between individual coastal states (either bilaterally or multilaterally, depending on the distribution of the stock). Allocations for stocks in NEAFC have been based on historic catches. In the case of redfish, this approach was adopted because of the inability of coastal states to agree on a zonal attachment model that was proposed (Peñas Lado, *pers. comm.*). However, bilateral arrangements in the North East Atlantic are often based on the principle of zonal attachment.

Reaching an allocation agreement can be difficult, and as a result there is usually no timeframe built in to agreements to review or revise them. There are some exceptions. For example, the tripartite agreement on mackerel between the EU, Faroe Islands and Norway applies for the period 2014–2018, after which it will need to be renegotiated. The Faroe Islands were prepared to agree to an allocation key, but only for a specific time period, so that if the distribution of the mackerel stock shifts further, renegotiation of the allocation key could be undertaken.

3.1.1 Historic track record

For allocations based on historic track record, the share of the TAC is determined by each party's landings or effort during a reference period. The reference period may be fixed or rolling, however, the latter has often suffered from strategic fishing activities or over-declaration of landings in an attempt to maximise the proportion of quota received in subsequent years. For example, the UK originally used rolling track records for quota allocation to vessels, but switched to a fixed reference period to avoid this kind of manipulation (Hatcher *et al.,* 2002).

The CFP uses historic track record as one of the key factors in determining the distribution of the EU's quota among Member States (see Section 2.2.1). Historic track record is also frequently used in national systems to allocate quota to individual vessels or groups of vessels, including in Denmark, Sweden, Germany and the UK (MRAG *et al*., 2009). Historic track record may be used on its own, or combined with other factors, e.g. vessel power, socio-economic and market factors.

Allocations based on historic track record can be problematic for vessels that were inactive for any reason during the agreed reference period. It also favours those fleets that may have contributed to over-exploitation of stocks in the past, and penalises those countries that may have a legitimate interest in the fishery and have not over-exploited it in the past (FAO, 2002; Willman, no date; Caddy & Seijo, 2005). Furthermore, it reflects past fishing patterns (relating to stock distribution and fleet specialisation) and may not reflect contemporary stock abundance and distribution.

3.1.2 Zonal attachment

The zonal attachment of a stock is the share of the stock residing within a particular country's EEZ, weighted by the time it spends in a country's zone over a year, if necessary (Engesæter, 1993, cited in Hannesson, 2011). This then determines or influences the share of the TAC that each country receives for that stock (Bjørndal and Ekerhovd 2013). For herring, allocation to Contracting Parties is based on zonal attachment, with the stock size in a given zone multiplied by the duration of the stay to determine the allowable biomass removals for that zone (Bailey *et al.,* no date). Zonal attachment can help to overcome disputes on how to share the TAC of shared and widely-ranging stocks and is used for allocation of shared stocks between the EU and Norway (Bjørndal and Lindroos 2004; Hannesson 2013).

Different models, criteria and weightings can be used in determining zonal attachment. Specific life stages can be included (as in the Hamre model [1993]) used in the 1995 work on Norwegian spring-spawning herring) or all life stages. Fishery-dependent (for example, catch data by month and by square [0.5° latitude, 1° longitude] or by economic zone) and fishery-independent (for example, survey data on biomass and abundance or appropriate proxies, by age and by area) data can be used (Coastal States Working Group, 2013). Aspects that can be taken into account include:

- Mature and immature components of the stock, or fishable and non-fishable biomass;
- Production (areas or seasons in which the fish reproduce, grow and die); and
- The location of spawning and nursery grounds.

In practice, there can be difficulties in applying zonal attachment and achieving agreement. The confidence of the parties involved can be undermined by disagreement on the model used, uncertainty in the data feeding in to the model, and ambiguity around the weighting of various criteria in the model, which can result in stakeholders feeling that the model is a 'black box'. For example, a proposal by Iceland to NEAFC for allocation of redfish using a sophisticated zonal attachment model was not accepted by the other parties due to a lack of trust in the model and its outputs (Peñas Lado, *pers. comm.).*

Based on game theory modelling studies, Hannesson (2013) concluded that where zonal attachment varies over time, the scope for cooperation is greater if countries share more than one stock, as long as each country is a dominant player (i.e. receives a larger share of the stock on average) for one of the stocks. In contrast, where one country has only a minor interest in all the stocks under consideration, zonal attachment may not be an appropriate way of allocating the TAC because it would give the coastal state with a minor interest a worse outcome than if it were to pursue its own interest in the absence of cooperation (Hannesson, 2013). This is the case for Iceland and the Faroe Islands for mackerel, herring and blue whiting. In such cases, cooperation can still be achieved, but

probably through providing the minor players with more generous shares of quotas than zonal attachment would prescribe. Niemmenen *et al.* (2016) also showed that for Baltic Sea fisheries for cod, herring and sprat, multispecies management increases the scope of cooperation compared to management of each species separately, as the benefits from harvesting other species play a role.

Zonal attachment can also raise disputes as well as settle them. Changes in fish migration patterns can be caused by changes in environmental conditions and increases or decreases in spawning stock biomass (among other factors). These types of changes can cause problems for agreements based on zonal attachment, which are based on the distribution of the stock at a particular point in time. The disputes over mackerel, herring and blue whiting in the North-East Atlantic are examples of this. For mackerel, changing migration patterns (possibly brought about by an increase in stock size and climate change) have resulted in the stock expanding into Icelandic and Faeroese waters, where it was not previously prevalent, and these coastal states thus requesting a proportionately greater share of the TAC. In the NEAFC blue whiting fishery, coastal states requested a study on the zonal attachment of the stock in 2009[12]. As a result of the study (NEAFC, 2013), the EU indicated its intention to request a re-evaluation of the allocation of the TAC, and in 2015 the allocation arrangement broke down, with coastal states setting unilateral quotas (see Box 3).

3.1.3 Other criteria

Other criteria may be invoked in the determination of allocations, either instead of or in addition to historic track record and zonal attachment. Other criteria include vessel capacity (tonnage or power), or socio-economic factors such as employment provision or dependency.

UNCLOS does not specify criteria for the allocation of fishing rights, but Article 11 of UNFSA sets out a number of principles to be taken into account for the allocation of participant rights for *new members or participants* (in addition to the status of the stocks and the existing level of fishing effort in the fishery):

i) The respective interests, fishing patterns and fishing practices of new and existing members or participants;
ii) The respective contributions of new and existing members or participants to conservation and management of the stocks, to the collection and provision of accurate data and to the conduct of scientific research on the stocks;
iii) The needs of coastal fishing communities which are dependent mainly on fishing for the stocks;
iv) The needs of coastal states whose economies are overwhelmingly dependent on the exploitation of living marine resources; and
v) The interests of developing states from the subregion or region in whose areas of national jurisdiction the stocks also occur.

Dankel *et al.* (2015) argue that track record of fisheries, historic allocation keys and other evidence of previous fishing practices should not be the focus of mechanisms for sharing TACs between interested parties (coastal states and non-coastal interested parties). Instead, they propose an approach that is based on zonal attachment (spatio-temporal distribution of stocks), modified by principles (i), (ii) and (iv) of the above list. Principle (iii) is considered to be of limited relevance at international level due to difficulties in operationalising it, although it could be implemented for allocation decisions at the national level. Principle (v) is not relevant in the North East Atlantic where there are no 'developing states'.

[12] https://www.regjeringen.no/globalassets/upload/fkd/vedlegg/kvoteavtaler/2010/kolmule/kolmuleavtale-for-2010.pdf. Accessed 11 October 2017.

How to assess each of the principles, and what weight to give to each one in an allocation system, is of fundamental importance and likely to be subject to intense discussion and negotiation. Indeed, the development of the NEAFC Working Group on allocation criteria found that there was no common understanding on the meaning or interpretation of a number of criteria under consideration, nor on the relative importance in quantitative terms (NEAFC, 2016).

4 Governance Adaptations to Changing Conditions

Changing climate conditions and shifts in the distribution and abundance of fish stocks can put existing management and governance arrangements under strain. This section explores a series of case studies that provide examples of the effect of changing climate conditions, or shifts in stock distributions, on fisheries management and governance arrangements and how systems have been adapted to deal with this. The case studies are used to develop insights on key features for resilient governance systems (Section 4.2) and how they can be applied to the North East Atlantic (Section 5). In particular, they provide examples of:

- Ensuring allocation keys adapt to changing distributions and abundance;
- Flexibility in approach providing resilience over time;
- Where arrangements have broken down due to a lack of resilience, and new arrangements have been established.

The case studies explored are:

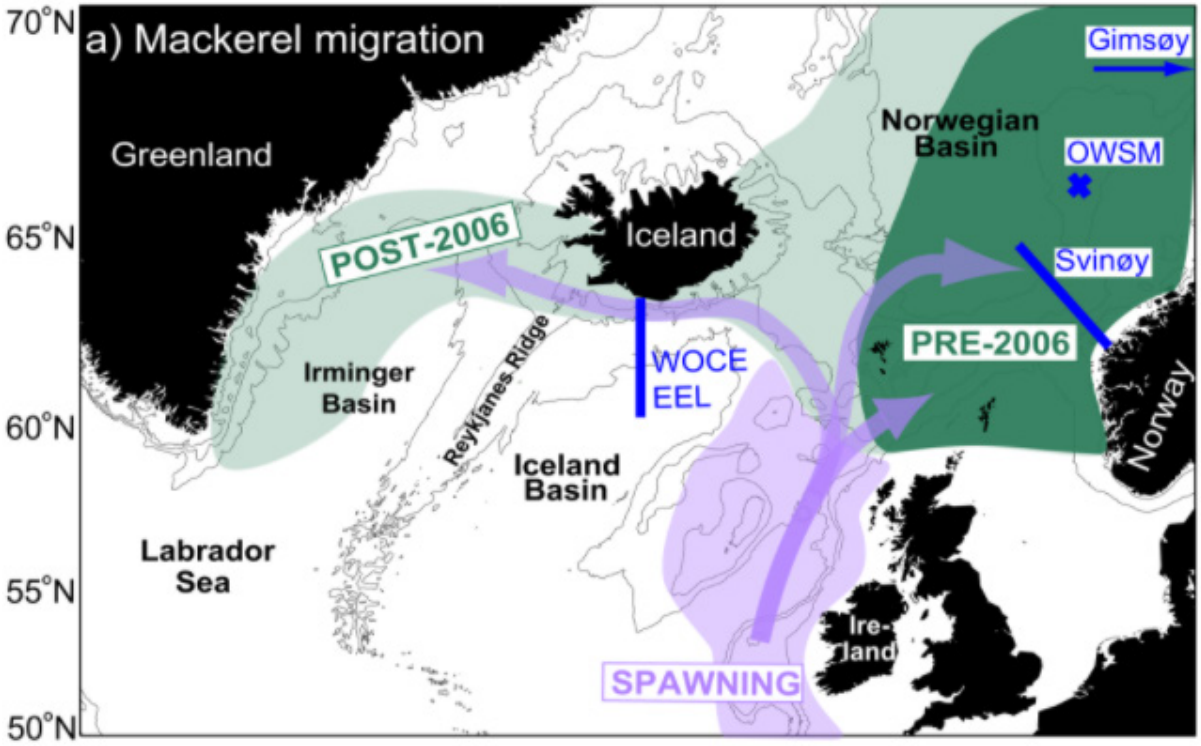
- Atlantic mackerel;
- Norwegian spring-spawning herring;
- North Sea herring;
- Canada–USA Halibut Convention;
- USA–Canada Pacific Salmon Agreement; and
- Parties to the Nauru Agreement Vessel Day Scheme.

4.1 Case studies

4.1.1 Atlantic mackerel

Over the past decade, there has been a long-running dispute over mackerel stocks in the North East Atlantic, between the EU and Norway on one side, and the Faroe Islands and Iceland on the other. Expansion of the stock, and changes to its migratory pattern since the mid-2000s, resulted in some parties claiming a greater proportion of the TAC. Hence, the quota sharing arrangements broke down in 2009 and a comprehensive agreement that involves all relevant parties is still elusive.

The mackerel stock spawns along the European shelf, and then gradually moves northwards into the summer feeding areas in the Norwegian Sea (Figure 5). Since 2006, warming waters in the North East Atlantic, increasing stock size and density over the period 2007–2014, and nutrient depletion are likely to have contributed to this expansion in the migratory pattern of the species (Pacariz *et al.,* 2016).



Source: Pacariz *et al.*, 2016.

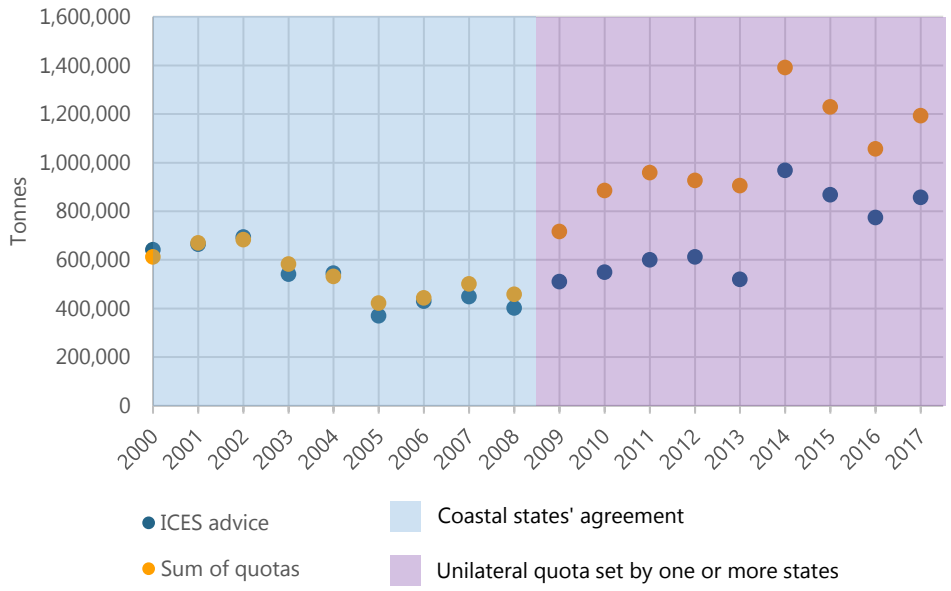
Figure 5. Mackerel migration pattern, pre- and post-2006

Due to the increasing availability of mackerel in the waters of Iceland and the Faroe Islands, these coastal states increased their allowable catches to reflect the quantities of the stocks they believed were present in their waters. Iceland increased their national annual quota from 2,000 tonnes in the mid-2000s to 130,000 tonnes in 2010, and the Faroe Islands increased theirs from 25,000 to 150,000 tonnes (Scottish Parliament, 2014). Coastal state consultations on joint management broke down in 2009, and the unilateral quotas that each party set meant the total catch exceeded that recommended under ICES advice. In 2012 the Marine Stewardship Council certification was suspended as a result of the inability of all states targeting mackerel to agree on quota allocations within the TAC, therefore compromising the management system through unilateral TAC-setting and fishing over the advised sustainable levels. Over the period 2009–2017, the sum of quotas was 150% of ICES scientific advice (calculated from ICES, 2017b) (Figure 6).

A tripartite agreement was reached in 2014 between the EU, Faroe Islands and Norway, which allocates 49.3% of the TAC to the EU, 22.5% to Norway, 12.6% to the Faroe Islands. No deal has yet been reached with Iceland, but in the tripartite agreement, 15.6% of the TAC is set aside for Coastal States and Fishing Parties in international (NEAFC) waters (Iceland, Greenland and Russia). In 2017, this equated to 128,655 tonnes for the Faroe Islands, and 159,275 tonnes for Coastal States and Fishing Parties in NEAFC waters[13].

The agreement is only valid for five years (2014–2018). The Faroe Islands did not want to agree to a longer-term arrangement, under the expectation the mackerel distribution may change further in the coming years, and they may be able to obtain a larger share of the TAC.

[13] Agreed Record of Conclusions of Fisheries Consultations between the European Union, the Faroe Islands and Norway on the Management of Mackerel in the Northeast Atlantic for 2017. Clonakilty, 19 October 2016.



Notes: Where ICES advice was provided as a range, the midpoint has been used. Iceland's unilateral quota of 112,000t added to the 2009 data, as this was not included in the ICES (2017b) data.

Source: Data from ICES, 2017b.

Figure 6. North East Atlantic mackerel quotas and scientific advice

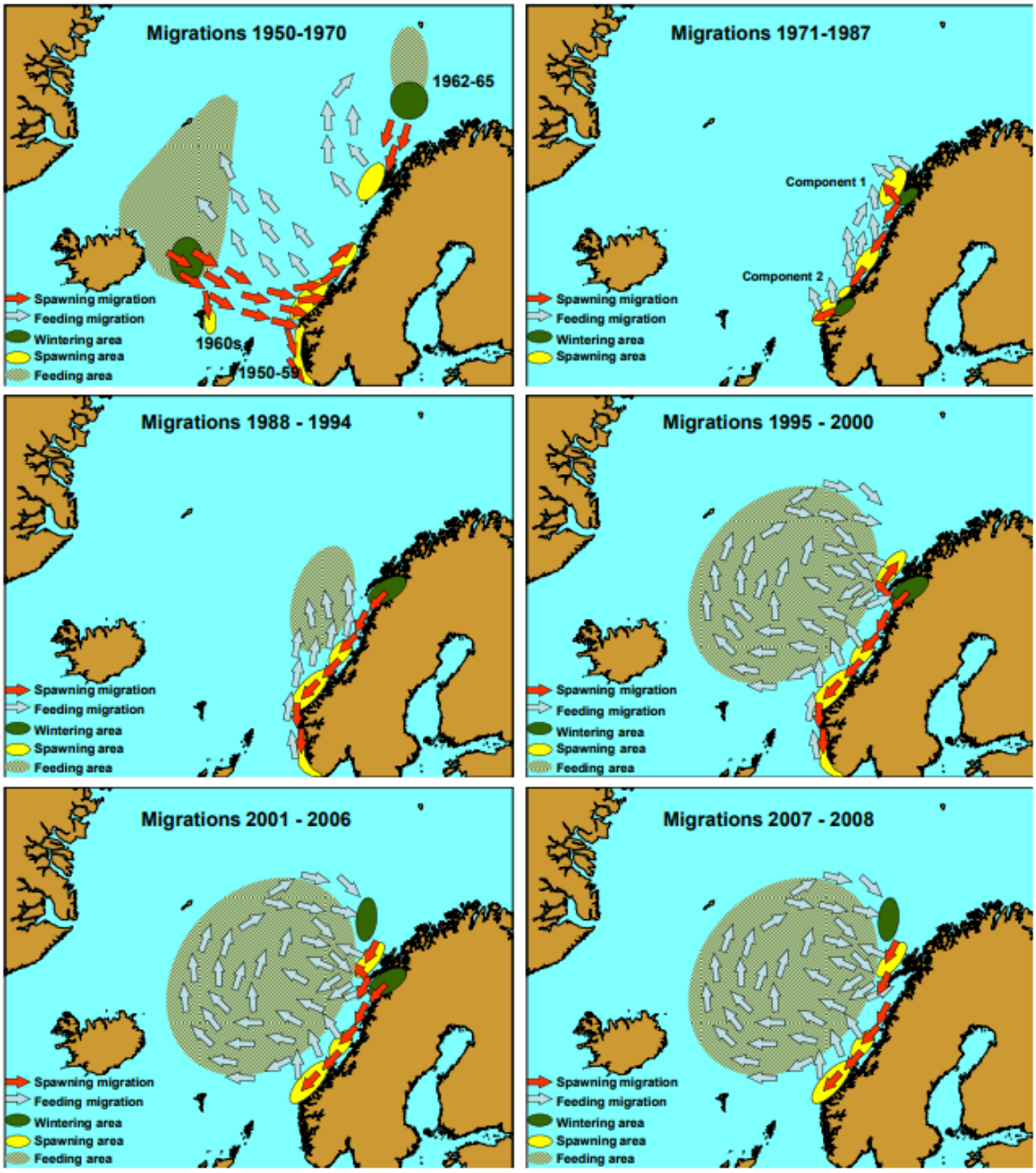
4.1.2 Norwegian spring-spawning herring

Norwegian spring-spawning herring provides an example of a fish stock that has changed its distribution over a number of decades as a result of changes to migration patterns and stock biomass. This has resulted in the break-down of agreements on sharing the TAC, with the result that unilateral quotas are currently set by the parties, the sum of which exceed scientific advice on the TAC.

In the 1950s and 1960s, Norwegian spring-spawning herring (Atlanto-Scandian herring) spawned along the Norwegian coast, with mature fish moving in early spring towards summer feeding grounds off the northern coast of Iceland, and overwintering grounds east of Iceland (Figure 7). The coastal states (states in whose waters the herring occurred) were Norway, Iceland, the Faroe Islands and Russia.

The stock collapsed in the late 1960s, becoming confined to what is now the Norwegian EEZ, and the migration to Icelandic waters ceased. This was a result of the reduced stock size but also at least partly a result of the cooling of the waters north and east of Iceland in the 1960s, which adversely affected primary production in the area and disrupted the traditional feeding migration of the herring to this area (Hannesson, 2011). The stock began to recover in the 1980s and migrations resumed, although the previous migration pattern stock has not fully been restored (Hannesson, 2011), with the stock dominated by the component that overwinters off the Norwegian coast.

The fishery reopened in the mid-1990s, and there was a coastal states' agreement on setting and sharing the TAC among Norway, Iceland, Faroe Islands and Russia. The harvest allocations were based on the zonal attachments of the resource. In 1996 the EU set its own quota, and was subsequently brought into the agreement in 1997, with the stock being managed cooperatively by the five states with NEAFC as the RFMO. The arrangement was considered a model of cooperative resource management (Lodge *et al.*, 2007), but between 2003 and 2006, and again in 2012, this system faltered (Weissenberger, 2013).



Notes: High abundance (1950–1970); low abundance (1971–1987); recovery (1988–1994); and the recovered stock (since 1995).

Source: Petitgas, 2010.

Figure 7. Atlanto-scandian herring migrations, 1950–2008

Changes in abundance and distribution of herring caused a breakdown in cooperation in 2003, with Norway and Russia (which has an agreement to harvest its share in the Norwegian zone) demanding a higher allocation (Bailey *et al.*, no date). They claimed that their share of the TAC was below what zonal attachment dictated and Norway revoked the right of several members to take some of their allocations within the Norwegian zone. After several years of tension and discord, the issue was resolved at the end of 2006 (Lodge *et al.*, 2007), and in 2007 a coastal states agreement allocated Norway 61%, Iceland 14.51%, the Russian federation 12.82%, the EU 6.51%, and the Faroe Islands 5.16% of the TAC.

This arrangement persisted for several years, until during the coastal state consultations in 2012 for fishing possibilities in 2013, the Faroe Islands requested a revision to its allocation (which had been 5.16% of the TAC, equivalent to 31,000 tonnes). The Faroe Islands withdrew from the agreement, and in March 2013 set a unilateral national catch limit of 105,000 tonnes (Weissenberger, 2013), on the basis of increased availability of herring in its national waters.

The EU introduced trade sanctions against the Faroe Islands in 2013, with a ban on imports of herring and mackerel from the Atlanto-Scandian stocks, and restrictions on the use of EU ports by Faroese vessels fishing for the herring and mackerel stocks[14]. The Faroe Islands subsequently set a lower quota, and the coastal states agreed to establish a Working Group to collect and collate information on the distribution of all life stages of herring, to update the zonal attachment analysis, which reported in 2014 (Coastal States WG Herring, 2014). A TAC has not been agreed since 2012, with overall quotas set above scientific advice (ICES, 2017c), illustrating the need for arrangements that are resilient and can be adapted to such variations in the migratory and distribution pattern of widely-distributed stocks.

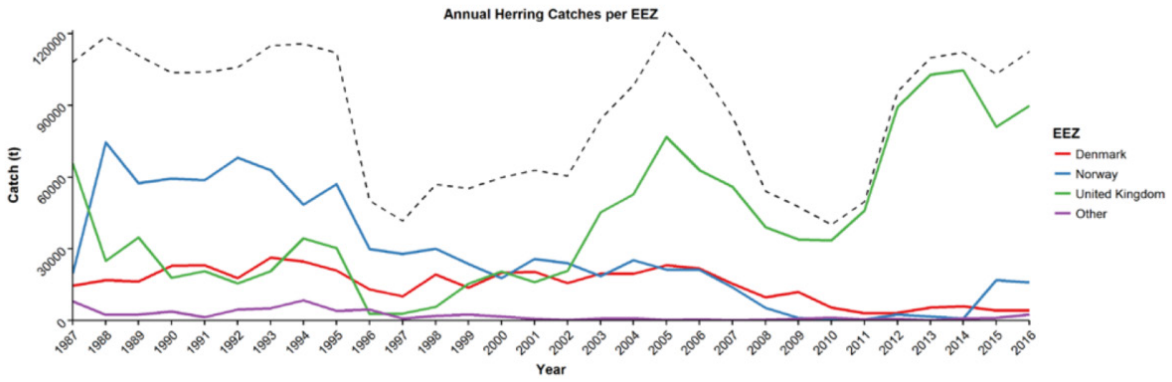
4.1.3 North Sea herring

North Sea herring provides a further example of a stock in the North East Atlantic where changes to its distribution have resulted in adjustments to the TAC-sharing agreement. As the stock is shared between only two parties (Norway and the EU), it has proved easier to obtain agreement on sharing arrangements than for the more widely distributed Norwegian spring-spawning herring (shared by five parties) and Atlantic mackerel (shared by four parties).

The North Sea herring stock collapsed in the 1970s and became more concentrated in the EU part of the North Sea. When the fishery resumed in the 1980s, the stock was shared between Norway and the EU. The EU proposed sharing the stock on the basis of zonal attachment, and proposed a 4% share for Norway based on the zonal attachment in the Norwegian zone. The Norwegians refused to accept the offer, arguing that the low attachment in the Norwegian zone was due to the overall reduction in stock abundance and the concentration of the stock in EU waters. Subsequently, a sliding scale for sharing the total catch was agreed, with the Norwegian share being greater as the stock abundance increased (OECD, 2010; Hannesson, 2011). The current management system entered into force on 1 January 1998, and the distribution of the TAC in 2016 and 2017 was 29% to Norway and 71% to the EU (Norway & EU, 2016).

In the period since the herring fishery reopened, the location of catches by the Danish fleet has shifted from predominantly in Norwegian waters during the late 1980s and 1990s, to being predominantly in UK waters since the early 2000s (Figure 8) (Beukhof & van Gemert, 2017). Changes in hydrographical conditions and subsequent changes in productivity have likely caused the distribution of herring to shift (Corten & van de Kamp, 1992), and climate change may cause further changes to their distribution.

[14] http://europa.eu/rapid/press-release_IP-13-785_en.htm



Coloured lines represent landings subdivided by EEZ of origin, the dashed line represents total landings

Source: Beukhof & van Gemert, 2017

Figure 8. Time series of annual landings (t) of North Sea herring by the Danish fleet from 1987 to 2016

4.1.4 Canada–USA Halibut Convention

The Canada-USA Halibut Convention provides an example of an agreement between two parties to manage a fish stock, in which the approach to stock assessment and setting of catch limits in individual management areas also results in the division of the TAC between the parties in a way that adjusts each year to the distribution of the fishable portion of the stock.

Pacific halibut (*Hippoglossus stenolepis*) are found along the continental shelf in the North Pacific as well as the Bering Sea, and have been commercially harvested by Canada and the USA since the late 1880s. The Canada–USA treaty for the preservation of the fishery in 1923 was the first environmental treaty targeting conservation of an ocean fish stock, and the first treaty independently negotiated by Canada without the involvement of Britain. It established an international commission between the USA and Canada. In 1953, the Canada–USA Halibut Convention replaced the previous treaty. It established the International Pacific Halibut Commission (IPHC), which comprises three members from each party, with the aim to conserve, manage and rebuild the halibut stocks in the Convention Area to levels that would achieve and maintain the maximum sustainable yield from the fishery.

The IPHC sets out management areas, conducts stock assessments and decides on total removals of Pacific halibut in all management areas off the USA and Canada at their annual meeting (NOAA, 2014). The management areas are delineated along national boundaries, so that the determination of removals from each management area effectively represents the division of the TAC between the two parties.

Through annual stock assessments, IPHC estimates the coast-wide exploitable biomass. Exploitable biomass by regulatory area (eight areas in total) is then calculated based on survey data, and a fixed exploitation rate is applied to that biomass to obtain an allowable yield for each regulatory area (Bailey *et al.,* no date). As such, the percentage of the TAC allocated to different management areas varies by year according to the stock assessment results; it is not a fixed percentage. The regulatory areas also follow national boundaries (so a single regulatory area is entirely within Canadian waters, or entirely within USA waters). The result is that the exploitable biomass is effectively allocated between the two countries based on the regulatory areas, and the allocation varies each year with the distribution of the stock across the different management zones. This is similar to a zonal attachment

approach, although it is calculated every year, and based only on the exploitable component of the stock.

The Commission sets catch limits, fishing seasons, and can also adopt other regulatory recommendations. The regulations are enforced by the National Marine Fisheries Service (NMFS), the Coast Guard, and the state police in the USA, and by the Department of Fisheries and Oceans (DFO) in Canada (IPHC, 2014). The governments of Canada and the USA adopt domestic regulations to manage the portions of the fishery in their respective waters. The Canadian portion of the fishery is conducted in Area 2B, within which management of the fishery is executed under IPHC and DFO regulations[15]. Canada has established a division of the quota of 88% to the commercial fishery and 12% to the recreational fishery. In the USA, NMFS establishes a Catch Sharing Plan for the allocation of opportunities between the commercial, sport and subsistence sectors, and to minimise bycatch of groundfish species.

4.1.5 USA–Canada Pacific Salmon Commission

The USA-Canada Pacific Salmon Commission incorporates the use of 'side payments' between parties to achieve agreement on the sharing of catch opportunities.

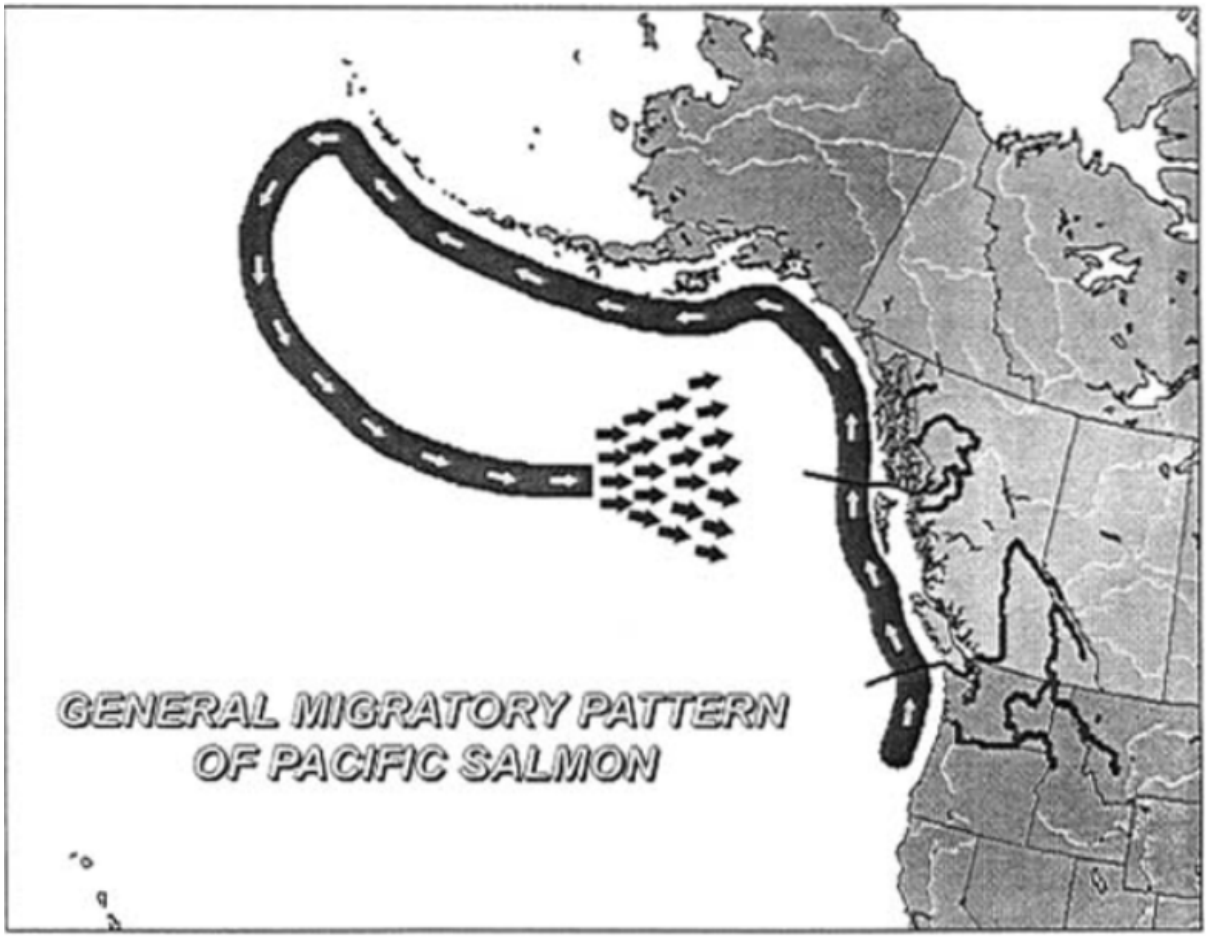
The Pacific salmon fishery extends from northern California to the Gulf of Alaska. The salmon swim north along the coast as juveniles to feed in more productive waters, and then return along the coast from north to south as they head to their spawning streams (Figure 9). This migration pattern creates distinct asymmetries between the various parties, as Alaska is in a good position to intercept salmon that spawn in British Columbia's rivers, and British Columbia fishers can target many of the coho and chinook salmon that head further south to spawn in the Columbia River and other US west coast streams. In this way, deliberate overexploitation of resources took place with the intention of denying harvest opportunities to other parties.

In the late 1970s, warming waters affected the salmon migratory patterns. The Fraser River salmon run went increasingly to the north and east of Vancouver Island, instead of to the south of it, where it would have been temporarily available for harvest in US waters (Hannesson, 2011). This reduced the potential for US 'interceptions' of Canadian salmon, at the same time as the salmon runs to Oregon and Washington states were also reduced. Salmon runs to Alaskan rivers increased greatly.

The Canada-USA Pacific Salmon Treaty of 1985 set out cooperative management arrangements for Pacific salmon resources from northern California to the Gulf of Alaska. Both countries had an interest in investing in salmon resources through enhancement projects on the major salmon rivers. The Treaty set out the division of economic returns from the fisheries based on Canadian and American fleets operating wholly within their respective home waters, with Canadian catches of American-produced salmon carefully balanced against American 'interceptions' (catches) of Canadian-produced salmon (Lodge *et al.*, 2007).

However, continuing changes to salmon migration and abundance disrupted the balance in 'interceptions' that had previously existed, and the sharing agreement broke down in 1993. The salmon stocks were abundant in Alaska but were continuing to decline further south. Canadians were unable to reach their harvest ceilings, and in attempting to do so were potentially further overexploiting the declining southern stocks. Additionally, habitat degradation, mortality at dams, water diversions, and hatchery practices threatened stocks. The agreement lacked the resilience to withstand the shock of climate-induced changes to the stocks (Munro *et al.*, 2004).

[15] http://phmana.org/fishery.htm



Source: Miller, 2003.

Figure 9. General migratory pattern of Pacific salmon

The agreement was eventually renegotiated in 1999, producing the Pacific Salmon Agreement. This moved away from short-term ceiling-based harvest levels, and instead focussed on a long-term commitment to define harvest shares as a function of the abundance of each salmon species in the areas covered by the treaty. For example, the US share of Fraser River sockeye was fixed at a percentage of the TAC for a 12-year period. The percentage was lower than the post-1985 average share, but was greater than the share actually attained by the US fleet during the 1992–1997 'salmon war' period. By basing allocations on a fixed proportion of the TAC, the agreement allows for differential changes in salmon abundance. In addition, the agreement includes the establishment of two endowment funds to support scientific research, habitat restoration and enhancement of wild stock production. The funds are provided principally by the USA, and thus can be viewed as implicit side payments from the USA to Canada. This allows greater flexibility and allows the distribution of benefits to be decoupled from the allocation of commercial harvests (Miller, 2003).

4.1.6 Parties to the Nauru Agreement Vessel Day Scheme

The Parties to the Nauru Agreement Vessel Day Scheme provides an example of cooperation between coastal states that has increased their revenue from the fishery, by setting a limit on the total number of fishing ('vessel') days that can be sold to fishing interests and allocating these to the parties. The ability to transfer vessel days between the parties ensures flexibility and that all parties benefit from the agreement. The key for the distribution of vessel days is based on several criteria, including one which adjusts according to stock distribution (location of catches).

The tuna fishery of the Western Central Pacific Ocean (WCPO) is one of the largest and most valuable fisheries in the world, with an estimated delivered value to processors on the order of US$3.4 billion in recent years (World Bank, 2016). The tuna resources are distributed in large part across the interlocking EEZs of coastal states, which cover 14.8 million square kilometres, but are also in high seas areas. The eight Pacific States that are Parties to the Nauru Agreement[16] (PNA) have developed a Vessel Day Scheme (VDS) for purse seine tuna vessels[17], which aims to establish a management system that both conserves the resource and secures the flow of net economic benefits from the fishery (Arnason *et al.,* 2015). The fishing fee revenues amount to a significant part of the landed catch value (approximately 7% in 2013).

The VDS limits the number of fishing day licences that may be sold by each party, and sets a minimum price to ensure increased revenue for the PNA and to avoid distant water fishing nations from pitting PNA members against each other to see which will offer the lowest price. The size of the vessel also determines the number of fishing days that must be purchased — to be able to fish for one day, vessels under 50 m length require half a fishing day, vessels 50 to 80 m length require one fishing day, and vessels 80 m or over require one and a half fishing days.

The vessel days are allocated to the Parties according to an agreed formula (Havice, 2013, cited in World Bank, 2016). The Palau Arrangement establishing the VDS states that the distribution of vessel days is based on formulae that rely at least in part on the seven-year moving average of the distribution of tuna catch in the waters of member countries (PNA, 2015, cited in World Bank, 2016). Whilst rolling reference periods can result in strategic fishing behaviour (see Section 3.1.1) to influence future allocations, the VDS decouples the allocation of vessel days (which are allocated to parties to the agreement) from the fishing activity (fishing vessels must purchase vessel days from the parties to the agreement), reducing the likelihood of this occurring. Vessel operators will fish in the area that is most advantageous to them in terms of the cost of a vessel day and the anticipated returns from fishing; this does not affect their future fishing opportunities.

Fishing days can be transferred between PNA members, so that if one party has sold all its fishing days, it can purchase more from another member, if foreign vessels are still interested in fishing in its waters. This helps to ensure that all parties, even those whose waters are not in the prime fishing grounds, receive benefits from the agreement.

The parties have also sought to harmonise management regimes through the '1st Implementing Arrangement' under the Nauru Agreement, which established a binding obligation on PNA Members to apply agreed minimum standards. Later, a wider group of Forum Fisheries Agency members adopted a set of Harmonised Minimum Terms and Conditions for Foreign Fishing Vessel Access (Clark, 2014).

The agreement has been successful in restricting the exploitation of tuna and achieving revenue from the resource for the coastal states involved. This has been achieved by limiting the vessel days and — importantly — selling those days at a market price, with the tax revenues representing the net economic benefits from the fishery (Arnason *et al.,* 2015). The small number of parties involved in negotiating the agreement, their similar development and economic status, interests and goals for the agreement, and their joint experience in negotiating a prior tuna agreement with the United States, are all key factors identified as contributing to the success of the agreement (Bernadett, 2013).

[16] The Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Interest was executed in 1982 between the Federated States of Micronesia, Kiribati, the Marshall Islands, Nauru, Palau, Papua New Guinea and the Solomon Islands (Tuvalu joined at a later date) with the aim of harmonising fisheries management in the parties' EEZs.

[17] The Palau Agreement for the Management of the Western Pacific Fishery was adopted in 1995, to limit the number of purse seine vessels that were allowed to fish in PNA EEZs, and amended in 2007 to the Vessel Day Scheme.

The agreed formula for distributing vessel days, which includes a moving average of the distribution of tuna catches, makes the arrangement adaptable to future changes to distribution of the stocks. Modelling of the future impact of climate change indicates that there may be a re-distribution of tuna stocks throughout the WCPO and beyond, reinforcing the importance of flexible management systems that can cope with spatial shifts in fishing activity (Bell *et al.*, 2011, cited in World Bank, 2016).

Basing the distribution of vessel days on catches rather than stock distribution reduces the data requirements for the system, but its accuracy depends on the comprehensiveness of catch declarations. The decoupling of fishing activity (foreign vessels that will choose to fish in the economically most advantageous location) from distribution of vessel days (to the parties of the agreement) reduces the potential for strategic fishing behaviour to influence future allocations — if catches are not anticipated in an area by vessel operators, they will not purchase vessel days for that area, reducing the risk of parties trying to over-sell vessel days in their waters in order to manipulate future allocations. In addition, the rolling average of catches is only part of the formula for allocation of vessel days. Parties with less attractive fishing grounds can sell days to Parties where fishing is more profitable, and both parties share the benefits (Clarke, 2014).

4.2 Key features of resilient fisheries governance systems

The case studies, together with information from the wider literature, point towards the following key features that are necessary for governance systems to be resilient to changes in fish stock distribution and productivity.

Cooperation

Coastal states must cooperate in the conservation of shared, straddling and high seas fisheries resources through arrangements to determine sustainable stock levels and management measures (Miller 2011) and with all relevant parties involved, such as in the Canada–USA Pacific Halibut Convention and Pacific Salmon Agreement.

For cooperation arrangements to be stable, there must not be an alternative arrangement which is capable of making all 'players' better off, and each individual player should not be able to do better by refusing to cooperate (Munro *et al.*, 2004). Such agreements are easier to reach and are more stable with fewer parties, as in these bilateral agreements and as seen in the EU–Norway agreement. Where more parties are involved, such as with the widely-distributed stocks of blue whiting, herring and mackerel in the North East Atlantic, agreements are harder to achieve and maintain. In these cases, an overarching framework is needed to avoid one country being able to withdraw from an agreement and set its own unilateral quota with impunity, such as has occurred in the North East Atlantic fisheries for blue whiting, herring and mackerel.

TAC setting and allocation

Best scientific evidence should be used to determine sustainable catch levels. TACs should be set in line with scientific advice, that ideally adopts an ecosystem approach[18], and takes into account the Malawi Principles[19], recognising that there is a need to balance conservation and use of biodiversity.

[18] The Ecosystem Approach is a concept that integrates the management of land, water and living resources and aims to reach a balance between three objectives: conservation of biodiversity; its sustainable use; and equitable sharing of benefits arising from the utilisation of natural resources (http://jncc.defra.gov.uk/default.aspx?page=6276).

[19] In a workshop on the Ecosystem Approach in Malawi in 1998, twelve principles/characteristics of the ecosystem approach to biodiversity management were identified, including that management objectives are a matter of societal

Additionally, all parties should agree to follow the scientific advice provided. That includes agreements to limit overall catches (of all parties fishing the stock) to within sustainable levels.

The conservation decision (setting the TAC) should be separated from the allocation decision (sharing the TAC), to reduce the influence of short-term political priorities on annual quota negotiations that are a feature of many RFMOs and shared stocks (OECD, 2009). This is achieved in the Pacific Halibut Convention through the setting of a coast-wide TAC which is then divided between management areas based on stock abundance from survey data. The Chatham House review to develop best practices for RFMO governance concluded that mandatory consensus is not necessarily the best approach to allocation issues, recommending instead a combination of recourse to voting, review procedures, dispute settlement and regular review of allocations (Lodge *et al.*, 2007).

Various criteria can be incorporated in quota allocation keys, with different weightings, including historic participation in the fishery, zonal attachment, socio-economic dependency and accountability (e.g. with greater levels of science-based quota awarded in return for fully documented fisheries). The PNA vessel day scheme uses the resource distribution as just one part of the formula for allocation of vessel days among the parties. The type of criteria that are incorporated to allocate the resource should be dependent on the appropriateness for a particular fishery. Thorough analysis and consultation should be carried out to agree on the most appropriate criteria to use, and their relevant weighting, with relevant contracting parties and stakeholders.

Flexible and adaptable

Fisheries management and governance systems need to be flexible and adaptable, with built-in mechanisms for addressing changing ecosystem dynamics (OECD, 2010). Responding to changes in fish stock abundance, through the use of reference points and agreed flexible harvest control rules, is well-embedded in fisheries management approaches. However, mechanisms for responding to changes in the distribution of fish stocks over time, are less well resolved. This is the case both within single jurisdictions (e.g. the CFP) and internationally between different parties.

Cooperative resource management systems — and in particular allocation arrangements — need to have mechanisms built in to them for dealing with changes to stock distribution that might otherwise result in a break-down of arrangements (FAO, 2002). This can be achieved through:

- Provisions that a specific (pre-agreed) change will result in specific amendments to the agreement, including a common understanding of how to measure the pre-agreed parameters that measure the change in question (Lodge *et al.*, 2007);
- An explicit periodic review process with defined timescale and procedure (Lodge *et al.*, 2007);
- An agreed formula for allocation of fishing opportunities that automatically adjusts the allocation according to changes in stock distribution (Miller, 2007); and
- Mechanisms for dispute resolution and arbitration to ensure revisions to agreements at the institutional and coastal state level are effectively dealt with (see below for more detail).

The use of an agreed formula that automatically adjusts the allocation according to changes in stock distribution is exemplified by the PNA vessel day scheme, where a moving average of the distribution of catches forms part of the allocation formula, as well as the Pacific Halibut Convention, where the allocation between the parties automatically adjusts each year in line with the stock distribution between the two parties' waters.

choice, and the appropriate balance between conservation and use of biodiversity should be sought (http://www.fao.org/docrep/006/Y4773E/y4773e0e.htm#bm14).

Quota trading arrangements

The potential movement of (and access to) species could also be addressed by the opportunity to trade quota more flexibly and responsively, both domestically and internationally (Inglis & MacLennan, 2011). This could act as an interim arrangement to adjusting allocation arrangements, to allow fishing opportunities to be matched with fish availability on fishing grounds; and could also ensure that industry members are able to access quota of interest to them even if the allocations between countries change. The transferability of fishing opportunities is also used in the PNA vessel day scheme to ensure that all parties receive benefits from the agreement, even if their waters are not within the prime fishing grounds.

The EU–Norway agreement includes the exchange of quotas between the parties, to provide fishing opportunities of interest to each side. These exchanges are based on the 'cod equivalents' key, but other currencies or pseudo-currencies could be used to facilitate quota trades. Transparency regarding quota availability and uptake, and quota trading platforms, can also be used to facilitate potential quota trades at different levels (e.g. between parties to an agreement, between Member States, or between fishing industry entities).

Incentive structures and transitional arrangements

New arrangements for international fisheries management to deal with stock migration and conserve the stocks are required (OECD, 2010). Where quota allocations change, transitional arrangements may be necessary, and innovative incentive structures and adaptation strategies will need to be considered. This could include side payments to countries to offset reductions in their allocations, as in the USA–Canada Pacific Salmon Agreement (see Section 4.1.5). The allocation formula can also address this aspect to some extent, for example by incorporating historic participation in the fishery as one of several factors that determine the allocation, so that past resource 'owners' don't lose out entirely as stocks shift.

Implementation and enforcement

Monitoring, control and surveillance are vital to promote compliance with agreement provisions. Munro *et al.* (2004) highlight that effective implementation and enforcement are key requirements for cooperative resource management arrangements to be stable through time. For Pacific halibut, this is achieved by the IPHC being able to adopt regulatory recommendations, which are then enforced by the relevant bodies of each party to the agreement. Industry engagement in the management process and greater accountability and responsibility through results-based management are likely to play a key role in this process.

Dispute resolution

A dispute resolution procedure is necessary to resolve cases where there is a lack of agreement over quota allocations, in order to avoid non-cooperation and the setting of unilateral quotas. This goes hand-in-hand with the conclusion above of a requirement to limit overall catches (of all parties fishing the stock) to within the limits indicated by scientific advice, and the need to ensure that benefits of being part of an agreement outweigh the potential benefits of withdrawing from the agreement. It would also help to resolve situations where coastal states believe that conditions necessitate a revision of the existing allocation arrangements, without needing to withdraw from the agreement — currently the only recourse that they have is to withdraw from the agreement and set a unilateral quota to force the other parties to renegotiate quota shares, such as has been observed repeatedly with blue whiting, herring and mackerel in the North East Atlantic. This is not a sustainable arrangement, and is not in line with the precautionary principle.

Science–policy interface

The need for scientific evidence to inform policy will be increasingly important to help ensure future resilience of governance to climate change. Predictions of changes in physical oceanography, and the potential impacts on species, will need to inform policy and management. Therefore, stock assessment models will need to be adapted to take into account climate change impacts on stock dynamics (Miller, 2011). The interface between science and management needs to be strengthened and with technological developments there are increasing opportunities for real-time data to feed in to the science and management decision-making system.

5 Application to North East Atlantic Fisheries Governance

External drivers can be a powerful force to generate political pressure and will to tackle difficult challenges in the process of strengthening and reforming RFMOs (OECD, 2009); the same can be said of fisheries management and governance arrangements more generally. In the context of RFMOs, the adoption of the UNFSA as well as domestic political processes and environmental NGO pressure were key drivers for strengthening and reforming them (OECD, 2009). The political and governance changes precipitated by Brexit may also represent a key driver for reviewing fisheries governance in the North East Atlantic region, and provide an opportunity to future-proof the governance system to be more resilient to other political changes as well as to factors related to environmental alterations, such as climate change.

The improving status of stocks in the North East Atlantic (reductions in fishing mortality, increasing stock biomass) (EC, 2017) may offer an opportunity for a gradual shift in governance arrangements and quota allocations without significant short-term negative consequences for the parties involved. A recent example is the adjustment to the allocation of the bluefin tuna TAC in the International Commission for the Conservation of Atlantic Tuna (ICCAT), where the increasing TAC facilitated parties being able to accept a lower percentage of the TAC in order to make room for new contracting parties. This is in contrast to a situation in many RFMOs where agreement on allocation is delayed until stocks are at low levels and allocations based on proportions of the TAC may be well below current catches (Lodge *et al.*, 2007). In addition, there are only around six key players in the North East Atlantic region (the EU (and UK), Faroe Islands, Greenland, Iceland, Norway and Russia), which simplifies the situation compared to the dozens of countries of varying socio-economic development status that are involved in some other RFMOs around the world. The region is relatively data-rich, with significant scientific resources upon which to draw. In short, the North East Atlantic has a number of attributes making it an excellent candidate to set a world class example for climate-resilient management.

A process for setting TACs and their allocation that restricts total catches to levels consistent with scientific advice

At the international level, it is fundamental that a process is in place to agree on TACs and associated quota allocation keys so that total catches of shared and straddling stocks do not exceed catch levels recommended by independent scientific analyses conducted by ICES. All relevant parties must be involved and must come to an agreement — unilateral quotas should not be an option. One possibility suggested by Dankel *et al.* (2015) is that if coastal states do not come to an agreement on the sharing of the TAC, the TAC should be set to zero. Alternatively, interim or default allocation keys could be applied to a reduced TAC for years when coastal states fail to reach agreement. Such arrangements should ensure that the benefits of being part of a cooperative arrangement are greater than the potential benefits of withdrawing from the arrangement. An effective dispute resolution mechanism, which is used by the coastal states when required, is an important component of this process.

Supra-national coordination

A supra-national authority to coordinate the setting of catch limits, management measures and allocation agreements across the whole North East Atlantic area for widely-distributed stocks would help to avoid the current stock-by-stock multilateral negotiations on quota setting and allocations. Bilateral agreements could also be brought under this umbrella if desired. As the RFMO in the region, NEAFC could play a key role in this, providing the governance structure for all coastal states to come together to agree on TACs and allocations.

The fact that NEAFC has already established two Working Groups that are considering guidelines for coastal state negotiations and allocation criteria demonstrates that NEAFC is engaged in an evaluative process and is considering its potential future role. It is important that such proposals are pushed to be as ambitious as possible.

An overarching agreement that encompasses multiple widely-distributed shared and straddling stocks, with all relevant parties involved (even if all parties do not have an interest in all stocks), may provide a more stable framework than the current series of individual agreements between multiple parties on a stock-by-stock basis (e.g. for herring, mackerel and blue whiting). This is because benefits can be traded off among different stocks, which may facilitate allocation agreements. Conversely, it may discourage parties from withdrawing from such an agreement as the potential losses across several stocks may be greater than under a single stock agreement. However, achieving such a multi-stock and multi-party agreement is likely to be a challenging endeavour that will require political will and commitment from all sides.

A system that is flexible and can adapt to changes in stock distribution

Any arrangement for setting TACs and allocating quotas needs to be flexible and adaptable to changing stock distributions and conditions. This could be achieved with allocation keys that incorporate criteria that will automatically adjust the allocation according to such changes. Such allocations can take into account various criteria including those outlined in Section 3.1.3 in addition to stock distribution. It could also be achieved by establishing specific periodic reviews and procedures, with the possibility for flexibility within the agreement period, such as through quota swaps and leasing arrangements, to enable industry to better match fishing opportunities to catches. The periods could be set to a defined time horizon, or could be triggered by a change in biomass or abundance of a certain magnitude, with parameters agreed by the parties in advance.

Such an arrangement should help avoid the current situation that exists in the North East Atlantic region, where the only option available to countries that believe an adjustment to existing quota allocations is warranted, is to withdraw from an agreement and set a unilateral quota to force the other parties to renegotiate the allocations.

EU internal issues

The constraints imposed by the CFP Landing Obligation and a fixed quota allocation key (Relative Stability) amongst Member States make it difficult to respond to changing stock distributions and abundances. The anticipated UK exit from the EU may provide an opportunity to revisit and revise the Relative Stability key, with the potential to introduce elements of flexibility and take into account issues that arise from the implementation of the Landing Obligation and changes to stock distribution (Sobrino Heredia, 2017). Arrangements to facilitate quota swaps between Member States, such as by increasing the transparency and availability of information on quota uptake, and to enable quota leasing or transfers among willing industry players, would also help to alleviate such problems.

6 Conclusions

> *The world of fisheries is not static. In recognition of this fundamental fact, the Report of the Norway–FAO Expert Consultation places considerable stress on the importance of the cooperative arrangement being able to withstand the shocks of unanticipated changes, which can, in turn, arise from environmental, economic, political and other factors. The Report maintains that management plans for shared fish stocks need to recognize the dynamic nature of the systems they are managing and take these into account in their specifications of management targets (e.g. changes in distribution, abundance and/or migration patterns of target species). Past experience has shown that plans not incorporating this flexibility often fail to deliver. The plans should incorporate a review schedule, so that they can be evaluated and updated, as required (FAO, 2002a)…One element, which will be important in this regard, will be the ongoing cooperative scientific efforts to understand better the linkages between the changing biophysical conditions and the stock dynamics and the geographic distribution of the target species.*
>
> Source: Munro *et al.*, 2004

Climate change is one of many factors that fisheries management and governance frameworks need to be able to respond to, and good governance and management of fisheries is increasingly important in the face of shifts to stock dynamics and distributions as a result of climate change. Such shifts are putting additional pressure on existing stock allocation agreements; even without such changes, coastal states have in many cases not been able to agree on quota allocations. In these cases, and where agreements break down, total catch levels often exceed scientific advice and threaten stock sustainability.

There are demonstrable challenges faced in the North East Atlantic region and particularly in EU waters. Shifts in stock distribution and abundance, fixed quota allocation keys, and (under the CFP) the Landing Obligation are coming together to form a 'perfect storm' that is putting pressure on existing fishery management and governance arrangements. There are examples of successfully negotiated agreements that have withstood the test of time, and are responsive so that they can adapt to changing conditions. The North East Atlantic region has the incentive, scientific knowledge and capability to successfully address these issues.

ICES, NEAFC, the coastal states, European Member States, and fishing industries and stakeholders need to come together to discuss and agree on new approaches to fisheries management and governance that can respond to these changes. Resilient governance systems will be founded on cooperation, with agreed processes and procedures for TAC setting and quota allocation that can respond to shifts in stock distribution and biomass, coupled with quota trading and exchange mechanisms to balance quota availability with need (with built-in review periods), strong implementation and enforcement of regulations, an effective and responsive dispute resolution procedure, and supported by a strong science–policy interface.

The UK's Exit from the EU has the potential for the UK Government to become a new and significant player in the region, and is likely to require a reimagining of existing governance structures[20], providing a unique opportunity to forge newly resilient governance frameworks that can benefit the entire region and set a benchmark for fisheries governance around the world.

[20] Norway has recently proposed a tripartite arrangement for the North Sea between the EU, Norway and the UK entitled 'Future Framework for management of joint fish resources in the North Sea' (http://nffo.org.uk/news/norway-outlines-its-postbrexit-vision-for-the-north-sea-sustainability-requires-cooperation.html).

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8 Abbreviations/Acronyms

AC	Advisory Council
CFP	Common Fisheries Policy
DFO	Department of Fisheries and Oceans (Canada)
DG MARE	Directorate-General for Maritime and Fisheries (European Commission)
EC	European Commission
ECJ	European Court of Justice
EEZ	Exclusive Economic Zone
EFCA	European Fisheries Control Agency
EMFF	European Maritime and Fisheries Fund
EU	European Union
FAO	United Nations Food and Agriculture Organization
HELCOM	Helsinki Commission – Baltic Marine Environment Protection Commission
HLG	High-Level Group
ICCAT	International Commission for the Conservation of Atlantic Tuna
ICES	International Council for the Exploration of the Sea
IPHC	International Pacific Halibut Commission
IUU	Illegal, unreported and unregulated (fishing)
NASCO	North Atlantic Salmon Conservation Organization
NCP	Non-Contracting Party
NEAFC	North East Atlantic Fisheries Commission
NGO	Non-governmental organisation
NMFS	National Marine Fisheries Service (US)
OSPAR	Oslo-Paris Commission for the Protection of the Marine Environment in the North East Atlantic
PNA	Parties to the Nauru Agreement
PO	Producer Organisation
RFMO	Regional Fisheries Management Organisation
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total Allowable Catch
TFC	Transferable Fishing Concession
UNCLOS	United Nations Convention on the Law of the Sea
UNFSA	United Nations Fish Stocks Agreement
USA	United States of America
VDS	Vessel Day Scheme
WCPO	Western Central Pacific Ocean

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

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