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Annex 4: 2018 options for monitoring UK fish

Bill Turrell and the HBDSEG fish subgroup

Edited by Yessica Griffiths and Karen Webb

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For further information on JNCC's report series please contact:

Joint Nature Conservation Committee

Quay House, 2 East Station Road, Fletton Quays, Peterborough PE2 8YY

<https://jncc.gov.uk/>

Communications@jncc.gov.uk

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Author affiliations:

¹ Scottish Government, Marine Directorate

² Healthy and Biologically Diverse Seas Evidence Group (HBDSEG) fish subgroup

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Foreword

Yessica Griffiths and Dr Karen Webb, JNCC (2024)

This historical paper is part of an archival report series, produced between 2016 and 2018, which collectively presents options for monitoring UK marine biodiversity. These options for monitoring were evaluated at a series of workshops in 2017 and 2018, by scientific experts from the Healthy and Biologically Diverse Evidence Group (HBDSEG) and policy advisors from the four governments of the UK. The initial set of workshops provided a steer on political ambitions for monitoring specific aspects of marine biodiversity, while a final workshop garnered advice from scientific experts on the proposed monitoring across UK marine biodiversity. In 2019, the combined outcomes of these workshops formed advice for UK Governments on monitoring of UK marine biodiversity. The process for developing this advice is outlined in the summary paper ([Webb et al. 2024](#)).

Publication of this historical report series provides a publicly available audit of the information underpinning the 2019 advice to UK Governments on proposed marine biodiversity monitoring in UK waters. This information provides a solid foundation for developing updated future advice. At the time of publication (2024), many of the evidence gaps which have been highlighted remain and, in some instances, have increased.

This paper provides a snapshot in time of UK fish monitoring in 2017 and the collated viewpoints, on proposed monitoring, of HBDSEG and policy representatives in 2018. These viewpoints are historical and do not necessarily reflect viewpoints at the time of publication in 2024. All monitoring options developed and presented in this paper were dependent on the assumption that core UK monitoring programmes would continue at the same level of funding. However, inflation has significantly increased the costs of marine monitoring, particularly those that were vessel based, and as a result there has been ongoing, yearly erosion of core monitoring.

Greater understanding of fish stock and community changes are required to provide evidence for tackling the biodiversity loss and climate crisis. Biodiversity is intricately and complexly linked to many other issues such as food supply via various food webs. Monitoring fish provides valuable data on the overall ecosystem health and biodiversity, fulfilling legal obligations and informing decisions to ensure sustainable management and conservation of marine resources.

It should be noted that some of the legislative drivers which have been referenced in this report have been updated or superseded since 2017. In addition, new legislation and obligations have been introduced since 2017. For clarity, '[2017]' has been included alongside all occurrences of the term 'current' (and its derivatives) and within all table and figure captions and headings, throughout this paper.

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1. Submission: Decision on options for monitoring of UK fish, shellfish, and cephalopod populations

1.1. Issue

The UK Marine Biodiversity Monitoring R&D Programme has been tasked by UK Governments with developing recommendations for an integrated monitoring scheme for all marine biodiversity across all UK waters as it was felt that we are not currently [2017] fulfilling our nature conservation obligations for monitoring and assessment in a coordinated and cost effective manner.

This paper discusses potential options to enhance the monitoring of fish, shellfish, and cephalopod populations with respect to delivering indicators of biodiversity health, rather than the health (in terms of sustainable harvesting) of fish stocks exploited commercially.

1.2. Recommendation

That governments jointly decide on preferred options for UK fish, shellfish, and cephalopod population monitoring.

1.3. Background

The fish and shellfish expert group have been asked by the Governments of the UK for advice on options for marine biodiversity monitoring for the waters of the UK. This work forms part of the UK Marine Monitoring and Assessment Strategy (UKMMAS) and is being undertaken in partnership with the UK's Healthy and Biologically Diverse Seas Evidence Group (HBDSEG). The advice aims to cost-effectively encompass the UK's significant policy and statutory obligations, such as the:

- High Level Marine Objectives
- UK Biodiversity Action Plan
- OSPAR Convention
- EU Habitats Directive
- EU Water Framework Directive
- EU Marine Strategy Framework Directive

1.4. Argument

1.4.1. Objective:

This policy decision will begin to enable UK Governments to cost-effectively meet their national and international obligations for biodiversity monitoring, assessment and reporting of fish, shellfish, and cephalopod populations, and to robustly inform advice on management of human activities in the marine environment.

1.4.2. Criteria:

The criteria used to evaluate the effectiveness of each potential monitoring option are as follows:

1. Meeting legislative obligations for monitoring and/or assessment
2. Establishing a long-term, wide-scale monitoring network to provide an understanding of change due to natural variation, thereby allowing the interpretation of other change detected through monitoring activities
3. Undertaking targeted pressure – state relationship studies and management effectiveness monitoring for habitat \ pressure \ management measure relationships

1.5. Legislative Background – Offshore Fisheries

Most stocks exploited by UK fishermen are managed under the Common Fisheries Policy (CFP) by the European Commission. An important part of the management procedure is the use of Total Allowable Catches (TACs). These are intended to allocate fish resources to different member states and to control the amount of fish removed each year.

At its heart, the reformed CFP (1380/2013) has a goal of much greater regionalisation, where regional groupings of Member States, with advice from regional Advisory Councils and other stakeholders, are expected to take much greater responsibility in developing the rules and management approaches that govern their fisheries, stepping back from the old-fashioned top-down 'one size fits all' approach.

UK Fisheries Management is co-ordinated in terms of a Concordat that exists between the four UK Fisheries Administrations. The Concordat is an agreement between the UK Administrations that sets out several arrangements for UK fisheries management, including which fishing vessels each Administration will license and how UK quotas are allocated to the four UK countries.

Most TACs are set on an annual basis and are the result of a cycle of events ending in the December Council of Fisheries Ministers, which decides on the final TACs for the following year. Fixing the level of fish quotas that can be caught by EU member states is a complex process and EU fisheries ministers have the final say on the quotas to be allocated for the next 12-month period.

Different quotas are applied to different areas for different species, the so-called TAC areas. For example, the TAC area for North Sea whiting comprises International Council for the Exploration of the Sea (ICES) divisions IVa, b, c and VIId. The TAC area for *Nephrops* relates to ICES subdivision VII which contains multiple individual functional units which are assessed separately and persecuted to different extent by the fleets of individual nations.

Before the December Council of Fisheries Ministers meeting is held, several rounds of negotiations with non-EU countries must also take place in relation to fish stocks that straddle such international boundaries and are therefore jointly managed. These negotiations set the TACs and quota for such stocks for subsequent consideration at December Council, and in many cases also establish arrangements allowing mutual access to fish in each other's territorial waters. These external negotiations include:

- EU/Norway (complex talks which deal with key North Sea stocks such as cod, haddock, whiting, saithe and plaice and quota swaps between the parties [the so-called 'balance']).

- Coastal States (a suite of talks involving the EU, Norway, Iceland, the Faroe Islands and Russia, and dealing with mackerel, Atlanto-Scandian herring and blue whiting).
- EU/Faroes (a bilateral agreement providing UK fishing vessels access to predominantly whitefish opportunities in Faroese waters).

1.5.1. Scotland

Within the EU, Scotland's seas are the fourth largest of core European waters and these seas make up over 60 percent of the UK's total European waters. Scotland accounts for 80% by weight of the total UK landings of key stocks (88% by value) [2017].

Marine Scotland is an active participant in both the North Sea and the North West Waters regional groups which cover the waters around Scotland.

At a UK level, Marine Scotland works with several others including the Department for Environment Food & Rural Affairs (Defra), the Marine Management Organisation (MMO) and Seafish.

1.5.2. England and Wales

Cefas engage with the regional Advisory Councils that cover the waters around England (including Pelagic, North Sea and the North Western Waters).

At a UK level, Cefas works with several others including the Department for Environment Food & Rural Affairs (Defra), Natural Resources Wales (NRW), Agri-Food and Bioscience Institute (AFBI), Natural England (NE), Environment Agency (EA), Joint Nature Conservation Committee (JNCC), the Association of Inshore Fisheries and Conservation Authorities (IFCA) the Marine Management Organisation (MMO) and Seafish.

1.5.3. Northern Ireland

The Agri-Food and Bioscience Institute (AFBI) is an active participant in the North West Waters regional groups which cover the main fishing areas of the Irish Sea and West of Scotland.

At a UK level, AFBI works with several others including the Department of Agriculture, Environment and Rural Affairs (DAERA), Department for Environment Food & Rural Affairs (DEFRA), the Marine Management Organisation (MMO) and Seafish. AFBI works closely with other science partners in the UK, Marine Scotland and Cefas to coordinate data collection efforts for policy advice.

1.6. Legislative Background – Inshore Fisheries

Although the European Union (EU) is responsible for much of the legislation relating to sea fisheries, the UK has exclusive rights to fish within six nautical miles (nm) of its coastline. Between six and 12 nm, fishing by non-UK vessels is restricted to those with historic rights relating to specific fisheries and specific countries. In addition, the Marine Strategy Framework Directive was adopted by the European Union in 2008 and transposed into UK law in 2010. The MSFD requires an assessment of the current state of the UK seas, targets, and indicators to achieve Good Environmental Status (GES) and the development of a programme which will help achieve GES.

1.6.1. Scotland

Through devolution, Scottish Ministers are responsible for the regulation of sea fishing around Scotland and within 12 nm of Scotland's coast, the Scottish Government can take non-discriminatory conservation measures, provided that the EU has not already legislated in this area.

Since 1984, inshore fisheries in Scotland have been regulated primarily through the Inshore Fishing (Scotland) Act 1984. This Act enables Ministers to regulate fishing in inshore waters by prohibiting combinations of the following:

- all fishing for sea fish;
- fishing for a specified description of sea fish;
- fishing by a specified method;
- fishing from a specified description of fishing boat;
- fishing from or by means of any vehicle, or any vehicle of a specific description;
- fishing by means of a specified description of equipment.

Ministers may also specify the period during which prohibitions apply, and any exceptions to any prohibition.

Regional Inshore Fisheries Groups (RIFGs) are non-statutory bodies that aim to improve the management of Scotland's inshore fisheries out to 6 nautical miles, and to give commercial inshore fishermen a strong voice in wider marine management developments.

The development of the Inshore Fisheries Groups (IFGs) in Scotland led to the establishment of a new regional structure that commenced from April 2016. The regional structure has succeeded the IFGs that were formerly in place. The Regional Inshore Fisheries Group network includes North & East Coast RIFG, West Coast RIFG, Outer Hebrides RIFG, Orkney Management Group, Shetland Shellfish Management Organisation.

Fisheries Management and Conservation Group (FMAC) was not entirely suitable for inshore fisheries management as it naturally focuses on major issues relating primarily to offshore fisheries. Because of this focus the group had insufficient representation of inshore fishermen, particularly static gear operators. This was seen as a significant weakness from an inshore point of view, as the creel sector makes up at least 75% of the fleet operating in inshore waters.

The FMAC model was therefore revised to create a separate inshore group. The Inshore Fisheries Management and Conservation Group (IFMAC) allows inshore issues to be addressed by representatives of fishermen operating in inshore waters. IFMAC complements the Regional IFG network by focusing on national, as opposed to local, inshore issues and covering inshore sea areas not covered by Regional IFGs (e.g. 6–12 nm).

1.6.2. England and Wales

The Conservation of Habitats and Species Regulations 2010 consolidate various amendments made to the Conservation (Natural Habitats, &c.) Regulations 1994 in respect of England and Wales. The 1994 Regulations transposed Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) into national law. The Regulations provide for the designation and protection of 'European sites',

the protection of 'European protected species', and the adaptation of planning and other controls for the protection of European Sites. New provisions implement aspects of the Marine and Coastal Access Act 2009. The Habitats Regulations apply only as far as the limit of territorial waters (12 nautical miles from baseline). The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 apply the Habitats Directive and the Birds Directive in relation to oil and gas plans or projects wholly or partly on the United Kingdom's Continental Shelf and superjacent waters outside territorial waters (the UKCS).

The Marine and Coastal Access Act 2009 established the Marine Management Organisation (MMO) who license, regulate, and plan marine activities in the seas around England. In 2011, the Inshore Fisheries and Conservation Authorities (IFCAs) replaced the Sea Fisheries Committees with extended responsibilities not only to achieve sustainable inshore fisheries, but also to help achieve conservation objectives. The Natural Environment and Rural Communities Act 2006 established Natural England and as part of their remit they are responsible for promoting nature conservation and protecting biodiversity. In Wales, marine licensing and commercial fisheries are regulated by Natural Resources Wales.

1.6.3. Northern Ireland

Through devolution, the Department of Agriculture, Environment and Rural Affairs (DAERA) is responsible for the regulation of commercial sea fishing around Northern Ireland, having the responsibility of preparing and enforcing all fisheries regulations, both for the offshore and inshore sectors. The Northern Ireland Government can take non-discriminatory conservation measures, provided that the EU has not already legislated in this area.

Under the Fisheries Act (Northern Ireland) 1966 as amended, DAERA has full responsibility for the management, conservation, protection, and improvement of inshore fisheries (out to 12 nm) in Northern Ireland. The Sea Fish (Conservation) Act 1992 extends the powers of the 1967 Sea Fish (Conservation) Act to Northern Ireland. This includes the entitlement to introduce minimum landing sizes, the issue of penalties for offences and greater enforcement powers to DARD and sea-fishery officers.

The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 gave the Department of Environment (now part of DAERA) the powers to implement the Habitats Directive and thus designate areas for the protection of important species or habitats.

In 2005 the Registration of Fish Buyers and Sellers and Designation of fish auction sites regulations (Northern Ireland) was created. Under these regulations sales notes must be submitted within 48 hours of sale by the registered seller (if fish sold at auction) or the buyer. The sales notes must include the name of the species, its geographical area of origin, price and quality of each species, the vessel landing the species and the port and date landed. Sales notes are not required if the quantity landed is less than 25 kg per day and is being sold direct to the public. This has significantly increased the data available to monitor the effort and landings into Northern Ireland.

The Northern Ireland inshore is also regulated by several EU directives. In 2000 the Water Framework Directive (WFD) was adopted into EU legislation. The aim of the WFD is to integrate the way water bodies are managed throughout Europe. In 2003 this was transposed into Northern Ireland legislation through the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2003, which gave the Department of Environment the powers to manage and enforce the legislation which includes the protection and enhancement of coastal waters out to one mile.

Following public consultation of a document which examined sustainable development strategy options for inshore fisheries, DAERA responded to the issue of inshore governance

by creating an Inshore Fisheries Partnership Group (IFPG). The group consists of members from DAERA, national and regional fishing groups, AFBI, relevant NGO's and the recreational angling community. The main roles of this group include:

- Improving communication and transparency regarding the management of inshore fisheries.
- Considering the need for local management plans.
- Promoting the sustainable development of the sector.
- Identifying ways to maximise economic returns for fishermen.
- Identifying data gaps and making recommendations on priorities for scientific research to support management decisions.
- Providing advice on legislative and compliance issues, including the need to introduce new legislation.
- Developing and promoting voluntary codes of practice.

2. Current [2017] Monitoring – Fish and Shellfish (*Nephrops* and Scallops) Populations

All UK nations participate in ICES coordinated surveys (Table A1.1). In addition, Northern Ireland and Scotland carry out scallop surveys.

The demersal fish community is sampled by the bottom trawl surveys of the International Bottom Trawl Survey (IBTS) programme, and additional beam trawl surveys (+ one sandeel survey). In total 259 days of offshore survey vessel time is used, during 13 surveys, at an estimated annual cost of approximately £5.5M. An additional survey is conducted in the Western Channel on the fishing vessel Carhelfmar as part of the Fisheries Science Partnership (FSP).

The demersal surveys already record all species, not just commercially exploited species. There is a quality assurance issue with respect to species identification for some species, particularly those where the data are not used in stock assessment and for those sampled by international surveys. Some pelagic species are sampled by the demersal trawl surveys; hence these provide a reasonable full-community estimate.

In the 2017 OSPAR Intermediate Assessment, and the 2018 UK MSFD Assessment, approximately 80% of the bottom trawl survey data was used to derive a data product which allowed the calculation of the fish community Indicators.

There are an additional eight annual surveys, using 122 days of offshore survey vessel time at an approximate annual cost of £2.6M, focused on the pelagic fish community. Most of this monitoring is performed using acoustic techniques, with some validation fishing, hence its utility for current [2017] fish size-based assessments is limited.

There are an additional six annual surveys, using 76 days of offshore survey vessel time at an approximate annual cost of £1.6M, focused on monitoring the offshore *Nephrops* community. Most of this monitoring is performed using underwater TV techniques, with some validation fishing, hence its utility for fish community assessments is limited. However, it may be relevant to offshore habitat monitoring, although this is not considered here (see introductory paragraph above).

Finally, there are five UK surveys targeting scallops. These surveys generally utilise the smaller research vessels and are conducted in inshore waters. They use scallop dredges which, although potentially useful for some benthic organisms, do not catch fish quantifiably. The five surveys use 68 days vessel time at an approximate cost of £0.8M. Scallop stocks are not a quota species, and hence no DCF refund is available for this monitoring.

In summary, 525 days of survey vessel time is currently [2017] expended gathering data on UK fish, shellfish, and cephalopod populations. Currently [2017] approximately 40% of these surveys contributed to the 2018 UK MSFD Assessment.

Shellfish comprise five of the ten most valuable fish species to the UK, however only *Nephrops* and scallops are routinely monitored by scientific surveys. The fisheries on the remainder of the shellfish species are managed through a combination of EU technical regulations, and National (or local - IFCA) legislation. Crab and lobster stocks are assessed based on fisheries dependent data in UK waters and the population structure of around the UK is not well understood. Commercially important whelk stocks are not assessed.

2.1. Current [2017] Monitoring – Inshore Fish Populations

Specifically inshore fish stocks are hard to define. Many fish species which are caught offshore in the commercial fisheries spend some of their life cycle in inshore waters.

2.1.1. Scotland

No specific inshore fish monitoring is carried out.

SEPA performs some estuarine surveys in transitional waters (i.e. Clyde and Forth Estuaries) to provide assessments for the Water Framework Directive.

2.1.2. England and Wales

Limited inshore fish monitoring is carried out by the EA for the purposes of WFD reporting in transitional waters and by the IFCAs. The Cefas Young Fish Survey was conducted from 1970 to 2010, with full standardisation since 1981, but has since ceased. Sea bass (*Dicentrarchus labrax*) tagging studies have been conducted through the Defra project MF1233 (“C-Bass”) since 2013.

2.1.3. Northern Ireland

No specific inshore fish monitoring is carried out.

The Department of Agriculture, Environment and Rural Affairs (DAERA) undertakes regular (annual) fish surveys of Northern Ireland’s transitional waters for the Water Framework Directive; these include the Foyle, Faughan, Bann, Lagan, and Newry estuaries. DAERA has also been collecting long-term fish data on selected sea loughs from power station intake screens; these include Lough Foyle (Coolkeeragh power station), Larne Lough (Ballylumford power station), and Belfast Lough (Kilroot power station).

2.2. Current [2017] Monitoring – Deep Water Fish Populations

There is currently one UK deepwater survey each year, which is combined with a survey of the Rockall Plateau.

2.3. Current [2017] Monitoring – Cephalopod Populations

There are no specific targeted cephalopod population surveys in the UK. When cephalopods are caught in fishing gears on other surveys, they are recorded (ME5311 Final Report Defra). Species identification remains an issue and efforts to improve this are ongoing (HBDSEG paper Paper_38_12.1, Feb 2017). Squid abundance is strongly linked to environmental conditions (van der Kooij *et al.* 2017).

2.4. Monitoring Options for UK Fish, Shellfish and Cephalopod Populations

For the purposes of this options paper, a specific policy has been adopted whereby options have been restricted to those which enhance the UK's ability to assess the health and status of the fish, shellfish, and cephalopod populations. Many options are also available to utilise fish and shellfish surveys to enhance the assessment of other components of biodiversity, such as plankton, seabirds, mammals, and benthic components. It is assumed that any option to monitor these other components, but utilising fisheries survey vessel time, will be covered with the options papers of those other components. Many technological developments are in progress to allow ecosystem processes to be better monitored during current [2017] fisheries surveys through the integrative monitoring approach but these are not costed here. We recognise that any additional monitoring aims adopted for biodiversity will likely require a re-evaluation of current [2017] monitoring to make resource available. This may be partly alleviated by moving to a multi-annual monitoring system with a rolling programme of monitoring since many species do not require annual monitoring.

Table A2.1 summarises the suggested monitoring options for UK fish, shellfish, and cephalopod populations. In brief, these are:

2.4.1. Option 1 – Status Quo

To maintain the current [2017] level of fish, shellfish and cephalopod monitoring as summarised by Table A2.

Currently [2017] this fulfils the UK's commitments to ICES and to the EU through the Data Collection Framework (DCF).

Note that approximately 80% of the offshore survey costs is refunded by the EU under the DCF. It is not known what will happen to this funding post-EU membership, and hence this introduces a risk to the current [2017] level of monitoring.

2.4.2. Option 2 – Status Quo + Continued Indicator Assessments Based on OSPAR Data-product

For the 2017 OSPAR Intermediate Assessment and the 2018 UK MSFD Assessment, only 80% of the available fish community data derived from the international bottom trawl surveys was utilised. This took approximately two FTE for one year at a cost of £120k.

To maintain these assessments annually, to include the additional 20% of bottom trawl data, and to expand the assessments to include additional data such as from pelagic, deep water and inshore surveys, as well as observer and market data, would require a similar annual cost.

2.4.3. Option 3 – Additional Shared Stock Monitoring

Over the last 10 to 15 years the UK has dropped several surveys which contributed to the ICES stock assessments and could have contributed to the MSFD fish community assessments. It might be argued that in a post-EU UK, these surveys would need to be recommenced to increase our understanding of the stocks we exploit, as well as be seen to be contributing to the understanding of stocks shared with the EU to maintain negotiating positions.

This option assumes the addition of three more 30-day surveys at a cost of £1.9M.

2.4.4. Option 4a – Enhanced Inshore Fish Community Monitoring

Currently [2017] there is no systematic surveys of UK inshore fish stocks.

At a workshop between agencies and Defra (January 2015), it was concluded that it is likely that the ecology and pressures in the inshore marine environment are likely to differ from those offshore. The participants concluded that further work be undertaken to assess the seriousness of the gap in monitoring, and the actions that may be required to address it. Following the workshop in January 2015, a three year project (£75k pa) was proposed to HBDSEG (34.5.2.1, Item 32) to evaluate what monitoring would be required in the future to ensure that data were collected to provide operational indicators for key species.

At most, this option assumes the addition of six, 20-day inshore vessel surveys at a cost of £1.3M. However, a targeted project to fully evaluate the needs and costs (as suggested previously by HBDSEG) has not been made and such a project may result in more cost-effective options.

2.4.5. Option 4b – Targeted Inshore Fish Monitoring

A key biodiversity issue at present is the dramatic fall in seabass stocks. The current [2017] C-Bass project is providing an evidence base for the spatial and temporal movements of sea bass in UK waters, primarily through the deployment of bass tagged with archival tags. The program is spatially restricted but could usefully be developed to provide a longer term evidence base to evaluate the spatial extent and habitat usage of the species to identify appropriate conservation measures. To minimise costs, tagging should be spread over multiple years moving around the coast to build up data over time. Tagging using archival tags would be supplemented by the release of conventional mark-ID tags. This would cost in the region of £100k per annum (assuming the release of tagged bass in two locations per annum).

2.4.6. Option 5 – Enhanced Deepwater Fish Population Monitoring

To enhance the current [2017] Scottish deepwater survey, this option adds two further 15-day surveys to cover more of our Atlantic margin, at a cost of £0.6M per annum.

2.4.7. Option 6a – Enhanced Cephalopod Population Monitoring

To start targeted surveys for Cephalopods not adequately sampled in current [2017] surveys. Since Cephalopods are episodic and highly variable in timing and distribution, fisheries dependent data are suitable to inform on abundance. Surveys could best use commercial vessels and fishers' knowledge at a cost of up to £0.5M per annum.

2.4.8. Option 6b – Targeted Cephalopod Species Monitoring

Employing scientific observers on key fisheries only where pressure on the stock is known to be high. Cuttlefish (*Sepia officinalis*) in the Channel are a priority and monitoring through a Fisheries Science Partnership model but with a multi-year duration, would prove cost-effective (approximately £0.1M per annum).

2.4.9. Option 7 – Enhanced Elasmobranch Population Monitoring

Many elasmobranch species are poorly represented in trawl surveys and a suite of options would be best employed to monitor key species of conservation concern. Many species agreed within OSPAR as [priority species for assessment and protection](#) are elasmobranchs that occur in UK waters: including Angel shark *Squatina squatina*, common skate (species complex) *Dipturus batis*, white skate *Rostroraja alba*, porbeagle *Lamna nasus*, spurdog *Squalus acanthias*, spotted ray *Raja montagui*, thornback ray *R. clavata*.

Additional species that are poorly sampled but important for fisheries management, as either target or bycatch species, include undulate ray *Raja undulata*, blonde ray *R. brachyura*, small-eyed ray *R. microocellata*, sandy ray *Leucoraja circularis*, shagreen ray *L. fullonica*, cuckoo ray *L. naevus*, (starry) smooth-hound *Mustelus asterias*, and tope shark *Galeorhinus galeus*.

A few species, such as spurdog and spotted ray, can be better sampled with additional stations on current [2017] fisheries surveys (£10,000 per day). Blonde ray and thornback ray would benefit from increased observer coverage on inshore vessels. Those elasmobranchs considered critically endangered by the IUCN (i.e. Angel shark, common skate), endangered (white skate), vulnerable (porbeagle) or near threatened (undulate ray) require targeted monitoring programmes, building on Defra funded projects (such as the pilot FSP for common skate, porbeagle and spurdog in 2011–2012, followed by the Neptune and Electra projects 2014–2017). Given the movement toward species level biodiversity assessments, these rare and red listed species are priority candidates for biodiversity indicator development.

Monitoring would prove most cost-effective for species known to be present in localised patches within UK waters (i.e. undulate ray, small-eyed ray, common skate, and Angel shark). Undulate ray in the Channel and common skate in the Celtic Sea and to the west and north of Scotland would be best sampled by targeted surveys using chartered commercial vessels. The Fisheries Science Partnership (e.g. FSP19 and FSP35) would be a suitable model at a cost of up to £2000 per day and between £35000 and £75000 per survey. FSP surveys could be used on a rolling basis with a multi-year plan to monitor multiple species. Angel shark are present in Cardigan Bay and as particularly rare species would benefit from non-destructive monitoring through moored cameras at inshore stations/bays: this would require a scoping project to establish its feasibility as a monitoring programme.

A suite of targeted monitoring options for species of conservation concern would prove useful for both fisheries management and for biodiversity assessment. This would cost of the order of £0.2M per annum.

2.4.10. Option 8 – Enhanced Shellfish Population Monitoring (Channel scallops)

Current [2017] scallop surveys are limited by areas accessible to dredge surveys. Underwater TV surveys can be used to compliment scallop dredge surveys and inform on the full distribution and abundance. This has been trailed in the English Channel for the

highly valuable king scallop (*Pecten maximus*) in 2016 in selected areas that are inaccessible due to gear conflicts, incompatible substrate types or conservation measures.

This option adds two further dredge surveys (23 days total) and one underwater TV survey (8 days), at a cost of approximately £0.25M per annum.

2.5. Discussion of options

This paper was circulated to HBDSEG ahead of their meeting 30 November 2017 and to the UK Marine Biodiversity Monitoring Board 5 March 2018. There was no country-level discussion of the monitoring options presented for fish as the general viewpoint of policy was to continue with current [2017] monitoring for the time being. Current [2017] monitoring was reviewed as the preferred policy option at the HBDSEG workshop 27 to 28th March 2018.

2.6. HBDSEG review of current [2017] of policy preferred option

The preferred option selected by policy was reviewed by HBDSEG, alongside the remaining biodiversity components, at a two-day workshop 27 to 28 March 2018. HBDSEG provided advice on whether an adequate level of evidence would be achieved by the policy option preferences and, if inadequate, what it would take to bring the option to a level of adequacy that would fulfil the following monitoring objectives:

- Understanding the natural variability of the biodiversity component and its role within ecosystem processes and functions.
- Understanding pressure-state relationships and facilitating the development of pressure-based monitoring to enable the sustainable management of human activities.
- Undertake robust assessments of conservation status and site condition at required scales and temporal frequencies to fulfil national and international reporting obligations.

HBDSEG developed advice on how best to address the key inadequacies identified within the policy preference and made recommendations on the minimum acceptable level of monitoring.

2.7. HBDSEG advice

HBDSEG concluded that the current [2017] monitoring of fish is inadequate in terms of the evidence which it provides for fulfilling our conservation and assessment commitments for all fish groups. HBDSEG considered that there is currently [2017] a strong focus on commercial species, with poor representation of inshore fish species particularly fish associated with rocky substrates. For some non-commercial species which are monitored, frequency of capture and catch rates are low and so may not be informative.

HBDSEG expressed concern around the absence of larger sharks and large pelagic species, and the general lack of focus on fish biodiversity. It was also noted that monitoring techniques deployed, actively avoid areas of reef, and subsequently reef species are poorly sampled. Reporting requirements for cephalopods were also lacking.

HBDSEG acknowledged that current [2017] monitoring of inshore fish varies around the country and It was noted that this paper lacks detail around current [2017] inshore fishing activities, only directly mentioning scallops and not referencing the remaining (eight or so) commercially exploited inshore species. It was noted that there is a very large range of both

species and environments included in current [2017] monitoring programmes and so the data available are very variable and lacking in some areas.

HBDSEG considered the following elements of the 'biodiversity of fish, shellfish and cephalopods' are either not monitored or not monitored effectively as part of current [2017] monitoring activities:

- Inshore/coastal species.
- Some shellfish and their habitats (e.g. oyster beds, mussel beds).
- Species of biodiversity concern (e.g. angel shark and various diadromous species).
- Reef-associated fish (e.g. wrasse and some early-stage gadoids).
- Large pelagic/epipelagic fish assemblages (and mesopelagic fish in deep-sea). Whilst large pelagic fish may be of high interest, such work may be high cost, and the more wide-ranging nature of stocks means that such work may need to involve internationally coordinated approaches).
- Ichthyoplankton and post-larval stages (better identification of spawning grounds; potential overlap with pelagic monitoring).
- Deep-water fish.
- Forage fish (including sandeels).
- Fish in MPAs.

HBDSEG emphasised the following associated risks of current [2017] monitoring activities:

- The lack of appropriate monitoring to inform on the status of the UKs most threatened fish species means there is a reduced ability to inform on potential 'biodiversity loss' (if threats are still impacting on population growth) or recovery of threatened species (if management is allowing population growth).
- Lack of data on coastal fish, including nursery grounds, in areas subject to a range of human pressures (e.g. discharges, dredging, coastal developments, habitat degradation, as well as fishing pressure), limits appropriate management of coastal zones (areas where there is high societal relevance).
- Impacts of EU-exit and DCF funding. Need robust plan for monitoring for post-EU Exit.

2.8. Incorporation of HBDSEG advice in policy option preference

HBDSEG advised that to improve the evidence base to a minimum level of adequacy for fulfilling our monitoring objectives, the following developments are required:

- A phased approach for introducing pilot projects that address data gaps (especially in the coastal zone, which could encompass sandy areas as well as rocky grounds). It may be useful to develop a 'road map' to start addressing remaining data gaps in such a way that allows cost-effective yet robust data to be collected).
- Further collation of relevant data to better identify and prioritise data gaps.
- Improved integration between 'offshore' fisheries monitoring with current [2017] WFD monitoring.

HBDSEG advised that by developing the current [2017] monitoring programme in this way, an improved understanding of fish community health in inshore waters and management

requirements will be achieved. Improved health of inshore fish stocks including commercial species will be of benefit to both commercial and recreational inshore fisheries as well as the wider marine ecosystem.

A summary of the costs, benefits and risks associated with the policy option and HBDSEG amended policy option, are provided in Table 1.

Table 1: Comparison of costs, benefits and risks associated with policy option and HBDSEG amended policy option [table created in 2018].

Policy	Key monitoring elements	Average annual cost (£Mill)	Risk	Benefits
Policy Preference/ current [2017] monitoring	1) Main stocks of offshore commercial fish and shellfish. Note some elements of the ‘biodiversity of fish, shellfish and cephalopods’ are either not monitored or not monitored effectively, including: - Inshore/coastal species. - Some shellfish and their habitats (e.g. oyster beds, mussel beds). - Species of biodiversity concern (e.g. angel shark and various diadromous species). - Reef-associated fish (e.g. wrasse and some early-stage gadoids). - Large pelagic/epipelagic fish assemblages (and mesopelagic fish in deep-sea). Whilst large pelagic fish may be of high interest, such work may be high cost, and the more wide-ranging nature of stocks means that such work may need to involve internationally coordinated approaches). - Ichthyoplankton and post-larval stages (better identification of spawning grounds; potential overlap with pelagic monitoring).	10.5	1) The lack of appropriate monitoring to inform on the status of the UKs most threatened fish species means there is a reduced ability to inform on potential ‘biodiversity loss’ (if threats are still impacting on population growth) or recovery of threatened species (if management is allowing population growth). 2) Lack of data on coastal fish, including nursery grounds, in areas subject to a range of human pressures (e.g. discharges, dredging, coastal developments, habitat degradation, as well as fishing pressure), limits appropriate management of coastal zones (areas where there is high societal relevance). 3) Impacts of EU-exit and DCF funding. Need robust plan for monitoring for post-EU Exit. 4) Data cleaning, analyses, and use/reporting of data for wider studies of fish biodiversity are variable.	1) No new spend required

Policy	Key monitoring elements	Average annual cost (£Mill)	Risk	Benefits
	<ul style="list-style-type: none"> - Deep-water fish. - Forage fish (including sandeels). - Fish in MPAs. 			
HBDSEG Advice	<p>1) A phased approach for introducing pilot projects that address the data gaps described above (especially in the coastal zone, which could encompass sandy areas as well as rocky grounds). It may be useful to develop a 'road map' to start addressing remaining data gaps in such a way that allows cost-effective yet robust data to be collected).</p> <p>2) Further collation of relevant data to better identify and prioritise data gaps.</p> <p>3) Improved integration between 'offshore' fisheries monitoring with current [2017] WFD monitoring.</p>	Additional R&D requirement (not costed)		1) Improved understanding of fish community health in inshore waters may aid in spatial management, which may in turn allow improved recruitment of commercial species and benefit to inshore fisheries (commercial and recreational)

References

Webb, K., Griffiths, Y. & Proudfoot, R. 2024. The U.K. Marine Biodiversity Monitoring Programme: Development of advice on future monitoring (2019). *JNCC Report 765*, JNCC, Peterborough, ISSN 0963-8091.
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Appendix 1

Table A1.1 Current [2017] status of UK fish and shellfish monitoring programme [table created in 2017].

Vessel	Start	End	Ndays	Org	Description	Method	Area	Comment
Endeavour	17/07/2016	30/07/2016	14	Cefas	Demersal Fish	Beam Trawl	Eastern Channel / S North Sea (GNSEngBT3)	Demersal Fish Community
Endeavour	10/09/2016	30/09/2016	21	Cefas	Demersal Fish	Beam Trawl	Irish Sea/Bristol Channel (CSEngBT3)	Demersal Fish Community
Scotia	28/08/2016	08/09/2016	12	MSS	Demersal Fish	Trawl	Rockall / Deepwater	
Scotia	23/01/2016	12/02/2016	21	MSS	Demersal Fish (IBTS Q1)	Trawl	North Sea (GNSIntOT1)	Demersal Fish Community
Corystes	02/03/2015	24/03/2015	23	AFBI	Demersal Fish (IBTS Q1)	Trawl	VIIa (CSNlrOT1)	Demersal Fish Community
Scotia	16/02/2016	07/03/2016	21	MSS	Demersal Fish (IBTS Q1)	Trawl	West Coast (CSScoOT1)	Demersal Fish Community
Endeavour	08/08/2016	07/09/2016	30	Cefas	Demersal Fish (IBTS Q3)	Trawl	North Sea (GNSIntOT3)	Demersal Fish Community
Scotia	05/08/2016	25/08/2016	21	MSS	Demersal Fish (IBTS Q3)	Trawl	North Sea (GNSIntOT3)	Demersal Fish Community
Corystes	05/10/2015	23/10/2015	19	AFBI	Demersal Fish (IBTS Q4)	Trawl	VIIa (CSNlrOT4)	Demersal Fish Community
Scotia	17/11/2016	07/12/2016	21	MSS	Demersal Fish (IBTS Q4)	Trawl	West Coast (CSScoOT4)	Demersal Fish Community
Endeavour	03/03/2016	29/03/2016	27	Cefas	Demersal Fish / Ecosystem	Beam Trawl	Western Channel / Celtic Sea	Ecosystem survey
Scotia	07/04/2016	20/04/2016	14	MSS	Monkfish (+ 2 CHARTERS)	Trawl	Rockall / West Shelf	

Vessel	Start	End	Ndays	Org	Description	Method	Area	Comment
Endeavour	21/06/2016	28/06/2016	8	Cefas	Nephrops	TV	Farn Deepes	Seapens / Burrowed Mud
Alba	07/08/2016	23/08/2016	17	MSS	Nephrops	TV	North Sea	Seapens / Burrowed Mud
Corystes	05/08/2015	13/08/2015	9	AFBI	Nephrops	TV	VIIa	Seapens / Burrowed Mud
Corystes	21/08/2015	25/08/2015	5	AFBI	Nephrops	TV	VIIa	Seapens / Burrowed Mud
Alba	06/01/2016	22/01/2016	17	MSS	Nephrops	TV	West Coast	Seapens / Burrowed Mud
Scotia	01/06/2016	20/06/2016	20	MSS	Nephrops (Offshore)	TV	North Sea / West Coast / Clyde	Seapens / Burrowed Mud
Alba	15/10/2016	31/10/2016	17	MSS	Herring	Acoustic	Clyde	
Scotia	23/01/2016	12/02/2016	0	MSS	Herring	MIK Plankton Net	North Sea	
Scotia	26/06/2016	15/07/2016	20	MSS	Herring (+ 1 CHARTER)	Acoustic	North Coast	
Corystes	02/11/2015	08/11/2015	7	AFBI	Herring Larval Survey	Plankton / Trawl	VIIa	
Scotia	08/05/2016	29/05/2016	22	MSS	Mackerel (Egg) (+2 CHARTERS)	Plankton / Trawl	West Shelf / Ireland	
Corystes	18/05/2015	07/06/2015	21	AFBI	MIK Net Survey	MIK Plankton Net	VIIa	
Corystes	27/08/2015	13/09/2015	18	AFBI	Clupeoid Acoustic	Plankton / Trawl	VIIa, Via	

Vessel	Start	End	Ndays	Org	Description	Method	Area	Comment
Endeavour	03/10/2016	19/10/2016	17	Cefas	Pelagic fish / Ecosystem	Acoustic	Western Channel / Celtic Sea (PELTIC)	Ecosystem survey, extended to eastern Channel in 2017
Alba	08/12/2016	21/12/2016	14	MSS	Sandeel	Trawl	North Sea	
Alba	26/01/2016	08/02/2016	14	MSS	Scallop	Dredge	Shetland	
Alba	28/03/2016	15/04/2016	19	MSS	Scallop	Dredge	West Coast	
Alba	19/05/2016	07/06/2016	20	MSS	Scallop	Dredge	North Sea / East Coast	
Corystes	16/02/2015	20/02/2015	5	AFBI	Scallop	Dredge	VIIa, Via	
Corystes	25/06/2015	04/07/2015	10	AFBI	Scallops (Queen)	Dredge	VIIa, Via	
			525					

Used in MSFD Fish Data Product Nephrops Surveys Pelagic Surveys Scallop Surveys

Appendix 2

Table A2.1 Monitoring options for fish, shellfish, and cephalopod populations [table created in 2017].

Option	Current [2017] status	Implications	Risks and benefits	Annual Monitoring Costs (estimated)	Annual R&D costs to deliver quantitative GES assessment	Total additional cumulative cost per year of implementing option
Option 1: Status Quo	Sufficient for shared stocks. Limited for deepwater and shellfish. None for inshore. Currently [2017] approximately 40% of these surveys contributed to the 2018 UK MSFD Assessment.	Fulfils UK commitments to ICES and to the EU through the DCF. No change is expected.	Risks: Current [2017] major risk is loss of EU funding post-Brexit. Currently [2017] approx. 80% of the demersal/pelagic/Nephrops costs are refunded to UK through the DCF. Benefits: Maintains UK ability to manage its stocks and negotiate with its neighbours.	£5.5M – demersal stocks £2.6M – pelagic stocks £1.6M – Nephrops stocks £0.8M – scallops Total = £10.5M	None	None
Option 2: Status Quo + Continued MSFD Assessments	Task finished for 2017 Intermediate Assessment. Currently [2017] no plans to repeat.	Would update assessments and include additional data.	Risks: Need suitable expertise. If not done assessments will get out of date and irrelevant. Benefits: Updated and enhanced assessments – UK coordinated.	None	£120k	£120k

Option	Current [2017] status	Implications	Risks and benefits	Annual Monitoring Costs (estimated)	Annual R&D costs to deliver quantitative GES assessment	Total additional cumulative cost per year of implementing option
Option 3: Enhanced Shared Stock Fish Population Monitoring	May be required to restart surveys previously axed owing to costs to maintain UK negotiating positions and stock knowledge.	Add 3 more large scale 30 day coordinated surveys.	Risks: Cost. Vessel availability. Benefits: Improved data. Better post-EU position re-shared stocks.	£1.9M	None	£1.9M
Option 4a: Enhanced Inshore Fish Population Monitoring	None	The contribution of inshore fish populations to marine biodiversity is unknown. Add 6 more small vessel 20 day surveys.	Risks: Benefits: Adds knowledge of our own inshore populations. May be most sensitive to pollution from land.	£1.3M	None	£1.3M
Option 4b: Targeted Inshore Fish Population Monitoring	Seabass tagging has been initiated through a Defra funded project but not part of regular monitoring.	Seabass are a species of great conservation concern. Additional sampling would incur costs.	Risks: success is dependent on tag returns. Benefits: Will allow the identification of suitable conservation measures and the protection of biodiversity.	£0.1M	£25k	£0.125M

Option	Current [2017] status	Implications	Risks and benefits	Annual Monitoring Costs (estimated)	Annual R&D costs to deliver quantitative GES assessment	Total additional cumulative cost per year of implementing option
Option 5: Enhanced Deepwater Fish Population Monitoring	Currently [2017] 1 10 day survey in Rockall Trough by Scotland.	Add 2 surveys of 15 days to extend information along Atlantic margin.	Risks: Need larger RVs. Benefits: Adds knowledge of our deep water stocks – long lived and hence sensitive to fishing pressure.	£0.6M	None	£0.6M
Option 6a: Enhanced Cephalopod Population Monitoring.	To start targeted surveys for Cephalopods.	Surveys could best use commercial vessels at a cost of £0.5M per annum.	Risks: These species are episodic, and highly variable in timing and distribution. Would need to be closely linked to industry observations. Benefits: Adds knowledge of cephalopod populations.	£0.5M	None	£0.5M
Option 6b: Targeted Cephalopod Population Monitoring.	Cuttlefish in the Channel are an important English fishery, but stock size is unknown.	Add 1 FSP survey per year.	Risks: Dependent on participation of chartered fishing vessel Benefits: Adds knowledge of Cuttlefish fishery and would develop a strong partnership with industry.	£0.1M	~£50k	£0.15M

Option	Current [2017] status	Implications	Risks and benefits	Annual Monitoring Costs (estimated)	Annual R&D costs to deliver quantitative GES assessment	Total additional cumulative cost per year of implementing option
Option 7: Enhanced Elasmobranch Population Monitoring.	Many elasmobranch species are IUCN red-listed and priorities for protection by OSPAR.	Add 2-3 FSP surveys per year and/or camera survey.	<p>Risks: Dependent on participation of chartered fishing vessel.</p> <p>Benefits: Adds knowledge of elasmobranch species abundance and would develop a strong partnership with industry.</p>	£0.2M	~£50k	£0.25M
Option 8: Enhanced Shellfish Population Monitoring.	King scallops are an important English fishery, but stock size is unknown.	Add 2 further dredge surveys on commercial vessels (23 days total) and 1 underwater TV survey on RV (8 days).	<p>Risks: Dependent on participation of chartered fishing vessel.</p> <p>Benefits: Adds knowledge of scallop fishery and would develop a strong partnership with industry.</p>	£0.25M	None	£0.25M