

UK Fisheries Management



Following EU withdrawal the UK will have full responsibility for fisheries policy and management within its waters. This POSTnote summarises the science used to inform management, current approaches to EU fisheries, and challenges and opportunities for future UK fisheries management.

Background

The UK fishing industry was worth an estimated £1.4bn to the UK in 2016 and is part of a complex fisheries supply chain.^{2,3} The focus of this note is on the capture of wild fish and shellfish (marine capture fisheries), but this wider industry estimate includes fish and shellfish aquaculture and processing.² In 2016, the UK commercial fishing fleet comprised 11,757 fishermen and 6,191 vessels.⁴ These landed 701 thousand tonnes of fish and shellfish into the UK and abroad, valued at £936m.⁴ The UK fishing fleet is regionally diverse with regulations varying depending on the size of the vessel (different regulations apply to boats under 10 metres compared to larger boats) and species caught.^{4,5} In addition to their economic benefit, fisheries have social and cultural value for coastal communities and the public.^{6,7}

UK waters can be classified depending on the distance from shore in nautical miles (nm) as follows:⁵

- 0-6nm – inshore waters largely fished by smaller vessels using diverse fishing methods to catch a variety of different species, particularly shellfish.^{5,8}
- 0-12nm – UK territorial waters. In both territorial and inshore waters, other non-UK vessels are only permitted according to historic access and/or neighbourhood agreements.^{5,9}

Overview

- The Government has stated that following EU withdrawal it intends to implement a new fisheries management system and will seek to restore and protect marine ecosystems.¹
- The current EU Common Fisheries Policy requires that the size and status of fish stocks are assessed annually.
- These assessments form the basis for setting catch limits ('Total Allowable Catch' – TACs) that are then shared among states via quotas. Each state is responsible for distributing its quotas among its fishing fleet.
- Shared stocks with non-EU states are also assessed, and annual TACs negotiated.
- Future UK management will have to meet international legal requirements.
- A key future challenge will be managing fisheries in a changing environment while meeting other social and economic needs.

- 0-200nm – UK Exclusive Economic Zone (EEZ).^{10,11} The EU Common Fisheries Policy (CFP) grants equal access for all member states to fish within the 12-200nm limit.^{5,12}

The CFP is primarily concerned with the conservation of fish stocks, with Member States responsible for implementation of management measures.¹³ In the UK, this responsibility for fisheries management is devolved.⁵ This includes licencing vessels, managing quota and ensuring compliance with CFP and UK rules.⁵ Upon EU withdrawal, the UK Government intends to develop new fisheries access and management arrangements, which will be set out in a Fisheries Bill and White Paper.¹⁴ The following sections outline some key aspects of fisheries, describe how fish stocks are assessed and how fisheries are currently managed, and outlines some of the future challenges for UK fisheries management.

Understanding Fisheries

Marine fish can live and move over large areas irrespective of human jurisdictional boundaries. The lifecycles of fish and shellfish can be complex, with larvae, juveniles and adults sometimes occupying and breeding in different areas and habitats.^{15,16,17} These species form part of, and interact with, the wider marine ecosystem and change over time. Fishing

not only affects species numbers and interactions, but can also affect habitats and the seabed.^{18,19,20} Conversely, changes in the marine ecosystem, such as alterations in habitat suitability or changes in wider food webs, can affect commercial species.^{21,22} Other pressures including climate change can affect fisheries.^{23,24} For example, warming sea temperatures have been shown to alter the distributions of commercial species.^{23,25}

Some fisheries target specific species while others are mixed, catching several different species. Species caught can be grouped into three main categories:^{4,26}

- Shellfish including langoustine (*Nephrops*), scallops, crabs and lobster. These are among the most valuable UK fisheries⁴ and may be caught using pots, traps and dredges.²⁷
- Pelagic fish that live in open water between the sea floor and surface.²⁸ They can form large shoals and are highly mobile or often migratory.^{29,30} Examples include mackerel and herring that are caught using nets.²⁶
- Demersal fish that live near or at the seabed such as cod and haddock, which are caught using trawls pulled along the seabed.^{26,31} They are often caught together in 'mixed fisheries',³¹ which can be more complex to manage (see below).³² Many mixed fisheries occur in Scotland and the south-west of England.⁴

Species differ in their vulnerability to fishing because of factors such as growth rates, reproductive capacity and age of maturity.³³ Some species are more easily caught than others.^{34,35} This can be because of their size, positioning in the water at different times of day, and behaviour regarding different fishing methods or gears.^{34,35}

Assessing Fish Stocks

For assessment purposes, populations of fish and shellfish species are split into area based stocks, such as North Sea and Rockall Cod.³⁶ Assessments of stocks rely on data from different sources which include:³⁷

- Internationally coordinated scientific surveys that collect biological information independently of fisheries.^{38,39}
- Data provided by fisheries from fish landings, satellite data (from vessels over 12m) and observers aboard fishing vessels.³⁹

Within the EU, data collection is undertaken by Member States' government research bodies, which informs both national and international advice (Box 1).

Stock Assessment Methods

Such data are used in annual stock assessment models to determine past and current fish stock size and status and examine the effects of different fishing levels on stocks.^{40,41} They also forecast future catches and Maximum Sustainable Yield (MSY, defined as the largest average catch that can be removed from a stock over time under existing environmental conditions without threatening future yields).^{40,41} Managing stocks for MSY is a globally recognised objective for fisheries management.⁴² MSY is affected and determined by different factors (Box 2). Stock assessments can examine fish stock status by using biological reference points (RPs).^{43,44} **Limit RPs** define points at which a stock is in an undesirable state. **Target**

Box 1. Data Collection for Stock Assessments

Within the UK, data are collected and assessed by the devolved administrations: Marine Scotland;⁴⁵ Welsh Government Marine & Fisheries Division;⁴⁶ Northern Ireland's Agri-Food and Biosciences Institute⁴⁷ and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS).⁴⁸ As a Defra executive agency, CEFAS also provides UK wide advice and assessments on certain issues.⁴⁹ These data inform national fisheries management and international advisory processes. The fishing industry can help improve stock assessments or fisheries data through involvement in schemes such as the Fisheries Science Partnerships,⁵⁰ which encourage knowledge exchange between industry and scientists. UK data collection for fisheries stock assessments is coordinated through the EU Data Collection Framework.⁵¹ Upon EU withdrawal the UK will need to find ways to fund its future data collecting activities and wider fisheries management because funding for this will become a national responsibility. The New Economics Foundation have suggested that funding from other sources, such as the fishing industry, may be required to help cover some science and management costs.⁵²

RPs define the ideal state of the stock. **Trigger points** can be set between limits and target points to help prompt corrective management action.

The International Council of the Exploration of the Seas (ICES) acts to provide scientific information and advice for management for over 200 fish stocks and some shellfish stocks occurring in the North-East Atlantic (Box 3).^{36,40,53} The UK and other ICES member countries take part in expert working groups that undertake stock assessments and other scientific work to inform management.^{54,55} The international nature of ICES helps to ensure balance and objectivity across individual countries interests. However, most advice and assessments for shellfisheries in national waters originate from national bodies (Box 1).

Variations in Assessment Approaches

There are variations in the types of stock assessment methods used. This can be due to differences in the type and availability of data.⁵⁶ For example, data issues can be common for new fisheries because of uncertainties about the stock's biology, and in some shellfisheries because of inadequate sampling.^{56,57,58} Methods may also differ depending on the information required for management purposes.⁵⁶ Many assessments are based on a single species to inform management, although this can create difficulties in accounting for species interactions or the nature of mixed fisheries.^{59,60} There are also differences in the ways stocks can be analysed and modelled.⁶¹ Fish assessments generally examine fishing effects on the stock using age or length based methods.⁶¹ When data are

Box 2. Factors Affecting Fishing Yield

The yield of a fish stock depends on the stock size and status. This can be influenced by factors relating to the stock's biology, the fishing pressure applied to it, as well as wider environmental and human factors. Stock assessments focus on determining a number of key aspects:^{40,41,62}

- **Fishing mortality:** rate of removal of fish from the stock by fishing.
- **Natural mortality:** number of fish dying due to natural processes such as predation or disease.
- **Recruitment:** number of young fish entering the fishery each year.
- **Spawning Stock Biomass:** total weight of all sexually mature fish in the stock.

Box 3. ICES Advice on Shared Stocks

For stocks shared between EU Member States only, the European Commission develops management proposals using advice from ICES and the Scientific, Technical and Economic Committee for Fisheries (STECF) for EU Council.^{63,64} For stocks shared between the EU and other countries, Regional Fisheries Management Organisations (RFMOs) have been established to coordinate management responsibilities and action.⁶⁵ Some RFMOs are only advisory, but most can set catch and fishing effort limits and other management measures. ICES provides advice to help inform their decisions.⁶⁶ The RFMOs of most relevance to the UK include:

- North-East Atlantic Fisheries Commission (NEAFC).⁶⁷
- North Atlantic Salmon Conservation Organisation (NASCO).⁶⁸
- International Commission for the Conservation of Atlantic Tunas (ICCAT).⁶⁹

limited or more uncertain other approaches are often used to model trends in annual yield or population size.^{56,61} Shellfish assessments use underwater TV surveys for langoustine; dredging surveys for scallops, cockles and mussels; and length based models for crab and lobster, which cannot be easily aged.^{58,70} Wider environmental impacts, such as climate change effects on species distributions or recruitment, can also be hard to include in assessments due to uncertainty in projections.⁷¹ The subsequent scientific advice is often precautionary to account for uncertainties arising from limitations of the data, modelling and the inherent complexities of fisheries.^{40,72}

Current Fisheries Regulation

The CFP uses a number of different approaches to manage fish and shellfish stocks in EU waters. These are discussed in the following sections and include plans, catch limits, quotas, and technical measures.

Multi-Annual Plans and Catch Limits

Some fish stocks in European waters are managed through multi-annual plans and most have annual catch limits called Total Allowable Catches (TACs).^{73,74} A multi-annual plan is a regionalised strategy to manage stocks on longer time frames and can include specific management objectives and measures.⁷⁴ Annual TACs are set using ICES advice after negotiations between the EU Council (for stocks shared by EU Member States only).⁷⁵ For stocks shared between EU and non-EU states, TACs are negotiated through bilateral and multi-lateral agreements (Box 4).^{73,76,77} TACs are divided among states as quotas.⁷³ Multi-annual plans consider multiple stocks and the interactions between them, and set ranges within which future TACs and quotas should be set.⁷⁸ While ICES provides scientific advice, it is the responsibility of ministers to set TACs, which are often set higher than the advice suggests.^{79,80} Not all stocks are managed using TACs and quotas (see below). These non-quota species include most commercial shellfish species.

Quotas

EU Member State quota shares are determined using an allocation method known as 'relative stability'.⁷³ This is based on an historical reference period from the 1970s and was adopted into the CFP in 1983.^{81,82} The relative shares remain constant to provide economic stability for fishing fleets.^{81,83} However, it cannot easily account for changes in fishing patterns or stock distributions.⁸³

UK Quota Allocation

Each Member State is responsible for allocating its quota share to its national fleet. In the UK, quota for each stock is split between devolved administrations according to the Concordat Agreement.⁸⁴ It is then divided among the fleet.^{52,85}

- 'The Sector' – vessels over 10 metres that are members of one of the 23 UK Producer Organisations (POs), which allocate and manage quota for their members.^{5,86}
- The 'non-sector' – over 10 metre vessels that are not PO members and hold licences mostly for non-quota species.²
- The 10 metres and under ('Under 10 metres') – these account for 78% of UK vessels.⁴ Many of these inshore vessels target non-quota species, particularly shellfish.

Quota is allocated via Fixed Quota Allocation units. These are based on historic records and determine the proportions of quota for individuals or collective groups.^{5,85} FQAs can be traded and this has led to increasing concentration of ownership in some cases.⁵² An FQA register is publicly available listing owners of FQA units.⁸⁷ Quota can be leased across certain sectors as required and swapped between POs and with other EU Member States.^{52,85} Governments of the devolved administrations allocate quota to the Under 10 metres and non-sector from a common pool.⁵ In England, this is done monthly by the Marine Management Organisation (MMO).⁸⁵ Some stakeholders argue that insufficient quota is allocated to vessels in the Under 10 metres category across the UK.^{88,89} Prior to the EU's regulation of buyers and sellers,⁹⁰ these vessels were not required to declare landings.⁵² This led to a poor record of landings and subsequently a small share of overall quota.^{52,88}

Box 4. Negotiating Fishing with Non-EU States

Specific international agreements determine fishing opportunities, access and management measures for shared stocks.^{75,76,77} Individual bilateral Northern Agreements exist for joint management of shared stocks between the EU and the Faroe Islands, Iceland and Norway.⁷⁶ Depending upon the stock, TACs are negotiated either through individual coastal state discussions or multi-laterally through the NEAFC (Box 2), prior to December EU Council meetings. However, these agreements do not have binding mechanisms to require states to reach a decision. This may result in unilateral TACs³⁰ that exceed ICES advice. For example, unilateral TACs were set in 2010 when mackerel abundances increased in the EEZs of Iceland and the Faroe Islands as no agreements could be reached between them, the EU and Norway.^{30,83}

Norway-EU Negotiations

Norway and the EU use zonal attachment in some bilateral negotiations on certain stocks.^{91,92} This allocates fishing opportunities using information on the spatial distributions of stocks over time and lifecycle.⁹³ This may be difficult because of complexity in species lifecycles or changes in their distributions due to factors such as climate change.^{30,94,95} Selecting the criteria to use, such as biomass or abundance, in determining allocations is done on a political basis.⁹² Although scientific evidence and advice can be provided to inform the political choice of criteria, there is also uncertainty over how objectively it can be used in decisions.⁹² For example, differences in survey sampling between areas could weight criteria differently. Social and economic factors will also need to be considered in negotiations.^{92,96}

Landing Obligation

Discarding is the practice of throwing back unwanted, often dead, fish to the sea because of management regulations or market conditions.⁹⁷ It was criticised by a public campaign.⁹⁸ The 2013 CFP reforms introduced a landing obligation (LO) to address discarding, to be implemented between 2015 and 2019, including on UK vessels.^{99,100} The LO requires all catches of quota species on board to be landed and counted against quota.¹⁰⁰ The objective is to incentivise an increase in fishing selectivity, including by moving areas, and provide a better understanding of the total amounts of fish being caught through full documentation.¹⁰⁰ However, its implementation presents challenges,^{101,102} including 'choke species'.⁹⁹ These are species with a low volume of quota, that when reached will cause fishing operations to halt, even if fishermen still have quota available for other species.¹⁰³ As the LO is still being implemented, it has yet to be evaluated for effectiveness.

Technical Measures and Effort Control

Fisheries managers also use technical measures and effort controls to manage both quota and non-quota stocks.¹⁰⁴ The many kinds of technical measures include minimum landing or conservation sizes, specifications on design and use of fishing gear, and closed areas or seasons.^{104,105} They aim to improve selectivity in fisheries and reduce ecosystem impacts.¹⁰⁵ For quota species they can be used as an additional management measure. For example, some gears are better at selecting out species for which fishers have no quota.^{106,107} Technical measures are often used as a main management tool for non-quota shellfish and can differ according to devolved, national and EU regulations.⁵⁸

Fishing effort controls can be used on certain stocks to limit fishing capacity and vessel usage.¹⁰⁸ For example, limits to the number of days at sea apply to some vessels targeting the quota species Dover sole in the western Channel.¹⁰⁹

Future UK Fisheries Management

After EU and CFP withdrawal, the UK will become an independent coastal state with sovereign rights to govern its 200 nautical mile EEZ under the United Nations Convention on the Law of the Sea (UNCLOS).^{11,83} As such, the UK has certain responsibilities for its fisheries¹¹⁰ according to international laws including UNCLOS and the UN Fish Stocks Agreement.^{111,112} The UK will have to determine access agreements for foreign vessels into UK waters, as well as for UK vessels into non-UK waters.¹¹³ New mechanisms for negotiating fishing access and TACs for shared stocks will also be needed and cooperation over management for regional seas.^{110,113} The UK is not currently a member of NEAFC or NASCO, as it is currently represented by the EU.¹¹² As such the UK may wish to re-join independently (Box 3). Outcomes from these negotiations may impact on the wider fisheries supply chain.¹¹⁴ Around two thirds of fish consumed in the UK currently comes from outside EU waters and the majority of what is caught by the UK fleet is currently exported to the EU.¹¹⁵

Technological Innovation in Fisheries

Technology is increasingly being used to generate data to inform management for compliance and enforcement and for scientific purposes.¹¹⁶ Remote Electronic Monitoring (REM) can provide information on fishing activities to help allow real time management of a fishery as well as providing better understanding of fleet behaviour.^{117,118} Vessel Monitoring Systems (VMS) are used on over 12 metre vessels in the UK fleet and an inshore VMS is now being implemented for the Under 10 metres.¹¹⁹ Cameras can also be used as a tool to collect catch and discard information,^{120,121} but there are some concerns regarding the processing of this information.^{117,118,122} Mobile phone apps are increasingly used to record catch information.¹²³

Managing Fisheries in a Changing Environment

The marine environment is increasingly being affected by climate change, pollution and ocean acidification.^{23,124,125,126} Current domestic legislation and international commitments outline broader long term responsibilities for the UK government to protect the marine environment and its ecosystems.^{127,128} These include adopting an Ecosystem Approach to marine management.^{128,129,130} In the context of fisheries management, such an approach requires acknowledging fisheries form part of this wider, changing marine environment, and integrating and aligning fisheries with wider objectives, such as marine conservation or renewable energy (Box 5).^{131,132,133,134} The Government's 25 Year Environment Plan states this approach will 'account for and seek to minimise impacts on non-commercial species and the marine environment generally'.¹

While management is often primarily focused upon managing fishery resources, the social, cultural and economic values of fisheries can be substantial.^{6,7,135} UK fisheries management seeks to consider these factors,^{127,136} but this can be a challenge. Fishery resources are a national, public asset and many sectors, such as recreational fishing and tourism also have an interest in their sustainable management.^{137,138} For example, a 2012 survey estimated that there are 884,000 sea anglers in England alone, who caught around 10 million fish.¹³⁷

Box 5. Marine Protected Areas in Marine Management

The European Marine Strategy Framework Directive¹³⁹, OSPAR Convention for the North-East Atlantic¹²⁸ and the International Convention on Biological Diversity¹²⁹ all outline obligations for an Ecosystem Approach for managing the marine environment. Marine Protected Areas (MPAs) are one of the many tools to help deliver this. The UK has 297 MPAs, including 56 Marine Conservation Zones (MCZs).^{140,141} The Government's 25 Year Environment Plan has set out a new approach to MPA designation.^{1, 142} Some suggest MPAs have the potential to benefit some fish stocks, through for example protecting nursery grounds or spillover effects, if areas are selected, designated and managed appropriately.^{143,144,145} Consulting stakeholders such as the fishing industry in the planning of MPAs helps ascertain potential wider social and economic implications and outcomes.^{141,146} However, some academic commentators argue that the current MPA network around the UK is not adequately protecting the marine environment from fishing activities.¹⁴⁷

Endnotes

- 1 DEFRA, 2018, *A Green Future: Our 25 Year Plan to Improve the Environment*
- 2 HoC Library, 2017, *The UK Fishing Industry debate pack*
- 3 Estimated as Gross Value Added which is a measure similar to GDP and is defined as the value of output less the value of intermediate consumption <https://stats.oecd.org/glossary/detail.asp?ID=1184>
- 4 MMO, 2016, *UK Sea Fisheries Statistics Report*
- 5 Department for Exiting the European Union, 2018, *Fisheries Sector Report*
- 6 Reed et al, 2013, *Marine Policy*; 37,62-68
- 7 GoS, 2017, *Future of the Sea: Health and Wellbeing of Coastal Communities. Foresight – Future of the Sea Evidence Review*
- 8 Seafish, 2012, http://www.seafish.org/media/publications/Project_Inshore_Stage_1_Report.pdf
- 9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269708/Fisheries_Conv_March-April_1964.pdf
- 10 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/346014/UK_Exclusive_Economic_Zone.pdf
- 11 http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
- 12 https://ec.europa.eu/fisheries/cfp/fishing_rules/access-to-waters_en
- 13 https://ec.europa.eu/fisheries/cfp_en
- 14 Queen's Speech, 2017, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620838/Queens_speech_2017_background_notes.pdf
- 15 Metcalfe, 2006, *Journal of Fish Biology*; 69, 48-65
- 16 Petitgas et al, 2013, *Fisheries Oceanography*; 22, 121-139
- 17 Ellis et al, 2012, *Cefas Science Technical Report No. 147*, 56pp
- 18 Pauly et al, 1998, *Science*; 279, 860-863
- 19 Molfese et al, 2014, *PLoS ONE*; 9, e101506
- 20 Hiddink et al, 2017, *PNAS*; 114, 8301-8306
- 21 Vasconcelos et al, 2014, *ICES Journal of Marine Science*; 71, 638-647
- 22 Capuzzo et al, 2017, *Global Change Biology*; 24, e352-e364
- 23 Pinnegar et al, 2017, *MCCIP Science Review* doi: 10.14465/2017.arc10.007-fis
- 24 Cheung et al, 2013, *Nature*; 497, 365-368
- 25 ICES, 2016, *WKFISHDISH Report*, ICES CM 2016/ACOM: 55, 197 pp
- 26 Seafish, 2007, *Fishing UK: past, present, future*
- 27 <http://www.gov.scot/Topics/marine/Sea-Fisheries/sustainfish/fishcapture/FishingGears/shellfish>
- 28 <http://www.gov.scot/Topics/marine/marine-environment/species/fish/pelagic>
- 29 Trenkel et al, 2014, *Progress in Oceanography*; 129, 219-243
- 30 Bjørndal and Ekerhovd, 2014, *Marine Resource Economics*; 29, 69-83
- 31 <http://www.gov.scot/Topics/marine/marine-environment/species/fish/demersal>
- 32 Ulrich et al, 2017, *ICES Journal of Marine Science*; 74, 566-575
- 33 Jennings et al, 2001, *Marine Fisheries Ecology*; Chapters 3 & 4. Blackwell Science
- 34 Marchal et al, 2003, *Scientia Marina*; 67, 63-73
- 35 Arreguin-Sánchez, 1996, *Reviews in Fish Biology and Fisheries*; 6, 221-242
- 36 <http://www.ices.dk/community/advisory-process/Pages/Latest-advice.aspx>
- 37 <http://www.fao.org/docrep/w5449e/w5449e0q.htm#14.2> review of methods to be used according to the type of data available
- 38 <http://www.ices.dk/marine-data/data-portals/Pages/DATRAS-Docs.aspx>
- 39 <http://www.gov.scot/Topics/marine/Sea-Fisheries/19213/fish-stocks>
- 40 ICES, 2016, http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Introduction_to_advice_2016.pdf
- 41 Seafish, *Information Sheet Number FS87.11.15*
- 42 FAO Code of Conduct for Responsible Fisheries
- 43 <http://www.fao.org/docrep/003/v8400e/v8400e02.htm>
- 44 PEW, 2016, *Reference Points Briefing*
- 45 <http://www.gov.scot/Topics/marine/science>
- 46 <http://gov.wales/topics/environmentcountryside/marineandfisheries/?lang=en>
- 47 <https://www.afbini.gov.uk/articles/7/10>
- 48 <https://www.cefas.co.uk/>
- 49 <https://www.cefas.co.uk/services/>
- 50 <https://www.gov.uk/government/organisations/centre-for-environment-fisheries-and-aquaculture-science/about/research#fisheries-science-partnership-fsp>
- 51 <https://datacollection.jrc.ec.europa.eu/>
- 52 NEF, 2017, *Who gets to fish? Report*
- 53 <http://www.ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx>
- 54 <http://www.ices.dk/explore-us/who-we-are/Pages/Member-Countries.aspx>
- 55 <http://www.ices.dk/explore-us/who-we-are/Pages/Expert-Groups.aspx>
- 56 Le Quesne et al, 2013, *Data-Deficient Fisheries in EU Waters*
- 57 ICES, 2012, *Implementation of Advice for Data Limited Stocks in 2012 in its 2012 Advice. Guidance Report 2012*
- 58 Pers. Comm. Dr R.C.Bannister, SAGB
- 59 Vinther et al, 2004, *ICES Journal of Marine Science*; 61, 1398-1409
- 60 ICES, 2017, *WGMIXFISH-Advice Report 2017*
- 61 Cadima, 2003, *FAO Fisheries Technical Paper*; 393, 161p
- 62 <http://www.fao.org/docrep/w5449e/w5449e0q.htm>
- 63 <http://www.ices.dk/Pages/default.aspx>
- 64 <https://stecf.jrc.ec.europa.eu/>
- 65 https://ec.europa.eu/fisheries/cfp/international/rfmo_en
- 66 https://www.neafc.org/managing_fisheries
- 67 <http://www.neafc.org/>
- 68 <http://www.nasco.int/>
- 69 <https://www.iccat.int/en/>
- 70 <http://www.gov.scot/Topics/marine/science/scienceops/Surveys>
- 71 Payne et al, 2016, *ICES Journal of Marine Science*; 73, 1272-1282
- 72 Sethi, 2010, *Fish and Fisheries*; 11, 341-365
- 73 https://ec.europa.eu/fisheries/cfp/fishing_rules/tacs_en
- 74 https://ec.europa.eu/fisheries/cfp/fishing_rules/multi-annual-plans_en
- 75 <http://www.consilium.europa.eu/en/policies/eu-fish-stocks/international-agreements-on-fisheries/>
- 76 https://ec.europa.eu/fisheries/cfp/international/agreements_en
- 77 http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_3.3.6.html
- 78 <http://www.consilium.europa.eu/en/press/press-releases/2017/12/08/north-sea-fisheries-new-multiannual-management-plan-agreed/>
- 79 O'Leary et al, 2011, *Marine Pollution Bulletin*; 62, 2642-2648
- 80 Carpenter et al, 2015, *Marine Policy*; 64, 9-15
- 81 Sobrino and Sobrido, 2017, In: Andreone G. (eds) *The Future of the Law of the Sea*. Springer, Cham
- 82 http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_3.3.1.html
- 83 HoL, 2016, *Brexit: Fisheries Report*
- 84 <https://www.gov.uk/government/publications/concordat-on-management-arrangements-for-fishing-quotas-and-licensing-in-the-uk>
- 85 <https://www.gov.uk/guidance/manage-and-lease-fishing-quota>
- 86 MSEP, 2014, *An Overview of UK fishing quota (FQA) ownership*
- 87 <https://www.fqaregister.service.gov.uk/>
- 88 Pers. Comm. NUTFA
- 89 <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environment-food-and-rural-affairs-committee/fisheries/written/74772.html>
- 90 <https://www.gov.uk/government/publications/buyers-and-sellers-of-first-sale-fish-and-submission-of-sales-notes/buyers-and-sellers-of-first-sale-fish>
- 91 Hoel and Kvalvik, 2006, *Marine Policy*; 30, 347-356
- 92 Dankel et al, 2015, *Allocation of Fishing Rights in the NEA*
- 93 Hamre, 1993, *A Model of Estimating Biological Attachment of Fish Stocks to Exclusive Economic Zones*. ICES Statistics Committee, 43.
- 94 Perry et al, 2005, *Science*; 308, 1912-1915
- 95 Engelhard et al, 2011, *ICES Journal of Marine Science*; 68, 1090-1104
- 96 Hannesson, 2013, *Fisheries Research*, 40;149-154
- 97 [http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2013/130436/LDM_BRI\(2013\)130436_REV1_EN.pdf](http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2013/130436/LDM_BRI(2013)130436_REV1_EN.pdf)
- 98 <http://www.fishfight.net/story.html>
- 99 Seafish, 2014, *Industry Briefing Note: Landing Obligation*
- 100 https://ec.europa.eu/fisheries/cfp/fishing_rules/discards_en
- 101 Catchpole et al, 2017, *Marine Policy*; 82, 76-86
- 102 Hedley et al, 2015, *The Landing Obligation and its implications on the control of fisheries* [http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563381/IPOL_STU\(2015\)563381_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563381/IPOL_STU(2015)563381_EN.pdf)
- 103 <http://www.gov.scot/Topics/marine/Sea-Fisheries/glossary>
- 104 https://ec.europa.eu/fisheries/cfp/fishing_rules/technical_measures_en
- 105 <https://www.gov.uk/government/publications/fishing-regulations-the-blue-book/section-e-technical-measures-for-the-conservation-of-fisheries-resources>
- 106 <http://www.ices.dk/news-and-events/Bloqs/Inotherwords/Lists/Posts/Post.aspx?ID=32>
- 107 <https://gearinup.eu/>
- 108 https://ec.europa.eu/fisheries/cfp/fishing_rules/fishing_effort
- 109 <http://data.sfp.ae/Portals/0/legislation/fisheries%20conservation/eu%20regulations/2018/EU%202018-120%20TAC%20Req%20EU%20&%20Non%20EU%20Waters.pdf>
- 110 Phillipson and Symes, 2018, *Marine Policy*
- 111 http://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm
- 112 Syreloglou et al, 2017, *The UK maritime sectors beyond Brexit*
- 113 HoC Library, 2017, *Brexit: What next for UK fisheries?*
- 114 <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environment-food-and-rural-affairs-committee/fisheries/oral/75942.html>
- 115 UK Seafood Industry Alliance, 2017, <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environment-food-and-rural-affairs-committee/fisheries/written/74774.pdf>
- 116 OECD, 2017, *Issue Paper: An Inventory of New Technologies in Fisheries*
- 117 Mangi et al, 2015, *Fish and Fisheries*; 16, 426-452
- 118 Needle et al, 2015, *ICES Journal of Marine Science*; 72, 1214-1229
- 119 <https://www.gov.uk/government/publications/vessel-monitoring-system-devices>
- 120 WWF, 2017, *Remote Electronic Monitoring Report*

-
- 121 <https://marinedevelopments.blog.gov.uk/2017/03/20/fully-documented-fishery-discards-quota-fish-cctv/>
- 122 <http://nfpo.org.uk/news/cctv-debate.html>
- 123 <https://succorfish.com/catch-app/>
- 124 Poloczanska *et al.*, 2016, *Frontiers in Marine Science*; 3, 62
- 125 Fernandes *et al.*, 2016, *Fish and Fisheries*; 18, 389-411
- 126 GoS, 2017, *Future of the Sea: Hazardous Chemicals and Physical Contaminants in the Marine Environment Report*
- 127 <https://www.legislation.gov.uk/ukpga/2009/23/contents>
- 128 <https://www.ospar.org/convention/text>
- 129 <https://www.cbd.int/convention/>
- 130 Long *et al.*, 2015, *Marine Policy*; 57, 53-60
- 131 Pikitch *et al.*, 2004, *Science*; 305, 346-347
- 132 Garcia *et al.*, 2005, *ICES Journal of Marine Science*; 62, 311-318
- 133 <http://www.ices.dk/explore-us/Documents/ICES%20and%20EBM.pdf>
- 134 <http://www.northdevonbiosphere.org.uk/aboutmarinepioneer.html>
- 135 Urquhart *et al.*, 2011, *Fisheries Research*; 108, 2402-47
- 136 <http://www.association-ifca.org.uk/>
- 137 Armstrong *et al.*, 2012, *Sea Angling 2012*, 16pp
- 138 Austen and Malcolm, 2011, National Ecosystem Assessment, Chapter 12: Marine <http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>
- 139 http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm
- 140 <http://jncc.defra.gov.uk/page-4549>
- 141 POST PN 437 Selection of Marine Conservation Zones
- 142 Rees *et al.*, 2013, *Marine Pollution Bulletin*; 72, 14-21
- 143 Mesnildrey *et al.*, 2013, *Aquatic Living Resources*; 26, 159-170
- 144 Howarth *et al.*, 2015, *Marine Biology*; 162, 823-840
- 145 Roberts *et al.*, 2005, *Phil. Trans. R. Soc. B*; 360, 123-132
- 146 DEFRA, 2010, *Guidance on selection and designation of Marine Conservation Zones Note 1*.
<http://webarchive.nationalarchives.gov.uk/20130402152000/http://archive.defra.gov.uk/environment/biodiversity/marine/documents/guidance-note1.pdf>
- 147 <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environmental-audit-committee/marine-protection-areas-revisited/oral/44693.html>