



Department
for Environment
Food & Rural Affairs

Marine Strategy Part Two:

UK updated monitoring programmes

March 2021

We are the Department for Environment, Food and Rural Affairs. We're responsible for improving and protecting the environment, growing the green economy and supporting our world-class food, farming and fishing industries.

We work closely with our 33 agencies and arm's length bodies on our ambition to make our air purer, our water cleaner, our land greener and our food more sustainable. Our mission is to restore and enhance the environment for the next generation, and to leave the environment in a better state than we found it.



© Crown copyright 2021

This information is licensed under the Open Government Licence v3.0. To view this licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/

This publication is available at www.gov.uk/government/publications

Any enquiries regarding this publication should be sent to us at

Marine.strategy@defra.gov.uk

www.gov.uk/defra

Contents

Introduction	5
Section 1: Context	6
1.1 The UK Marine Strategy	6
1.2 Good Environmental Status (GES).....	7
1.3 Our approach.....	8
1.4 Geographic scope of monitoring programmes.....	9
1.5 Coordination of monitoring programmes across the UK	11
1.6 Progress with UK Monitoring Programmes.....	12
1.7 Detailed information about monitoring programmes	13
1.8 Addressing issues and opportunities	14
1.9 Our approach to climate change in the UK Marine Strategy Part Two	14
Section 2: Monitoring programmes used to assess Good Environmental Status (GES)....	15
Descriptors 1 & 4: Cetaceans	17
Descriptors 1 & 4: Seals	23
Descriptors 1 & 4: Birds	27
Descriptors 1 & 4: Fish	32
Descriptors 1 & 4: Pelagic Habitats	38
Descriptors 1 & 6: Benthic Habitats	40
Descriptor 2: Non-Indigenous Species	46
Descriptor 3: Commercial Fish and Shellfish	50
Descriptor 4: Food Webs	55
Descriptor 5: Eutrophication	59
Descriptor 8: Contaminants	64
Descriptor 9: Contaminants in Seafood	69
Descriptor 10: Marine Litter	71

Descriptor 11: Underwater Noise.....	75
Section 3: Monitoring programmes for prevailing conditions used to support the assessment of Good Environmental Status (GES)	78
pH & ocean acidification	80
Temperature	81
Salinity	83
Turbidity	84
Waves	85
Sea Level	86

Introduction

The UK Marine Strategy Regulations 2010 require the UK to take the necessary measures to achieve or maintain Good Environmental Status (GES) through the development of a UK Marine Strategy. The UK Marine Strategy, made up of Parts One, Two and Three, sets out a comprehensive framework for assessing, monitoring and taking action across our seas to achieve the UK's shared vision for 'clean, healthy, safe, productive and biologically diverse ocean and seas'.

In October 2019, we published the updated UK Marine Strategy Part One, which laid the foundations for the second implementation cycle of the Strategy, and showed the progress made towards our vision, what targets and indicators we would be using, and what further action was necessary.

This updated UK Marine Strategy Part Two sets out the monitoring programmes that we propose to use to provide the evidence to support the 2024 assessment of progress towards achieving GES within the UK Marine Strategy area. For details of the changes made to this document as a result of public consultation and a broader discussion of issues raised by consultation responses, interested readers are referred to the Summary of Responses published alongside this document.

The requirement to monitor and assess the state of the UK seas is enshrined in UK legislation and demonstrates the combined commitments of the four UK Administrations to work together to monitor and protect what are some of the most biologically diverse and productive seas in Europe.

We will also continue to collaborate internationally with those countries that share our seas, particularly through the OSPAR Convention for the Protection of the of the Marine Environment of the North East Atlantic (OSPAR).

Section 1: Context

1.1 The UK Marine Strategy

The UK Marine Strategy Regulations 2010 require us to take action to achieve or maintain GES in our seas by 2020¹. The Regulations require the production of a “Marine Strategy” for all UK waters and that the approach is coordinated across all four UK Administrations. It also requires that we cooperate with other countries sharing our seas. The objective of the UK Marine Strategy reflects the UK’s vision for ‘clean, healthy, safe, productive and biologically diverse ocean and seas’. It helps to deliver key international obligations and commitments to protect and preserve the marine environment under the UN Convention on the Law of the Sea (UNCLOS), the UN Sustainable Development Goal 14 (to conserve and sustainably use the ocean, seas and marine resources for sustainable development), the OSPAR North East Atlantic Environment Strategy and the Convention on Biological Diversity.

The Strategy applies an ecosystem-based approach to the management of human activities. In doing so, it seeks to keep the collective pressure of human activities within levels compatible with the achievement of GES. Achieving GES will maintain the capacity of marine ecosystems to respond to human-induced changes and enable the sustainable use of marine goods and services by present and future generations.

The Strategy has three components:

- a. UK Marine Strategy Part One²: an assessment of marine waters, sets out objectives for GES and targets and indicators to measure progress towards GES (published December 2012, updated October 2019);
- b. UK Marine Strategy Part Two³: sets out the monitoring programmes to monitor progress against the targets and indicators (published August 2014, updated March 2021 through this document); and

¹ The data from our monitoring programmes that will tell us whether we have reached GES in our seas by 2020 is not available until 2023 and will form part of the 2024 update to UK Marine Strategy Part One.

²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69632/pb13860-marine-strategy-part1-20121220.pdf and

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/841246/marine-strategy-part1-october19.pdf

³https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/341146/msfd-part-2-final.pdf

- c. UK Marine Strategy Part Three⁴: sets out a programme of measures and actions for achieving GES (published December 2015, to be updated by the end of 2021).

This updated UK Marine Strategy Part Two sets out the monitoring programmes we propose to use to collect the required data to assess the indicators set out in the updated UK Marine Strategy Part One, which we use to assess progress towards GES.

1.2 Good Environmental Status (GES)

Good Environmental Status (GES) is defined as the environmental status of marine waters where they constitute ecologically diverse and dynamic ocean and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations.

To help assess progress towards GES, it is broken down into 11 qualitative descriptors:

- D1 - Biological diversity (cetaceans, seals, birds, fish, pelagic habitats and benthic habitats);
- D2 - Non-indigenous species;
- D3 - Commercially-exploited fish and shellfish;
- D4 - Food webs (cetaceans, seals, birds, fish and pelagic habitats);
- D5 - Eutrophication;
- D6 - Sea-floor integrity (benthic habitats);
- D7 - Hydrographical conditions⁵;
- D8 - Contaminants;
- D9 - Contaminants in fish and other seafood for human consumption;
- D10 - Marine litter; and

⁴https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/486623/marine-strategy-part3-programme-of-measures.pdf

⁵ No specific monitoring programme has been put forward for Descriptor 7, See Section 3 for further details.

- D11 - Introduction of energy, including underwater noise.

1.3 Our approach

We will continue to collaborate at a UK, regional (OSPAR) and international level to deliver high-quality monitoring of the marine environment, applying the principles of continuous improvement. Going forward we will direct particular effort and resource on monitoring programmes for those descriptors and ecosystem components where there is low confidence on whether GES has been achieved.

The purpose of the monitoring programmes is to provide sufficient evidence to demonstrate the extent that the revised objectives and targets set out in the updated UK Marine Strategy Part One have been met so we can provide a robust assessment of progress towards achieving GES in 2024 within the UK Marine Strategy area.

Most of the proposed monitoring programmes are a continuation of existing programmes and often fulfil other policy purposes. The term “existing programmes” includes both the programmes that continued from the first cycle (published in 2014) and the improvements we have made to these programmes, as listed in the Developments in Monitoring Since 2014 sections. The Developments section sets out how some of the programmes from the first cycle have been refined or extended to address knowledge gaps, so that we have more robust evidence to evaluate whether GES has been achieved. We have also identified a number of issues and opportunities to take forward as part of our system of continuous improvement to develop our current monitoring and to seek out collaboration to progress these ideas for the benefit of future GES assessments.

A key aim for the updated UK Marine Strategy Part Two is to coordinate our actions with other countries, particularly for OSPAR Region II (the Greater North Sea) and OSPAR Region III (the Celtic Seas). We will continue to do this through OSPAR using common indicators, jointly agreed assessments and monitoring methodologies, and through developing new indicators where necessary.

In developing the updated monitoring programmes, we also took account of the recommendations in the European Commission’s evaluation of UK Marine Strategy Part Two in 2017⁶.

The UK Marine Strategy is being implemented in a coordinated way across the UK Administrations. The UK monitoring programmes have been developed with input from

⁶ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017SC0001&from=EN>

experts and policy makers across the UK Administrations at a scale appropriate for the particular descriptor or ecosystem component. Gibraltar has a separate implementation process and is developing a monitoring programme for British Gibraltar Territorial Waters.

1.4 Geographic scope of monitoring programmes

The UK Marine Strategy covers the extent of the marine waters over which the UK exercises jurisdiction. This area extends from the landward boundary of coastal waters, which is equivalent to Mean High Water Springs to the outer limit of the UK Exclusive Economic Zone (EEZ). It also includes the seabed in the area of the continental shelf beyond the EEZ over which the UK exercises jurisdiction on the basis of a submission to the Commission on the limits of the continental shelf⁷. The area of UK waters over which the UK Marine Strategy applies is shown below in Figure 1, which also shows the Celtic Seas (pale blue colour) and the Greater North Sea (dark blue colour) Sub-regions on which many of our assessments are based.

⁷ This area is defined by the Continental Shelf Act 1964. In this area the requirements of the Regulations (including the requirement to put in place measures to achieve GES) applies only to the seabed and subsoil and not to the water column.

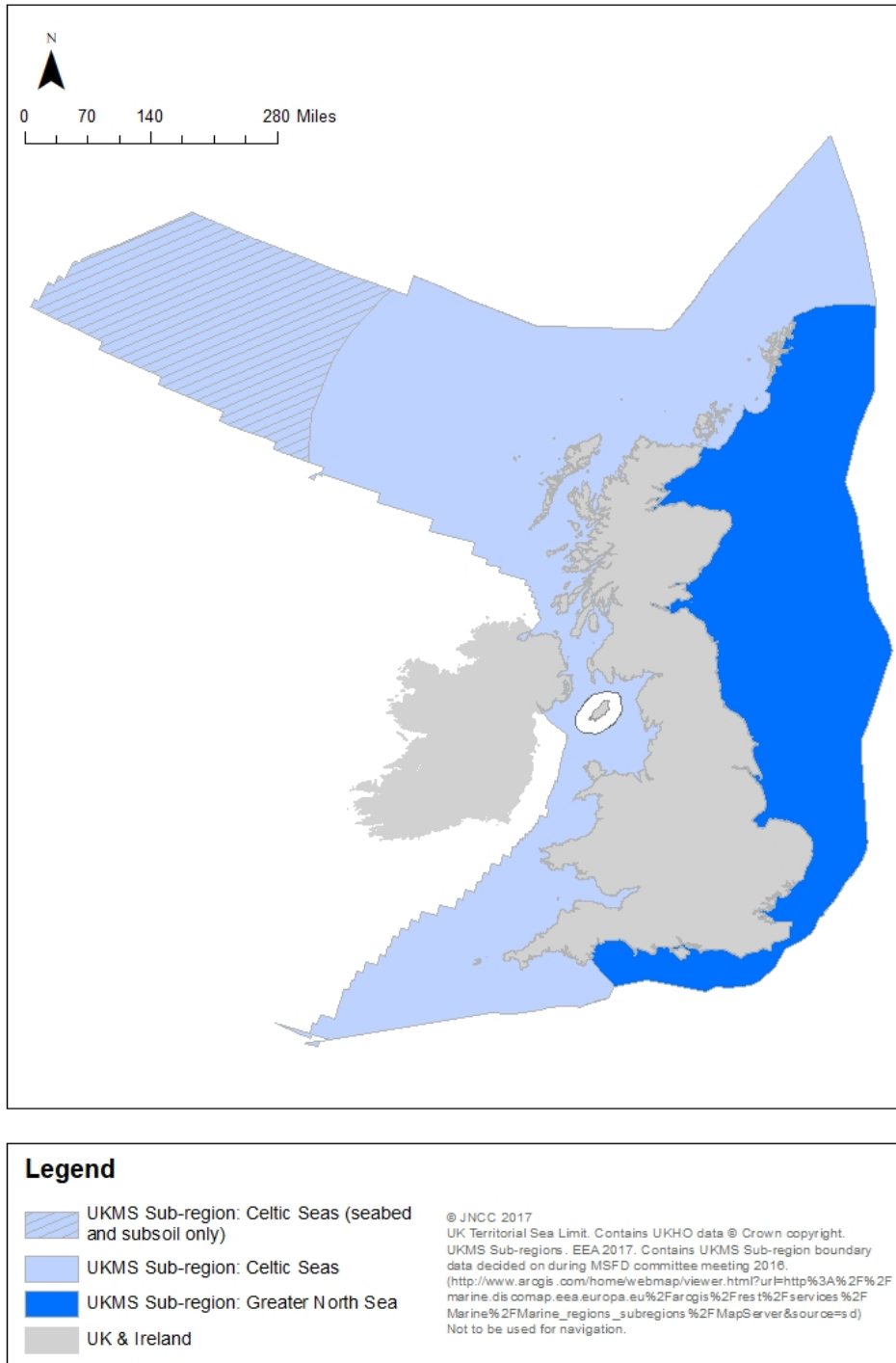


Figure 1: Area of UK marine waters where the UK Marine Strategy (UKMS) applies, covering the Celtic Seas sub-regions and Greater North Sea subregion.

The UK’s marine waters are in the North East Atlantic Ocean marine region, with waters to the West of the UK comprising part of the Celtic Seas Sub-region, and waters to the East of the UK, including the Channel, forming part of the Greater North Sea Sub-region. The UK shares the Celtic Seas Sub-region with Ireland and France, and the Greater North Sea Sub-region with France, Belgium, the Netherlands, Germany, Denmark, Sweden and Norway.

The ecosystems of the Greater North Sea and the Celtic Seas and their various uses are not necessarily contained within the boundaries of the UK. Similarly, some of the habitats and species, particularly some of the mobile species, can exist over wide areas of the North East Atlantic. For this reason, it is important to develop and coordinate monitoring programmes with other countries in OSPAR.

Furthermore, there are significant biogeographical differences between the Greater North Sea and the Celtic Seas Sub-regions which need to be taken into account. Monitoring programmes have therefore been developed at the scale most relevant to each particular descriptor or ecosystem component. This can be at sub-regional scale or smaller areas where appropriate.

There are also strong links between the UK Marine Strategy and the River Basin Management Plans (RBMPs). The RBMPs address the improvement and protection of the chemical and ecological status of surface waters over the whole river basin ranging from rivers, lakes and groundwaters through to estuaries and coastal waters out to one nautical mile at sea (in Scotland it is three nautical miles and out to 12 nautical miles for chemical status) and overlap with the UK Marine Strategy in coastal waters.

In order to improve consistency between the approaches for coastal waters and offshore waters, the monitoring programmes in this updated UK Marine Strategy Part Two have been aligned with those used for coastal waters under RBMPs where appropriate.

1.5 Coordination of monitoring programmes across the UK

The monitoring programmes have been developed with the Devolved Administrations, other government departments and with scientists in the UK Marine Monitoring and Assessment Strategy (UKMMAS) evidence groups.

In developing the monitoring programmes, wherever possible we use existing monitoring programmes established to support other policies and obligations under conventions and frameworks such as the Bern Convention, RBMPs, domestic fisheries legislation and OSPAR.

1.5.1 The framework used for monitoring the marine environment in the UK

The scientists working in the four evidence groups of the UKMMAS⁸ develop and carry out the monitoring programmes required to assess the status of UK seas, ensuring that the methodologies are up to date. The evidence groups are overseen by a science/policy committee called the Marine Assessment and Reporting Group (MARG). The UKMMAS was set up in 2006 to achieve a more coordinated and systematic approach to marine monitoring, assessment and data collection across the UK. It brings together all the UK and Devolved Administration Departments with interests in the marine environment, the environment agencies, nature conservation agencies, marine laboratories, representatives from marine institutes and the research community.

The UKMMAS evidence groups and MARG have contributed significantly to the development of the updated UK Marine Strategy Part Two. The evidence groups ensure that the monitoring programmes are carried out at the relevant scale by laboratories operating within appropriate quality assurance systems, and where available, using internationally agreed methods and standards. Where appropriate the monitoring programmes are checked by statisticians to ensure that they are statistically robust and able to detect meaningful levels of change.

1.6 Progress with UK Monitoring Programmes

Since the UK Marine Strategy Part Two was published in 2014, there have been a number of developments.

1.6.1 Collaboration with other countries

In 2014, we took a policy decision to base most of our monitoring programmes around the OSPAR common indicators that were being developed in order to carry out a comprehensive assessment of the state of the North East Atlantic in 2017⁹ (the Intermediate Assessment (IA) 2017). The IA 2017 provided an opportunity to see how the monitoring programmes worked in practice and how they could be improved in the future. Further detail is provided under the Regional Cooperation headings in Section 2 of this document.

⁸ Clean and Safe Seas Evidence Group (CSSEG), Healthy and Biologically Diverse Seas Evidence Group (HBDSEG), Productive Seas Evidence Group (PSEG) and the Ocean Processes Evidence Group (OPEG)

⁹ <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/>

1.6.2 Developments in monitoring programmes since 2014

In the UK Marine Strategy Part Two in 2014, we identified a number of gaps in our monitoring. Since 2014 we have taken a range of actions to address those gaps:

- Research to identify what additional monitoring is needed;
- Working with other countries to develop methodologies and standards;
- National workshops to address monitoring gaps; and
- Extending surveys to provide better temporal or spatial coverage

In Section 2 we provide further, specific details of developments in monitoring programmes since 2014 for each descriptor and ecosystem component.

1.6.3 How monitoring programmes address ecosystem elements and pressures

The UK Marine Strategy Regulations 2010 require that the monitoring programmes address certain indicative ecosystem elements and pressures on the marine environment. These include:

- species, habitats and ecosystems that need to be considered if they are essential features and characteristics in UK seas;
- pressures and impacts which significantly affect marine species and habitats; and
- uses and activities which may affect the marine environment.

The indicative ecosystem elements and pressures are generally covered in Section 2. However, some elements which were highlighted during the consultation period for this update are not covered, either because they are not regarded as a 'key trophic group' in UK waters, such as turtles, or because we are still developing survey techniques for them, such as cephalopods (squid).

1.7 Detailed information about monitoring programmes

Summaries of the monitoring programmes for the 60 indicators we are using over the coming years are set out in Section 2.

Many of the indicators used in the UK Marine Strategy are OSPAR Common Indicators. For each of these, detailed information on the monitoring programmes used to assess the indicators is available on the OSPAR website¹⁰.

¹⁰ <https://www.ospar.org/work-areas/cross-cutting-issues/cemp>

1.8 Addressing issues and opportunities

The updated UK Marine Strategy Part One identified a number of gaps in our monitoring programmes. These are described in the Issues and Opportunities section for the descriptors and ecosystem components in Section 2 of this document. In many cases, further work is required to design monitoring programmes that would address those gaps. We are aiming to address as many of the issues and opportunities as possible through this cycle of the Strategy and will work with relevant experts to do so.

We will also seek to work with industry and stakeholders to incorporate currently untapped data sources into our monitoring programmes. For example, industry data could be incorporated into our assessments or we could use citizen science data or emerging technology more effectively. Autonomous vehicles are currently being incorporated into research and development work, but are not yet operationally functional, and will continue to be reviewed as developments emerge. These opportunities are flagged under Issues and Opportunities in Section 2 and 3.

1.9 Our approach to climate change in the UK Marine Strategy Part Two

The ocean and climate are fundamentally interconnected. Climate change has already caused a wide range of changes to the ocean. We have already begun to observe and anticipate changes to a range of factors impacting the status of the UK Marine Strategy environmental descriptors. For example, mean sea level around the UK has risen by about 12-16 cm since 1990; eight of the ten warmest years on record for UK sea-surface temperature have occurred since 2000; and the North Atlantic contains more anthropogenic CO₂ than any other ocean basin¹¹.

The Marine Climate Change Impacts Partnership¹² (MCCIP) regularly assess our growing understanding of the way that climate change is altering the marine environment and the impacts these changes are already having. These include community and distribution shifts leading to native biodiversity loss or greater recruitment of non-indigenous species; habitat degradation and/or loss, such as the deoxygenation of benthic habitats or sea level rise removing bird breeding sites ; direct impacts on physiology (e.g. temperature impacts on spawning or ocean acidification on invertebrate shell formation); shifts in the dynamics of contaminants and their pathways, such as extreme precipitation and storm activity

¹¹ MCCIP (2020) Marine Climate Change Impacts: Marine Climate Change Impacts Report Card 2020 (Stoker, B., Turrell, W.R., Robinson, K.A., Howes, E.L., Buckley P., Maltby, K. and Matear L., eds.) Summary Report, MCCIP, Lowestoft, 28pp. doi:10.14465/2020.arc00.000-000

¹² <http://www.mccip.org.uk/>

leading to high nutrient, heavy metal, or litter inputs from land; and alterations to the oceans physical properties, which impact the behaviour of marine life, such as increased temperature changing sound propagation.

Addressing climate change is not within the listed requirements of the Marine Strategy Regulations 2010. However, we recognise the impact climate change has on our aim to achieve healthy, clean, productive, biodiverse seas.

Climate change is a global problem that requires action at the international level, so the UK is encouraging efforts globally to enable adaptation and build resilience to climate change^{13 14 15 16 17}. Domestically, we are committed to ensuring the impacts of climate change are considered in our marine policies. The forthcoming UK Marine Strategy Part Three will set out the ways in which the UK is prioritising actions to enable adaptation and resilience to climate change (through our programme of measures), to protect UK seas.

In Section 2.7 of the recently published UK Marine Strategy Part One 2019, we set out an assessment of the spatial and temporal variation of ocean acidification, temperature, salinity, turbidity and waves. In addition, we provided a projection of how these parameters are likely to be affected by climate change and the likely impacts on marine ecosystems. The prevailing conditions monitoring and observational programmes described in Section 3 of this document can provide information on how these climate-influenced parameters are impacting our indicators of marine environmental status. This in turn gives us insight into the relative contributions of climate and direct-human impacts on marine habitats and species and allows us to refine our programme of measures to address this wherever possible.

Section 2: Monitoring programmes used to assess Good Environmental Status (GES)

For each descriptor and ecosystem component this section sets out:

¹³ <https://ukcop26.org/>

¹⁴ <https://www.gov.uk/government/news/time-to-step-up-and-save-our-ocean#:~:text=Environment%20Minster%20Rebecca%20Pow%20has,the%20planet's%20ocean%20by%202030.&text=That's%20why%20we're%20calling,the%20course%20of%20this%20decade.>

¹⁵ <https://bluecharter.thecommonwealth.org/>

¹⁶ <https://bluecharter.thecommonwealth.org/action-groups/ocean-climate-change/>

¹⁷ <https://bluecharter.thecommonwealth.org/action-groups/ocean-acidification/>

- a summary of the monitoring programme;
- the status of the descriptor or ecosystem component in 2018;
- the relevant high level objective;
- the targets, indicators and monitoring programmes used to measure progress towards GES;
- a detailed description of the individual monitoring programmes;
- the degree of coordination with other countries;
- developments in the monitoring programmes since 2014; and
- any issues and opportunities going forwards.

The summary of the status of the descriptor or ecosystem components include the following symbols as taken from the updated UK Marine Strategy Part One:



GES Achieved



GES Partially achieved



GES not achieved



Improving situation



Stable or mixed situation



Declining situation

The arrows represent our best judgement of whether there was progress towards achieving GES for the descriptor or ecosystem component concerned by 2018. In some cases they reflect a situation where several indicator results reveal a mixed picture, with some showing an improving situation, some being stable and some showing a decline. In these cases the arrow indicates our estimate of the combined position. Full details can be found in the individual indicator assessments¹⁸.

¹⁸ <https://www.gov.uk/government/publications/marine-strategy-part-one-uk-updated-assessment-and-good-environmental-status>

The monitoring programmes presented in the templates are adaptive in nature. For example, if concentrations of a contaminant are found to be regularly below detection limits, the frequency or coverage of monitoring may be reduced, or if new problems are revealed in a particular area, then frequency or coverage of monitoring may be increased.

Where we refer to “existing programmes” this is intended to mean the programmes that have continued since the first cycle of the UK Marine Strategy and any developments made to those programmes, as detailed below. Continuation and consistency of monitoring allows us to build time series of comparable data, which can provide more information about trends through time and gives us more confidence in our assessments.

In other cases, more monitoring is required to make a robust assessment of the status of an ecosystem component or pressure in the marine environment, and we identify these in the ‘Issues and Opportunities’ sections set out below.

Descriptors 1 & 4: Cetaceans

Overall summary

The monitoring of cetaceans will be carried out largely by existing programmes.

Data on abundance and distribution of cetaceans are collected by the following programmes:

- (i) Synoptic cetacean surveys including the Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys
- (ii) Bottlenose dolphin inshore population monitoring
- (iii) Regional acoustic detection programmes

Mortality of cetaceans caused by fishing bycatch is monitored by:

- (i) UK Bycatch Monitoring Programme (BMP)
- (ii) Cetacean Strandings Investigation Programme (CSIP) and Scottish Marine Animal Strandings Scheme (SMASS)

Environmental status in 2018



The extent to which GES had been achieved for cetaceans remained uncertain. The status of coastal bottlenose dolphin and minke whale was consistent with the achievement of GES in the Greater North Sea, but is uncertain elsewhere and for other species.

High level objective for GES

The population abundance of cetaceans indicates healthy populations that are not significantly affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Population abundance

Target: There should be no significant decrease in abundance caused by human activities

Indicators:

- Abundance and distribution of coastal bottlenose dolphins (OSPAR);
- and Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)

Monitoring programmes:

- SCANS Surveys
- Bottlenose dolphin inshore population monitoring
- Regional acoustic detection programmes

Criterion: Population distribution

Target: Population ranges are not significantly lower than favourable reference values for the species.

Indicators:

- Abundance and distribution of coastal bottlenose dolphins (OSPAR);
- and Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)

Monitoring programmes:

- SCANS Surveys
- Bottlenose dolphin inshore population monitoring
- Regional acoustic detection programmes

Criterion: Bycatch mortality

Target: The long-term viability of cetacean populations is not threatened by incidental bycatch.

Indicators:

- Cetacean bycatch (OSPAR)

Monitoring programmes:

- UK Bycatch Monitoring Programme (BMP)
- UK Cetacean Strandings Investigation Programme (CSIP)
- Scottish Marine Animal Strandings Scheme (SMASS)
- Department of Agriculture, Environment and Rural Affairs (DAERA) Marine Mammal Stranding Investigations (Northern Ireland)

Operational targets

We will continue existing monitoring of cetacean bycatch in fisheries under the BMP, and via post-mortem of stranded cetaceans under the CSIP. We will also continue the use of mitigation measures, for example acoustic deterrents ('pingers') to reduce bycatch, as well as supporting further work into novel approaches.

We will continue initiatives such as the SCANS survey and the Collaborative Oceanography and Monitoring for Protected Species (COMPASS)¹⁹ project to help build a picture of how cetaceans use an area of sea. This will assist our understanding of how they may be affected by or respond to pressure from human activities, such as underwater noise.

Monitoring programme details

Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys

SCANS is a multilateral (ship and aerial) survey conducted approximately once every ten years in Northern European waters to assess cetacean abundance. SCANS was initiated in 1994 and continued in 2005 (SCANS-II) and 2007 Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA) project, with the most recent survey taking place in 2016 (SCANS-III).

¹⁹ The Collaborative Oceanography and Monitoring for Protected Areas and Species (COMPASS), SeaMonitor and the Marine Protected Area Management and Monitoring (MarPAMM) projects are funded by INTERREG Va. These programmes will cease operationally in 2021 with no identified successor.

Bottlenose dolphin inshore population monitoring

Inshore bottlenose dolphin populations in Special Areas of Conservation (SACs) are monitored by existing schemes on the East coast of Scotland and in the wider Cardigan Bay area, Wales.

Regional acoustic detection programmes

There are a number of programmes in place at present which aim to establish acoustic data collection on cetaceans.

The COMPASS project increases understanding of how cetaceans use an area of sea and how they may be impacted by or respond to pressure from human activities. This information is also used to inform marine protected area management. Through a network of oceanographic and acoustic moorings across the regional seas of the Republic of Ireland, Northern Ireland and West Scotland, COMPASS provides effective cross-border monitoring of cetaceans. The project will complete in December 2022.

The East Coast Marine Mammal Acoustic Study (ECOMMAS) monitors dolphin and harbour porpoise populations. Run by Marine Scotland since 2013, ECOMMAS uses echolocation click detectors at 30 sites on the East coast of Scotland, and broadband sound recorders at ten of these sites, to acoustically detect and monitor cetaceans.

In Northern Ireland moored acoustic deployments are also used as part of ongoing monitoring and the COMPASS and Marine Protected Areas Management and Monitoring (MARPAMM) programmes.

The data generated by COMPASS, ECOMMAS and the Agri-Food and Biosciences Institute (AFBI) will contribute distribution information to the indicator on cetacean abundance and distribution but will not provide quantitative data on abundance of cetaceans.

UK Bycatch Monitoring Programme (BMP)

The UK BMP deploys dedicated protected species bycatch observers onboard commercial fishing vessels to monitor bycatch.

UK Cetacean Strandings Investigation Programme (CSIP)

The CSIP records stranded cetaceans and conducts post-mortems on a subset of cetacean strandings on the UK coastline. DAERA and SMASS feed in data from Northern Ireland and Scotland respectively. The results from the post-mortems help to identify the major causes of death, and can provide information on disease, contaminants, fisheries bycatch, reproductive patterns and diet. From April 2021, CSIP will only be conducting post-mortems on stranded cetaceans on English and Welsh coastlines as Scotland are running and funding the SMASS.

Regional Cooperation

There has been a concerted effort to coordinate UK monitoring programmes with those of other countries sharing the North East Atlantic to ensure, where possible, that the assessments carried out are comparable. We are currently exploring with other OSPAR countries, the possibility of expanding the Joint Cetacean Data Programme (JCDP – see Issues and Opportunities for further details) to facilitate the sharing and collation of cetacean monitoring data at the NE Atlantic scale.

Work in OSPAR focuses on the harmonisation of targets and indicators, potential measures, monitoring programmes and areas for further research.

ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas) provides a basis to coordinate UK monitoring programmes with those of other countries in the ASCOBANS region.

Developments in monitoring since 2014

The most recent SCANS survey (SCANS-III) took place in July 2016. The preliminary results have been published online and the data were used in the indicators listed above for the OSPAR Intermediate Assessment 2017 and the assessments used for the updated UK Marine Strategy Part One.

Since 2015, two deployments of the array per year have been undertaken by the ECOMMAS acoustic monitoring programme, allowing data to be recorded from April to November. This project is ongoing.

Since 2017, Northern Ireland moored acoustic deployments have been maintained at five locations as part of ongoing monitoring under the COMPASS and MarPAMM programmes. The COMPASS project has deployed acoustic moorings in both the North Channel and the Skerries and Causeway SACs (both with harbour porpoise as a feature) in Northern Ireland. This is complemented by dedicated land-based surveys of the Skerries and Causeway SAC.

The long-term UK BMP and CSIP schemes are ongoing, collecting data on bycatch through on-board fisheries observers and post-mortem of stranded animals. The UK BMP currently monitors vessels using pingers and so simultaneously collects data on bycatch rates and mitigation effectiveness.

A UK Cetacean Bycatch Plan of Action is being developed in collaboration with industry and other stakeholders, to set out a positive and coherent approach to understanding and mitigating bycatch. In support of this initiative, Clean Catch UK is a newly formed collaborative group that brings together representatives from a wide range of stakeholders in the bycatch of non-target species, such as scientists and fishers.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Insufficient data on cetacean abundance and distribution due to infrequent surveys;
- Data gaps regarding beaked whale species distribution, abundance and movements in the deeper waters off West Scotland.

There are opportunities for addressing these issues, in addition to maximising the use of available data, these include:

- The JCDP, which will become operational in Spring 2022 is developing a database holding cetacean at-sea monitoring datasets collected by government, industry, academics and NGOs. The ambition is to provide an accessible, up-to-date resource of cetacean monitoring data that can be analysed in support of a wide range of conservation and policy needs, improving temporal and spatial coverage. Data from voluntary cetacean observer schemes can significantly enhance our understanding, though the need to ensure observers are well trained, and data are robust and quality assured is noted;
- Continued decadal SCANS surveys covering offshore waters will contribute to an increase in our understanding of cetacean distribution and abundance. Increasing the frequency of SCANS is being discussed in many international fora (OSPAR, ASCOBANS) and the UK is engaging with those discussions;
- The data gaps in the deeper waters West of Scotland is being addressed through a passive acoustic monitoring through the Static Acoustic Monitoring of Scottish Atlantic Seas (SAMOSAS) project;
- The Offshore Wind Enabling Actions Programme will look to engage with the offshore wind industry and developers to include data in the Marine Noise Registry (MNR) and increase access to data to assess the effects of activities on marine species that would affect achievement of GES;
- Work in relation to cetacean bycatch is ongoing. For example, Clean Catch UK²⁰ is developing the use of Remote Electronic Monitoring (REM) to monitor wildlife bycatch, including marine mammals, and JNCC are part of a project developing small and easily portable REM systems that include CCTV for monitoring cetacean bycatch;
- Now that we are an independent coastal state we will ensure that the next iteration of the BMP contract, due for renewal in 2021 is based on current needs for cetacean monitoring specifically in UK waters. Full details on this are provided in the Summary of Responses published alongside this document; and
- The establishment of acoustic monitoring projects, such as COMPASS and SeaMonitor, will help to address some spatial knowledge gaps. In particular, the SeaMonitor project includes monitoring of the shelf edge near the Hebrides Terrace Seamount West of Scotland. The AFBI have also developed a towed survey method whereby a passive acoustic monitoring survey for cetaceans has been

²⁰ <https://www.cleancatchuk.com/>

integrated with an active acoustic clupeoid fish survey in the Irish Sea. Searches for deeper water cetaceans will be undertaken where opportunities arise. We will consider how these data may be incorporated into future indicator assessments.

Descriptors 1 & 4: Seals

Overall summary

We propose that the monitoring of seals will be carried out largely by a number of existing programmes, including:

- (i) Seal Population Monitoring
- (ii) UK Bycatch Monitoring Programme (BMP)
- (iii) Marine Animals Stranding Schemes

Environmental status in 2018



The UK achieved its aim of GES for grey seals in the Greater North Sea and Celtic Seas. There had been a significant increase in the abundance of harbour seals in West Scotland where the majority of harbour seals are located, but their status in other parts of the Celtic Seas was uncertain. Harbour seals in the Greater North Sea had not yet achieved GES.

High level objective for GES

The population abundance and demography of seals indicate healthy populations that are not significantly affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Bycatch mortality

Target: The long-term viability of seal populations is not threatened by incidental bycatch.

Indicator:

- Marine mammal bycatch (OSPAR)

Monitoring programmes:

- UK Bycatch Monitoring Programme
- Scottish Marine Animal Stranding Scheme (SMASS)

- DAERA marine mammal stranding investigations (Northern Ireland)

Criterion: Population abundance and distribution

Target: Population abundance and distribution are consistent with favourable conservation status.

Indicator:

- Seal abundance and distribution (OSPAR)

Monitoring programme:

- Seal Population Monitoring

Criterion: Grey seal pup production

Target: Grey seal pup production does not decline substantially in the short or long-term.

Indicator:

- Grey seal pup production (OSPAR)

Monitoring programme:

- Seal Population Monitoring

Operational Targets

We will conduct research to:

- a. investigate potential causes of the harbour seal declines in Scotland, focusing on interactions with grey seals (competition and predation), predation from other marine mammals and exposure to toxins from harmful algae.
- b. investigate the life history parameters (e.g. survival and birth rates) and population dynamics of seals to improve our understanding of what is happening within these populations.

We will continue existing monitoring of bycatch of seals in fisheries, making improvements where required and the identification of appropriate mitigation measures.

Monitoring programme details

Seal population monitoring

The UK seal monitoring programme is run by the Sea Mammal Research Unit (SMRU), University of St Andrews. It undertakes systematic monitoring of all major breeding colonies for grey seals (~90% of the total pup production in the UK) and the entire coast of Scotland and selected English sites (not just haul-out sites) for harbour seals. Monitoring of the smaller grey seal colonies in South West England, Wales, and some regions of Scotland such as Shetland is undertaken by a variety of groups, with information collated

by SMRU. Harbour seal monitoring occurs on a rolling schedule with all areas surveyed at least once every five years (grey seal summer distribution is included). Haul-out sites in the Moray Firth, Tay estuary and the Wash are surveyed annually. The major grey seal breeding colonies are monitored once every two years. In Northern Ireland, DAERA monitors breeding populations of harbour and grey seal at sites for which they are a designated feature (by land and sea).

UK Bycatch Monitoring Programme (BMP)

The BMP reports bycaught seals through data from observers on fishing vessels.

Scottish Marine Animal Stranding Scheme (SMASS)

In Scotland, the SMASS, monitors seal strandings around the Scottish coast to determine cause of death.

DAERA Marine Mammals Stranding Investigations

In Northern Ireland, DAERA monitor strandings of both grey and harbour seals and, where appropriate, post-mortems are undertaken by the AFBI.

Developments in monitoring since 2014

Through the continuation of the above monitoring programmes since 2014 the long time-series of data has been added to. This has helped develop and improve the abundance and distribution of seals indicator in the OSPAR marine mammal group, in which the UK plays a leading role. This resulted in successful assessments for seal abundance and grey seal pup production in the OSPAR Intermediate Assessment 2017. Similar assessments were carried out for seal abundance and grey seal pup production in UK waters for the updated UK Marine Strategy Part One.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Insufficient data on the causes of declines in some populations of harbour seals;
- Lack of seal post-mortems carried out; and
- The expansion of the UK BMP to cover more of the fisheries and regions identified as high risk.

There are opportunities to address these issues through various projects and programmes including:

- Clean Catch UK²¹ is a newly formed collaborative group that has representatives from a wide range of stakeholders in the bycatch of non-target species. The group will facilitate collaborations and further work to bring about improvements in monitoring and mitigation to reduce wildlife bycatch (including seals), with the UK Bycatch Mitigation Initiative underpinning the work;
- An approach for broadening bycatch monitoring is fisher self-reporting through a phone app, and this is being evaluated by a project led by Cefas in the South West of England, with steer from the Clean Catch UK group;
- Expanding the CSIP to include seals in England and Wales would allow us to better understand the reasons for seals mortality in these regions. This would help to identify any existing or emerging human pressures that might be contributing to seal mortality and improve our understanding of the scale of incidental seal bycatch. CSIP will not routinely post-mortem seals as this would require too much additional resource, but Defra will request seal post-mortems when there is a policy need to understand key threats and issues better (e.g. disease outbreak, shootings etc.). In Scotland, research is ongoing to investigate potential causes of the harbour seal declines along the Scottish coast in the Greater North Sea;
- Grey seal colonies are currently monitored annually on Skomer and Ramsay Islands by Natural Resources Wales and we will look to include these data in future assessments. We will explore the possibility of including additional seal population monitoring from other key colonies across the UK, including harbour seals in West Scotland to expand and complement the surveys currently undertaken by SMRU; and

New work is being undertaken to better understand the individual and, particularly, cumulative impacts of noise pollution on seals and cetaceans (see section on Descriptor 11 Underwater Noise section in the Summary of Responses published alongside this document).

²¹ <https://www.cleancatchuk.com/>

Descriptors 1 & 4: Birds

Overall summary

We propose that the monitoring of birds will be carried out largely by existing programmes.

Data on marine bird abundance, distribution and breeding success are monitored by the following programmes, to which citizen science make an important contribution:

- i) Seabird Monitoring Programme (SMP)
- ii) Wetland Bird Survey (WeBS)
- iii) Periodic bird surveys (various)

Data on seabird bycatch are currently collected by the BMP

Some other monitoring options are currently being explored through pilot projects (see below).

Environmental status in 2018



The UK achieved its aim of GES for non-breeding waterbirds in the Greater North Sea but not in the Celtic Seas. Breeding seabirds had not achieved GES.

High level objective for GES

The abundance and demography of marine bird species indicate healthy populations that are not significantly affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Bycatch mortality

Target: The long-term viability of marine bird populations is not threatened by deaths caused by incidental bycatch in mobile and static fishing gear.

Indicator:

- Seabird bycatch

Monitoring programme:

- UK Bycatch Monitoring Programme (BMP)

Criterion: Population abundance

Target: The population size of marine bird species has not declined substantially since 1992 as a result of human activities.

Indicator:

- Marine bird abundance (OSPAR)

Monitoring programmes:

- Seabird Monitoring Programme (SMP)
- Wetland Bird Survey (WeBS)
- Periodic bird surveys

Criterion: Population demographic characteristics

Target: Widespread lack of breeding success in marine birds caused by human activities should occur in no more than three years in six.

Indicators:

- Marine bird breeding success / failure (OSPAR)
- Kittiwake breeding success

Monitoring programme:

- SMP

Criterion: Distribution range

Target: There is no significant change or reduction in population distribution of marine birds caused by human activities.

Indicator

- Distribution of breeding and non-breeding marine birds

Monitoring programmes:

- Periodic bird surveys
- Volunteer Seabirds At Sea monitoring programme (VSAS; pilot)
- WeBS

Criterion: No set criteria

Target: Reduce risks to island seabird colonies from non-native mammals (operational target).

Indicator:

- Invasive mammal presence on island seabird colonies

Monitoring programme:

- UK invasive predatory mammal surveillance under the Biosecurity for LIFE project (pilot)

Operational targets

We will contribute to the further development of the assessment of bird populations and identify the most important pressures at a regional level through OSPAR. We will continue to enhance and protect marine birds through:

- a) effective management at protected sites;
- b) delivering the UK Plan of Action (PoA) on Seabird Bycatch;
- c) reducing the risks to island seabird colonies from invasive predatory mammals; and
- d) achievement of the targets to reduce marine litter, particularly floating litter.

Monitoring programme details

Seabird Monitoring Programme (SMP)

The SMP is a partnership of 19 organisations, led by the Joint Nature Conservation Committee (JNCC). It provides annual trends in abundance and breeding success of seabirds at a sample of breeding colonies in the UK, Isle of Man, Channel Isles and the Republic of Ireland. Monitoring is conducted by volunteers and professionals. It also contributes to protected site monitoring, including Special Protection Areas (SPAs).

Wetland Bird Survey (WeBS)

The WeBS scheme is a partnership between Royal Society for the Protection of Birds (RSPB), British Trust for Ornithology (BTO) and JNCC. It provides annual trends in numbers of waterbirds at a sample of estuaries and coastal sites where they stop-over on migration or spend the winter. Surveys are conducted largely by a network of volunteers co-ordinated by BTO. It is also used to monitor protected sites, including SPAs.

Periodic bird surveys

Data from periodic surveys will continue to provide more comprehensive geographical coverage than the annual SMP and WeBS, which monitor a sample of sites. Data from periodic surveys provide estimates of the size of UK bird populations, complete snapshots of their distribution and help validate the population trends in SMP and WeBS data.

Periodic surveys providing data for the UK marine bird indicators are: Breeding seabird censuses, including 'Seabirds Count' (coordinated by SMP) which will report in late 2022/early 2023; Bird Atlases of Britain and Ireland; Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme (SCARABBS); Rare Breeding Bird Panel (RBBP);

Non-Estuarine Waterbirds Survey (NEWS); the land-based arm of the European seaduck census; and Winter Gull Roost Survey (WinGS).

Volunteer Seabirds at Sea monitoring programme (VSAS) (pilot)

This pilot project aims to assess whether information on the distribution and abundance of seabirds at sea could be collected using volunteers on 'ships of opportunity' (ferries, research cruises, etc.).

UK invasive predatory mammal surveillance under the Biosecurity for LIFE project (pilot)

Improved surveillance of invasive predatory mammals is currently being developed alongside biosecurity measures by the Biosecurity for LIFE project, an EU/RSPB/Natural England /NatureScot project which runs from 2018 to 2022 (<https://biosecurityforlife.org.uk/>). Additional Defra funding is facilitating enhanced Biosecurity for LIFE activities for English seabird islands not already subject to such measures e.g. Lundy as well as enhancing existing measures e.g. on Isles of Scilly. These measures will be included in the updated UK Marine Strategy Part Three.

UK Bycatch Monitoring Programme (BMP)

Seabird bycatch is currently monitored by dedicated observers as part of the BMP. This data meets our statutory obligations and supports the implementation of the UK PoA on seabird bycatch.

Regional Cooperation

Data from the SMP, WeBS and periodic bird surveys are used in the OSPAR common indicators on marine birds, alongside data from other countries. Data from VSAS is fed into the European Seabirds at Sea Database (ESAS). Some ESAS data are being used to develop OSPAR indicators of abundance and distribution of seabirds at sea.

Developments in monitoring since 2014

The SMP and WeBS are long-established and their continuation since 2014 has added to a long time-series of data that have been used in the indicators listed above for the OSPAR Intermediate Assessment 2017, and the assessments used for the updated UK Marine Strategy Part One.

The Seabirds Count breeding seabird census was developed by the SMP Partnership and is being co-ordinated by JNCC. Census work began in 2015 and, to date, has incorporated data collected by volunteers and professional surveyors. The census, which will complete its final survey year in 2021, will deliver robust population estimates and trends for all 25 of the UK's breeding seabird species.

Since 2018, VSAS has begun to provide at sea monitoring of seabird abundance and distribution. JNCC has developed a training programme for volunteers and a bespoke app

to facilitate data capture, validation and storage. The first volunteer-led surveys were completed in 2019.

The newly formed Clean Catch UK national steering group will facilitate collaboration and further work to bring about improvements in monitoring and mitigation to reduce wildlife bycatch, including seabirds. Details on this initiative are expanded upon above in the Seals Issues and Opportunities section and in the Summary of Responses published alongside this document.

The periodic Non-Estuarine Waterbird Survey (NEWS), initiated in 2015, aims to address the limited coverage of the open coast and remote areas by WeBS. NatureScot have been developing, trialling and evaluating a citizen science-based approach to the monitoring of inshore wintering waterfowl within SPAs in Scotland.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Improvements to the Seabird Monitoring Programme;
- Improvements to monitoring seabird bycatch;
- Greater coverage of at-sea data collection and the inclusion of a wider selection of waterfowl species for the abundance and distribution indicator; and
- Improvements to the surveillance of invasive mammalian predators on island seabird colonies and improvements to monitoring of biosecurity measures.

There are opportunities for addressing these issues, in addition to maximising the use of available data these include:

- The SMP is currently under review and this will include an assessment of how improvements to its sampling strategy can increase the number of breeding seabird species for which trends can be delivered on an annual basis. The optimal census frequency for species that cannot be monitored annually will also be determined, as will the potential application of new technologies, such as use of Unmanned Aerial Vehicles (UAVs) and REM for breeding seabird monitoring. The SMP Partnership will finalise any changes to how the SMP is governed and funded by March 2022;
- Defra in conjunction with Devolved Administrations, in conjunction with the Devolved Administrations are developing a Plan of Action (PoA) on Seabird Bycatch, which regulatory bodies will be able to adopt. As part of this process, we are working with a wide group of stakeholders including environmental groups and the fishing industry. We aim for the PoA to be published by 2022. Part of the PoA will detail collecting seabird bycatch data more systematically and plans for regional projects that will increase monitoring and trialling mitigation measures for seabird bycatch beginning in 2020;
- Following the VSAS pilot, we are also considering targeted aerial and boat-based surveys of high priority species, such as Balearic shearwater, and the potential of tracking data to deliver seabird state-pressure relationships. In addition, a programme of strategic aerial surveys across the Scottish component of the North

- Sea was commissioned by Marine Scotland during 2020/21, this will provide an updated baseline for at sea abundance and distribution of seabirds for this region;
- We will explore the potential of expanding surveillance of invasive predatory mammals on seabird island SPAs and other important sites as part of the Biosecurity for LIFE project. Establishment of a National Island Biosecurity Database will be explored to direct conservation action beyond the 42 island SPAs that are included in the UK invasive mammal indicator and Biosecurity for LIFE;
 - Trend information on non-breeding marine waterbirds, with distributions within sight of land, will come from land-based WeBS and NEWS surveys. Supplementing these with surveys of high priority non-breeding marine waterbird species, with distributions beyond sight of land, would be beneficial, as would augmenting these with marine SPA monitoring data. A study by JNCC and BTO will expand the distribution indicator to waders and waterfowl along all coastal habitats including estuaries using existing data. Expansion to include breeding seabirds is expected before 2024; and
 - We will consider how future decadal Winter Gull Surveys (WinGS), including extra monitoring at key sites could allow the inclusion of gull species within the non-breeding component of the Abundance Indicator. We will also explore the possibility of including additional periodic bird surveys from selected offshore sites across the UK, for example; Common Scoters and Red Throated Divers as part of SPA monitoring in Wales. At-sea data collected in the European seaduck census could also be incorporated into the bird indicators in future.

Descriptors 1 & 4: Fish

Overall summary

The monitoring of fish will be carried out largely by existing programmes.

Data on abundance, distribution, bycatch and habitat of fish are collected by:

- (i) Otter trawl surveys
- (ii) Beam trawl surveys
- (iii) Coastal and estuarine monitoring

Fisheries dependent data: including landings declarations, commercial logbooks and scientific observer programmes

Environmental status in 2018



Demersal fish communities were recovering from over-exploitation in the past, but GES had not yet been achieved in either the Greater North Sea or the Celtic Seas. A partial assessment of pelagic shelf fish did not provide a clear result.

High level objective for GES

The abundance and demography of fish indicate healthy populations that are not significantly affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Bycatch mortality

Target: Incidental bycatch is below levels which threaten long-term viability and recovery of fish populations.

Indicator:

- Bycatch rate or risk for listed fish species

Monitoring programme:

- Official catch and effort data (including Vessel Monitoring Systems, VMS) for fisheries including from observer programmes

Criterion: Population abundance

Target: The population abundance of sensitive species is not decreasing due to anthropogenic activities and long-term viability is ensured.

Indicator:

- Recovery in the population abundance of sensitive fish species (OSPAR)

Monitoring programmes:

- Otter trawl surveys
- Beam trawl surveys

Criterion: Distributional range

Target: For each fish species listed in the Habitats Regulations population abundance and geographic distribution meets established favourable reference values.

Indicator:

- Distributional range for fish species in the Habitats Regulations

Monitoring programme:

- Coastal and estuarine surveys

Criterion: Species habitat

Target: For listed fish species the area and the quality of the habitat is sufficient.

Indicator:

- Assessments of species habitat for listed fish species

Monitoring programmes:

- Coastal and estuarine surveys
- Otter trawl surveys
- Beam trawl surveys

Operational targets

We will work together with other countries in OSPAR to establish appropriate threshold values where this is feasible.

Monitoring programme details**Otter trawl surveys, including International Bottom Trawl Survey**

UK research vessels participate in otter trawl surveys coordinated by the International Council for the Exploration of the Seas (ICES) including the International Bottom Trawl Surveys (IBTS).

Although these surveys were initiated to support fisheries stock assessment, data is collected for >200 species of fish and elasmobranchs, including both demersal and small pelagic species. Data are processed for both commercial and non-commercial fish species, as well as commercial shellfish, cephalopods and benthic invertebrates. The types of species sampled are also those that interact primarily with commercial fisheries, and thus in need of appropriate monitoring. The IBTS has been undertaken with consistent sampling methods in the North Sea during the first quarter of the year since 1983 and in the third quarter since 1998. IBTS has been undertaken in waters to the West of Scotland during the first quarter since 1985 and in the fourth quarter since 1995. In the Irish sea IBTS surveys have been run in quarter 1 and quarter 4 since 1992. A Scottish Deep Water Slope Survey including Rockall Bank has been conducted since 1998.

Beam Trawl and Dredge Surveys

The UK contribution to the ICES coordinated beam trawl surveys comprise the Cefas beam trawl surveys (BT) and the Ecosystem Survey. The beam trawl surveys cover the Eastern Channel and southern North Sea, Irish Sea and Bristol Channel, and the Ecosystem Survey collects data from the Celtic Sea and Western Channel. The Ecosystem survey and Irish Sea/Bristol channel surveys includes data collection in Welsh

waters. These annual surveys focus on flatfish fish species (including sole and plaice) but, similar to otter trawl surveys, they collect additional data on all species captured including shellfish and benthic invertebrates. The Ecosystem survey also collects data on benthic habitats.

Marine Scotland conduct a dredge trawl survey for sandeel in the Firth of Forth and around Turbot Bank.

Coastal and Estuarine surveys

Data are collected for estuarine and coastal fish by the Environment Agency, Scottish Environment Protection Agency, Natural England, the AFBI and DAERA. These data support assessments of species listed by the Bern Convention and contribute toward the assessment of ecological status under the RBMPs.

The Northern Ireland Fish surveys also cover transitional waters and the ten regional Inshore Fisheries and Conservation Authorities (IFCAs)²² in England undertake inshore monitoring programmes.

Regional Cooperation

Since 2012, the UK has worked in OSPAR to develop new OSPAR-wide indicators for fish communities covering population abundance of sensitive fish species. UK data was included in the associated assessments which were published in the OSPAR Intermediate Assessment 2017.

Data collection is conducted to meet the needs of international (ICES) and national stock assessment and advice to support fisheries management.

Developments in monitoring since 2014

The English Ecosystem Survey of the Celtic Sea and Western Channel (beam trawl) was started in 2006 and extended to include the northern Celtic Sea in 2013. Since 2017, additional ecosystem information for benthic habitats and food webs has been collected.

The Pelagic Ecosystem survey was started in 2012 in English waters of the Western English Channel, the Bristol Channel and Celtic Sea to monitor the pelagic food web. In 2017, the survey was extended to include the French waters of the Western Channel. Important biological data is also collected for black seabream, seabass, garfish, saury pike, red mullet and increasingly observations are made for bonito and bluefin tuna.

²² <http://www.association-ifca.org.uk/common-fisheries-policy/technical-advisory-group>

Groundfish (otter and beam trawl) surveys of the North Sea, Channel, Irish Sea and West coast fish communities have continued uninterrupted, lengthening the existing time series. There have been some changes to the quality assurance processes put in place to ensure consistency of data formats, units and assumptions between the countries submitting data.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Further sampling programmes, in co-operation with the fishing industry, are needed to boost monitoring efforts for sensitive elasmobranch species (sharks and rays) in UK waters and fill the gap in monitoring of sensitive species as well as inshore fish species and communities. For example, research suggests that sampling by the industry using longlines could provide useful data on elasmobranchs not effectively sampled by routine monitoring (ELSIE project 2019²³);
- Due to Covid-19 restrictions, the Observer programme has been largely suspended for vessels out at sea longer than a day;
- Additional research into novel monitoring methods (including the use of novel tools such as environmental DNA), could extend biodiversity indices to additional species to complement data collection by existing surveys;
- Existing assessments of rare species across all fish taxa is hindered by a lack of data and additional studies are required into their risk of bycatch in commercial fisheries;
- Logbook data from commercial fisheries provide data with a broad geographical coverage, but rare fish can be difficult to identify to species level and therefore data can be inaccurate;
- Observer programmes identify rare species accurately and therefore provide high quality data, but the data is too sparse to give a high-confidence quantitative assessment of bycatch rates of rare species; and
- Migratory fish species monitoring programmes do not currently feed data into UK Marine Strategy assessments.

There are opportunities to address these issues through various projects and programmes including:

- Natural England has set out, in liaison with Environment Agency, a comprehensive programme to monitor inshore waters and protected sites to de-risk coastal development. A number of pilot studies/R&D projects have been undertaken;
- In Northern Ireland, the Sea-Deep project is working with sea anglers to tag elasmobranchs. This is a citizen science project led by Ulster Wildlife and is providing DAERA with information on important areas for Common skate and other elasmobranch species;

²³ Elasmobranch Longline Surveys in Inshore Ecosystems (ELSIE) Sophy McCully-Phillips, Catarina Maia, Joana Silva, Suzanna Neville & Jim Ellis. 05 April 2019

- Two acoustic tagging projects in the Loch Sunart to the Sound of Jura Marine Protected Area (MPA) found that significant numbers of adult skate are resident in the MPA, spending time in a relatively small “home range”. Subsequent long-term acoustic tagging under the Movement Ecology of Flapper Skate (MEFS) project at the University of St Andrews has shown that small numbers of skate travel long distances and return to the MPA. Collaboration between the MEFS project and Seamonitor will provide further evidence for long range movements and may identify other sites important for skate and their connectivity to the MPA;
- In Scotland, the Skatespotter project is working with citizen scientists to collect data on flapper skate. Anglers can upload photos of skate for photo ID (based on the spot patterns on their upper surface) and beach combers can report strandings of dead animals and help by collecting DNA and vertebrae for genetic and age / growth studies;
- Skate charter skippers help with the monitoring of the Loch Sunart to the Sound of Jura Marine Protected Area on the West coast of Scotland by submitting PIT tag data to NatureScot / Marine Scotland Science, this data will be used to model survival rate of skate in the MPA;
- The Interreg Va SeaMonitor project is building on the Sea-Deep project and is using acoustic tags to gather provide information on the movements of Common skate in Northern Irish and Scottish waters;
- While Observer programmes have been suspended, alternative approaches using the cooperation of the fishing industry to provide catch samples for analysis upon landing are being developed. The success of such a trial will be informative in the potential for broadening the role of the fishing industry in providing such samples on a more routine basis offering the potential to significantly expand the monitoring programme covering Fish Descriptor 1, Descriptor 3 and Descriptor 4;
- The Environment Agency, Natural Resource Wales, Scottish Environment Protection Agency and DAERA have carried out fish monitoring in estuarine waters over a number of years and these data can contribute to the distributional range and fish species habitat indicators²⁴ since many fish species use the estuarine environment as nursery and overwintering habitat;
- Logbook data from commercial fisheries and observer programmes, together with the scientific survey data and commercial VMS data, these fisheries dependent data may support the development of risk-based indicators for the bycatch on non-commercial species; and
- Subject to the outcomes of technology testing, from 2021 we expect new legislation to be implemented requiring all British licensed fishing vessels under 12m to have inshore VMS. This will mean that more data with the potential to be used for understanding fishing patterns should come on stream over the next few years.

²⁴ <https://data.gov.uk/dataset/41308817-191b-459d-aa39-788f74c76623/trac-fish-counts-for-all-species-for-all-estuaries-and-all-years>

- In the next cycle of assessments for the UK Marine Strategy Part One, we will include biogeographical reports on a wider range of fish species, including migratory species such as salmon.

Descriptors 1 & 4: Pelagic Habitats

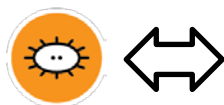
Overall summary

We propose that the monitoring of distribution and condition of pelagic habitats will be carried out largely by existing monitoring programmes:

Data on distribution and condition of pelagic habitats are collected by the following programmes:

- (i) Fixed-point sampling
- (ii) The Continuous Plankton Recorder (CPR)
- (iii) The Environment Agency's inshore programme

Environmental status in 2018



Prevailing environmental conditions were likely to be driving the observed changes in plankton communities, but human activities could not be ruled out and it was uncertain whether GES has been achieved.

High level objective for GES

Pelagic habitats are not significantly adversely affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Habitation distribution and condition

Target: The structure, function, composition and abundance of the plankton community is not significantly adversely influenced by anthropogenic drivers.

Indicators:

- Changes in plankton communities (OSPAR)
- Changes in plankton biomass and abundance (OSPAR)

Monitoring programmes:

- Fixed point sampling
- CPR
- The Environment Agency's inshore programme

Operational targets

We will work with other countries in OSPAR to:

- a) Understand and quantify the effects of the key anthropogenic and natural pressures on pelagic habitats; and
- b) Further develop and test regional assessment methods that can be used in the future for assessing the status of pelagic habitats.

Monitoring programme details

Coastal fixed point and inshore sampling

Coastal pelagic habitats are monitored by a network of up to 15 fixed sampling points around the UK, as well as the Environment Agency's inshore sampling programme. Some sites collect zooplankton and phytoplankton samples, some only collect phytoplankton data. Instrumented moorings at some of these fixed sampling points provide additional supporting physico-chemical data. The fixed-point samples are supplemented by vessel-based spot samples. Data collected are often used for multiple purposes, e.g. River RBMPs, Urban Waste Water Treatment Regulations (UWWTR) and OSPAR.

Fixed point sampling is distributed around the UK coast of England, Wales and Scotland, plus two stations in the Irish Sea sampled by AFBI. Sites are selected to ensure they encompass all the water types with distinct ecological and hydrological characteristics found in UK coastal and shelf waters. Samples are collected at regular intervals throughout the year, gathering quantitative information on the abundance of species that make up the plankton community.

Where appropriate, the monitoring programme makes use of existing monitoring programmes including those run by the AFBI, the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Environment Agency, Marine Scotland, Plymouth Marine Laboratory, and DAERA.

Continuous Plankton Recorder

Offshore pelagic habitats are monitored by the CPR, operated by the Marine Biological Association (MBA). The CPR uses ships of opportunity on commercial shipping routes to collect plankton samples in UK waters and beyond. Established in 1931, the CPR provides long-term time-series data on the state of plankton (including both phytoplankton and zooplankton) at a large scale in offshore locations.

Regional Cooperation

Implementation of the indicators at the OSPAR level is collaborative, with all Contracting Parties who have data (currently UK, Sweden, and France) using the same analysis methods to ensure consistency across the OSPAR region. This process is coordinated by the UK as chair of the OSPAR Pelagic Habitats Expert Group.

Developments in monitoring since 2014

The technical approach to phytoplankton monitoring remains relatively unchanged, although the potential of flow cams, flow cytometry and remote sensing are being investigated to see if they can be used in routine monitoring.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Since 2014, there has been a reduction in spatial and temporal distribution of sampling; and
- There are monitoring gaps in some parts of the food web (e.g. picoplankton) and some nearshore hydrodynamic features (e.g. large estuary “plumes”). Data density is variable so there are gaps in some less accessible regions, such as offshore and coastal areas to the West of Scotland.

There are opportunities to address these issues through various projects and programmes including:

- Some technical innovations such as flow cytometry, flow cams (and possibly eDNA and DNA barcoding) may help to improve monitoring effectiveness if their outputs can be made compatible and comparable with existing data streams; and
- Improving the harmonisation of existing monitoring programmes.

Descriptors 1 & 6: Benthic Habitats

Overall summary

Monitoring of benthic habitats will be carried out largely by a number of existing programmes.

Data on habitat loss, condition, and adverse effects and disturbance caused by human activities will be collected by:

- i) Inshore benthic Marine Protected Area (MPA) Monitoring Programmes
- ii) Offshore and deep sea MPA monitoring programme

iii) Marine biodiversity and Climate change (MarClim) Monitoring Programme

iv) River Basin Management Plan (RBMP) Monitoring Programme

Environmental status in 2018



The achievement of GES was uncertain for intertidal and soft sediment habitats. The levels of physical damage to soft sediment habitats were considered to be consistent with the achievement of GES in UK waters to the West of the Celtic Seas, but not in the Celtic Seas or in the Greater North Sea.

High level objective for GES

The health of seabed habitats is not significantly adversely affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Spatial extent of physical loss

Target: The physical loss of each seabed habitat type caused by human activities is minimised and where possible reversed

Indicator:

- Physical loss of predicted habitat

Monitoring programmes:

- Inshore benthic MPA monitoring programmes
- Offshore and deep sea MPA monitoring programme

Criterion: Habitat condition

Target: Habitat loss of sensitive fragile or important habitats caused by human activities is prevented, and where feasible reversed.

Indicator:

- Physical loss of predicted habitat

Monitoring programmes:

- Inshore benthic MPA monitoring programmes
- Offshore and deep sea MPA monitoring programme

Criterion: Spatial extent of habitat type adversely affected by physical disturbance

Target: The extent of habitat types adversely affected by physical disturbance caused by human activity should be minimized.

Indicators:

- Extent of physical damage indicator to predominant and special habitats (OSPAR)
- Benthic communities indicator (OSPAR)

Monitoring programmes:

- Inshore benthic MPA monitoring programmes
- Offshore and deep sea MPA monitoring programme

Criterion: Extent of adverse effects

Target: The extent of adverse effects caused by human activities on condition, function and ecosystem processes of habitats is minimised.

Indicator:

- Benthic communities indicator (OSPAR)

Monitoring programmes:

- Inshore benthic MPA monitoring programmes
- Offshore and deep sea MPA monitoring programme

Criterion: No set criteria

Targets: No set targets

Indicators:

- Aggregated Infaunal Quality Index
- Aggregated Saltmarsh Tool
- Aggregated Rocky Shore Macroalgal Index
- Aggregated Intertidal Seagrass Tool

Monitoring programme:

- RBMP monitoring programme

Operational targets

We will work with other countries in OSPAR to establish criteria and thresholds for the extent of habitat loss and the extent of anthropogenic activities where feasible.

We will complete a well-managed ecologically coherent MPA network.

Monitoring programme details

Current inshore benthic MPA monitoring programmes

All monitoring is carried out between mean high water (MHW) and the 12nm line.

English inshore waters:

Monitoring needs are identified by Natural England and delivered with partners including the Environment Agency, Cefas, the IFCAs, and the JNCC. Currently, benthic features (selected using a rolling risk-based approach) within MPAs are monitored each year. Currently, monitoring is conducted within 12-16% of English inshore MPAs, targeting 10-14% of habitat examples.

Scottish inshore waters:

Nature conservation-related monitoring needs are identified by NatureScot and delivered with partners including Marine Scotland Science, academic institutes and industry. Current monitoring focuses on the suite of MPAs and is prioritised annually under the framework established by the Scottish MPA Monitoring Strategy. Detailed monitoring is conducted at a small number of MPAs only. Other ad hoc, or research-focused monitoring may also take place and, where appropriate, be incorporated into MPA assessments. The Scottish Environment Protection Agency (SEPA) coordinates and undertakes RBMP-related benthic monitoring around Scotland.

Welsh inshore waters:

Monitoring needs are identified by Natural Resources Wales (NRW) and the monitoring programme receives governance and strategic steer from the NRW Marine Programme Board and the NRW Evidence Board. NRW has a specific monitoring programme that primarily supports delivery of obligations under the Habitats Regulations and the RBMP, but also contributes to other monitoring and reporting obligations. The monitoring programme focuses available resources on a selection of benthic features in a risk-based cycle. Current monitoring is largely limited to five SACs and one Marine Conservation Zone (MCZ), with monitoring of other MPAs and the wider seas occurring incidentally as part of SAC, MCZ and RBMP monitoring.

Northern Irish inshore waters:

Northern Irish inshore benthic habitats are monitored as part of established programmes for MPAs and RBMPs. Monitoring needs are identified by DAERA and delivered with partners including the AFBI. At present, monitoring takes place in a six-year rolling cycle and a selection of MPAs are prioritised and monitored each year. AFBI have monitored a selection of six sites in the Irish Sea annually since 1997 as part of the Clean Seas Environmental Monitoring Programme (CSEMP).

Other ad hoc or research-focused monitoring may also take place, and data will be incorporated into assessments where appropriate, for example Environmental Impact Assessment (EIA data from marine licensing) and data from research studies.

Current offshore and deep sea MPA monitoring programme

UK offshore habitats:

Dedicated monitoring of offshore MPAs has been taking place since 2014. Current monitoring for offshore benthic habitats focuses on MPAs beyond 12nm and in waters shallower than 200m. Offshore shelf MPAs are monitored each year by JNCC and partners including Cefas and Marine Scotland Science. To date, all offshore and deep sea MPA monitoring has been prioritised together on a yearly basis, based on factors including risk from physical abrasion pressure and amount of data available. Long term plans are currently being developed to monitor a limited number of representative MPAs in Scottish and English offshore waters once every 3 years.

UK deep sea habitats:

Dedicated monitoring of deep sea MPAs has been taking place since 2016. Deep sea benthic habitats (below 200m water depth) within MPAs are monitored by JNCC and partners including Cefas, Marine Scotland Science and the National Oceanography Centre. To date all offshore shelf and deep sea MPA monitoring has been prioritised on a yearly basis, based on factors including risk from physical abrasion pressure and amount of data available. Long term plans are being developed to monitor a limited number of deep sea MPAs once every 6 years for MPAs deeper than 200m in UK waters.

Other ad hoc or research-focused monitoring may also take place, and data will be incorporated into assessments where appropriate. Opportunities exist for collaboration with industry and academia, and JNCC is exploring these.

RBMP Monitoring programmes

Data from a number of other programmes that assess the status of benthic habitats will continue to be collated to inform our assessments. This includes monitoring associated with the RBMPs (where benthic habitats are assessed using the [Infaunal Quality Index](#)²⁵, Saltmarsh Tool, intertidal seagrass tool, and Rocky Shore Macroalgal Index), monitoring associated with SACs, the [Clean Seas Environmental Monitoring Programme](#)²⁶, [Marine Conservation Zones](#)²⁷, UK Oil and Gas industry, and [Regional Environmental Characterisation](#)²⁸.

²⁵ <https://www.gov.uk/government/publications/water-framework-directive-wfd-classification-scheme-for-marine-benthic-invertebrates-infaunal-quality-index>

²⁶ https://www.bodc.ac.uk/projects/data_management/uk/merman/project_overview/

²⁷ <https://jncc.gov.uk/our-work/marine-conservation-zones/>

²⁸ <https://ets.wessexarch.co.uk/recs/what-is-a-rec/>

MarClim Monitoring Programme

Monitoring of intertidal rocky shore habitats through the MarClim monitoring programme produces data for the MarClim indicator, which assesses the response of rocky shore communities to climate change pressures. This is one of the oldest long-term datasets in the UK. Annual surveys are carried out at over 100 sites around the UK coastline²⁹.

Regional Cooperation

Difference in methods and approaches make regional cooperation for benthic monitoring challenging at the operational level. However, there are some examples of regional cooperation at the MPA level for international sites such as Dogger Bank Special Area of Conservation. UK Marine Strategy and OSPAR monitoring programmes are aligned and a regional seas approach facilitates international cooperation and assessment, facilitating evaluation of transboundary impacts.

Developments in monitoring since 2014

The 2014 UK Marine Strategy Part Two document noted a gap in the monitoring of the condition of sediment, biogenic and rock habitats and the need to monitoring benthic communities. Since 2014, a new programme of MPA monitoring has been established to address gaps within the offshore and deep-sea environments, collecting data on a range of features. 28 out of a possible 65 offshore and deep-sea MPAs designated for habitat features have been monitored by JNCC and their partners.

Issues and opportunities

Key issues identified in relation to monitoring include:

- GES assessments, particularly in the offshore, are mainly restricted to MPA data sources. Currently, only a small selection of MPAs are able to be monitored at a reasonable frequency, and there is limited statutory monitoring being undertaken within the wider benthic environment outside of MPAs; and
- There are data available from alternative sources, such as those collected by Industry as part of licensing and consent procedures. However, datasets are in different formats and the type of surveys are not always suitable for assessments of status and condition.

There are opportunities to address these issues through:

- Monitoring:
-

²⁹ For further information: <http://www.marclim.co.uk/index.php?sec=info>

- Increasing levels of funding for wider UK benthic habitat monitoring would improve our ability to provide confident assessments of the change in status and trends;
 - Utilising new technology to enhance monitoring (e.g. Automated Underwater Vehicles, environmental omics, computer-assisted data analysis, machine learning and artificial intelligence).
- Collaboration:
- Increasing the standardization of biological and environmental data collected by Industry so that it can be used for the assessments of GES, and greater access to human activity and pressure data from non-fisheries activities. Further opportunities for accessing and using a wider evidence base for future assessments e.g. industry, academic and fisheries data, are being explored the UKMMAS community;
 - Future use of The Crown Estate's Offshore Wind Evidence and Change Programme (OWEC) and NERC's Sustainable Management of UK Marine Resources (SMMR) programme.
- Use of additional data sources:
- High resolution inshore fisheries data would help to improve confidence in the indicator results, such as physical damage. This includes for example; wider adoption of iVMS which is currently only for vessels over 12m length; greater access to additional data sets on fishing activity such as fish plotter data and/or Automatic Identification Systems (AIS); and working with the fishing industry to improve the data available;
 - Exploring the use of data gathered by developers and local recording initiatives such as Seasearch and Shoresearch;
 - Continuing integration of the benthic habitat monitoring from the RBMP and MPA monitoring programmes.

Descriptor 2: Non-Indigenous Species

Overall summary

The monitoring of Non-Indigenous Species (NIS) is carried out largely by existing programmes:

- i) Clean Seas Environmental Monitoring Programme (CSEMP)
- ii) Groundfish surveys (GFS)
- iii) Regional Seabed Monitoring Plan (formerly Aggregate Levy)
- iv) Clean Seas Environmental Monitoring Programme (CSEMP)
- v) Groundfish surveys (GFS)
- vi) Regional Seabed Monitoring Plan (formerly Aggregate Levy Sustainability Fund) (RSMP)
- vii) Dredge disposal site monitoring,
- viii) Marine Protected Area (MPA) monitoring

- ix) River Basin Management Plans (RBMPs) monitoring and
- x) Continuous Plankton Recorder (CPR)

This is complemented by citizen science projects and data records on the National Biodiversity Network (NBN) gateway and the Marine Recorder.

Environmental status in 2018



The UK did not achieve its aim of GES for NIS. Our ability to detect new NIS had improved but there had been no significant change in the number of new records of NIS made between 2003 and 2014.

High level objective for GES

The rate of introduction of NIS, spread and impact of invasive NIS caused by human activities is not adversely altering ecosystems.

How progress towards GES is measure using monitoring, indicators and targets

Criterion: NIS introductions and distribution

Targets: The number of newly introduced NIS is minimised and where possible reduced to zero; and

The rate of spread of invasive NIS, as a result of human activities is minimised and reduced where possible.

Indicators:

- The number of new NIS introduced (OSPAR); and
- The number of new populations of established invasive NIS.

Monitoring programmes:

- Clean Seas Environmental Monitoring Programme (CSEMP)
- Groundfish surveys (GFS)
- Regional Seabed Monitoring Plan (formerly Aggregate Levy Sustainability Fund) (RSMP)
- Dredge disposal site monitoring
- Marine Protected Area (MPA) monitoring
- RBMP monitoring

- Pelagic Habitats monitoring programme, including the Continuous Plankton Recorder (CPR)

Monitoring programme details

River Basin Management Plan (RBMP) monitoring

Intertidal and subtidal surveys using multiple methods, collecting data on a range of macro and microalgal and mobile and non-mobile animal species and non-trawl capture of fish in coastal and transitional waters. Monitoring is conducted in England, Scotland, Wales and Northern Ireland, but different elements of the programme are implemented over different time scales. Some surveys are undertaken opportunistically, but all surveys are conducted at a frequency of between bi-annually and every six years.

Marine Protected Areas (MPA) monitoring

Observations and grab samples taken in England, Scotland, Wales and Northern Ireland and offshore. Grab samples monitor benthic infauna (animal species living within the seabed) and smaller epifauna (organisms living attached to the surface of the seabed or other organisms) whereas the observations collect data on larger animal and algal species. MCZ sites are currently visited for site verification and baseline condition with specific monitoring programmes put in place after designation. Special Areas of Conservation and Areas of Scientific Interest are visited on a six-year cycle and monitoring is site specific (minimum frequency every 18 years, maximum every four years).

Regional Seabed Monitoring Plan (RSMP)

Grab and occasional trawl sampling of benthic infauna and smaller epifauna conducted in England and Wales.

Ground Fish Surveys (GFS)

Trawl sampling of benthic epifauna including larger and more mobile species, conducted annually between July and October in Scotland, England and Wales.

Clean Seas Environmental Monitoring Programme (CSEMP)

Trawl and water sampling of benthic epifauna and some planktonic species. Sites in England, Wales, and Northern Ireland are monitoring on a rolling basis every other year. Scottish sites are monitored on a six yearly, three yearly or annual basis according to the site concentrations in relation to Background Assessment Concentrations (BACs) and Environmental Assessment Criteria (EACs). Northern Ireland sites are monitored annually.

Dredge Disposal and other industry data

Grab sampling of benthic infauna and smaller epifauna across England, Wales and Northern Ireland. Frequency of monitoring is site specific depending on frequency and quantity of dredge disposal activities.

Continuous Plankton Recorder³⁰ (CPR)

Ad-hoc zooplankton monitoring across England, Wales and Scotland.

Capturing our Coast

An observational annual survey across England, Wales and Scotland, running from 2015-2018 with some data feeding into upcoming assessments. This is comprised of transects and quadrats conducted via underwater cameras, walkovers, or divers.

Regional Cooperation

NIS monitoring is reliant upon regional cooperation. The monitoring of NIS in the UK follows recommendations from OSPAR (i.e. with respect to monitoring NIS as part of wider biodiversity monitoring) and provides data for incorporation into OSPAR level assessments.

Developments in monitoring since 2014

NIS monitoring was integrated into ongoing statutory biodiversity monitoring programmes across the UK from 2016 as an efficient and cost-effective option. NIS data provided by these statutory monitoring programmes are currently complemented by non-statutory data sources collected via citizen science and data records on the National Biodiversity Network Atlas.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Marine litter is a potential vector of marine NIS introduction;
- There is currently limited coverage of locations at high risk of introduction of NIS (e.g. ports);
- Our understanding of deep-sea biodiversity is limited compared to shallow areas, which limits identification of NIS introductions in those areas; and
- NIS data collection is currently undertaken by monitoring programmes set up for other purposes, which are not necessarily optimised for NIS monitoring due to their frequency or location.

There are opportunities for addressing these issues, in addition to maximising the use of available data these include:

³⁰ <https://www.cprsurvey.org/services/the-continuous-plankton-recorder/>

- Collaboration and coordination between NIS and marine litter monitoring and assessment are ongoing;
- High risk locations have been identified and further work is being progressed on how this process can be improved. Improved spatial coverage in relevant habitats e.g. the intertidal zone, through improved integration with other marine monitoring initiatives, and work to determine the potential application of molecular technologies, is also being considered;
- Data from the deep-sea Porcupine Abyssal Plain Sustained Observatory (PAP-SO) and Invasive Species Ireland will be used in the next assessment;
- In order to detect trends, we will continue to work towards improving the standardization of coverage, frequency and location of sampling, and methodologies.

Descriptor 3: Commercial Fish and Shellfish

Overall summary

The monitoring of commercial fisheries is carried out by a number of existing monitoring surveys, along with a range of port sampling and observer programmes.

Environmental status in 2018



The UK achieved its aim of GES for some commercially exploited fish. In 2015, 53% of marine fish (quota) stocks were fished below maximum sustainable yield (MSY). Most national shellfish stocks had either not yet achieved GES or their status was uncertain.

The percentage of quota stocks fished below MSY and the proportion of marine fish spawning stock biomasses capable of producing MSY had increased significantly since 1990.

High level objective for GES

Populations of all commercially-exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Fishing mortality

Target: The fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield.

Indicator:

- Commercial fishing pressure for stocks of UK interest.

Monitoring programmes:

- Otter trawl surveys
- Beam trawl surveys
- Pelagic fish surveys
- Underwater television surveys
- Coastal surveys
- Sea angling programme
- Fisheries dependent data
- Supporting data

Criterion: Reproductive capacity of the stock

Targets: The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing the maximum sustainable yield.

Indicator:

- Reproductive capacity of commercially exploited stocks of UK interest.

Monitoring programmes:

- Otter trawl surveys
- Beam trawl surveys
- Pelagic fish surveys
- Underwater television surveys
- Coastal surveys
- Sea angling programme
- Fisheries dependent data
- Supporting data

Monitoring programme details

Otter trawl surveys, including International Bottom Trawl Survey

UK research vessels participate in ICES coordinated bottom trawl surveys that focus on demersal fish species (e.g. cod, haddock, whiting, monkfish) but sample a wide variety of species. These are carried out by AFBI in the Irish Sea in quarters 1 and 4; by the Centre

for Environment, Fisheries and Aquaculture Science (Cefas) in the North Sea in quarter 3; and by Marine Scotland Science in quarters 1 and 3 in the North Sea and quarters 1 and 4 for the West of Scotland Area.

Beam trawl surveys

The UK contribution to the ICES coordinated beam trawl surveys comprise the Cefas beam trawl surveys and the Ecosystem Survey. The beam trawl surveys cover the Irish Sea, Bristol Channel, and Eastern English Channel and the Ecosystem Survey collect data from the Celtic Sea and Western Channel. These annual surveys focus on flatfish (e.g. sole and plaice) but sample a wide variety of species in English and Welsh waters.

Pelagic fish surveys

Annual acoustic surveys are carried out across the UK for herring and sprat as part of the ICES coordinated pelagic fish surveys. These cover sites in the North Sea, Irish Sea, Celtic Sea, Bristol Channel and Western Channel, and a number of sampling stations in Welsh waters.

Underwater television surveys

Annual, bi-annual and ad-hoc ICES coordinated underwater television surveys for *Nephrops* are carried out across the UK. These take place in the Irish Sea, Botney Gut, Silver Pit, Farne Deep, Fladen Ground, Firth of Forth, Moray Firth, North Minch, South Minch, Clyde, Jura, Devil's Hole.

Annual surveys of king scallop populations are also undertaken in unfished areas in English waters.

Coastal surveys

Site-specific trawl surveys for sea bass, queen scallops and king scallops in are carried out in Welsh waters. In England, trawl surveys for pre-recruitment bass are carried out in the Solent and Chichester. Coastal surveys are also conducted in Northern Irish waters as part of the Irish Sea queen scallop survey.

Sea angling programme

Annual UK-wide survey under the Data Collection Framework of recreational catches of species used in stock assessments, for example, sea bass.

Fisheries dependent data

UK-wide observer programmes and routine monitoring of fisheries landings data for logbooks and port records.

At port data collection for landed crab and lobster in England.

Industry sampling scheme for king scallop in English waters, providing scallop size and age data.

Supporting data

A range of additional surveys inform our assessments. These include the Scottish Deep Water Slope Survey at Rockall Bank; the Scottish quarter 4 dredge surveys for sandeels off the Firth of Forth and around Turbot bank; the Scottish triennial contribution to the International Mackerel and Horse Mackerel Egg Survey; and the Fishery Science Partnership Western Channel Flatfish Beam trawl survey in English waters.

Regional Cooperation

Data collection is conducted to meet the needs of international (ICES) and national stock assessment and advice to support fisheries management.

Other notable international cooperation – beyond the ICES coordinated surveys described above - includes contributions the International Blue whiting spawning stock survey (North East Atlantic), and to the International Ecosystem Survey in the Nordic Seas (Atlanto-Scandinavian Herring “ASH” acoustic survey for both herring and blue whiting, ICES area IIa Norwegian Sea).

It should also be noted that the monitoring programmes for Descriptor 3 (particularly the fisheries independent data) also support all current OSPAR indicators for fish communities for Descriptors 1 and 4 and the fisheries dependent data are essential for D6 assessments of seabed habitats and planned indicators to improve D1 assessments related to bycatch.

Developments in monitoring since 2014

Both the onshore and offshore programmes have been improved to make them more statistically robust and effective.

The Pelagic Ecosystem survey was developed under project POSEIDON (starting in 2012 in English waters of the Western English Channel, Bristol Channel and Celtic Sea) to monitor the pelagic food web. Since 2016 it was incorporated in the European Data Collection Framework. In 2016, the short time series (starting in 2013) contributed to ICES Stock Assessments for sprat in the English Channel and, currently, data are being considered for inclusion in the assessment of sardine in the Celtic Sea and Western Channel. Additional data is provided to working groups for mackerel, horse mackerel and anchovy. In 2017, the survey was extended to include the French waters of the Western Channel. Important biological data is also collected for black seabream / seabass / garfish / saury pike / red mullet and increasingly observations are made for bonito and bluefin tuna.

Ground fish surveys (otter trawl and beam trawl) of the North Sea, Channel, Irish Sea and west coast fish communities have continued uninterrupted, lengthening the existing time series. There have been some changes to the quality assurance processes put in place to ensure consistency of data formats, units and assumptions between the countries submitting data.

There has also been a programme of research to improve the fishing gear used for scientific surveys to improve its usability and effectiveness. Similarly, research has progressed through tagging programs to understand habitat usage by species (such as seabass).

Wales have also conducted research into some shellfish species with NRW.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Limited information on national shellfish stocks (crab, lobster, whelks, and scallop) is available relative to biomass reference points for MSY (for reproductive capacity);
- Shellfish data gaps are due in part to limited coastal monitoring. Stock assessments are in place for these species, but they have only been implemented relatively recently and more time is needed develop a long enough time series to improve the accuracy of MSY estimates;
- Landings data can only provide an accurate indication of fisheries pressure if all that is caught is landed

There are opportunities for addressing these issues, in addition to maximising the use of available data, these include:

- UK representatives promote and develop assessments internationally for data-poor species not currently assessed (e.g. through UK chairmanship of ICES WKLIFEX³¹).
- Research and development are underway to improve monitoring for the growing cuttlefish fishery: e.g. cuttlefish in the Western English Channel ³²;
- The ongoing commitment of the UK, Scottish, Welsh and North Ireland governments, to minimise unwanted catches and end the practice of discarding fish at sea, will improve the accuracy of landings data;
- Landings data will be reviewed and assessed as part of our future catching policy.
- Data to support D3 assessments, such as from the following programmes, will be considered to determine whether they can be incorporated in a cost-effective manner to improve our assessments:
 - o SIAMISS: Scottish and Irish Anglerfish and Megrin Industry Science Survey;
 - o Industry/Science Survey of Herring in the Western British Isles (ICES DIV 6a, 7b, c)

³¹ <https://www.ices.dk/community/groups/Pages/WKLIFEX.aspx>

³²

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/923552/Western_Channel_Cuttlefish_Report_2018_19.pdf

- The Scottish Pelagic Fishermen's Association (SPFA) pelagic shelf sampling programme.
- New technologies can help collect full, verifiable documentation of what is being caught. Information on our approach to REM, VMS and other emerging technologies to capture data on stock assessments and sustainable fisheries can be found in the Summary of Responses published alongside this document.

Descriptor 4: Food Webs

Overall summary

We propose that the monitoring evidence food webs will be delivered largely by existing monitoring programmes.

Data on trophic guilds (a group of organisms or species sharing the same function within the food web and having shared nutritional relationships), fish community (species and size) composition and productivity are collected by the following programmes:

- i) Fisheries surveys
- ii) Plankton surveys
- iii) Remote sensing of chlorophyll and primary production
- iv) Seal Population Monitoring (SPM)
- v) Seabird Monitoring Programme (SMP)
- vi) Seabirds at Sea Monitoring Programme (SSMP)
- vii) Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys

Environmental status in 2018



The extent to which GES has been achieved is uncertain: plankton communities are changing; some fish communities are recovering, but others are not; breeding seabird populations are in decline; grey seal numbers are increasing and trends in cetacean populations are unclear. It is known that components of the marine food web are changing, but it is not clear how they are affecting each other.

High level objective for GES

The health of the marine food web is not significantly adversely affected by human activities.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Trophic guild diversity

Target: The species composition and relative abundance within representative feeding guilds are indicative of a healthy marine food web.

Indicators:

- Species composition (Mean Maximum Length indicator) within fish guilds (OSPAR); and
- Selected plankton lifeforms pairs (e.g. large vs small zooplankton) (OSPAR)

Monitoring programmes:

- Otter trawl surveys
- Beam trawl surveys
- Continuous Plankton Recorder (CPR)
- Fixed point sampling
- Research Vessel sampling

Criterion: Trophic guild balance

Target: The balance of abundance between representative feeding guilds is indicative of a healthy food web.

Indicators:

- Relative biomass of feeding guilds (including piscivores, benthivores, and planktivores); and
- Selected plankton lifeforms pairs (e.g. copepods vs diatoms) (OSPAR)

Monitoring programmes:

- Otter trawl surveys
- Beam trawl surveys
- Continuous Plankton Recorder (CPR)
- Fixed point sampling
- Acoustic surveys for pelagic fish
- SCANS
- SMP

Criterion: Size distribution

Target: The size structure of fish communities is indicative of a healthy marine food web.

Indicators:

- Fish community size structure - Typical Length within guilds and communities (OSPAR) and Large Fish Index overall (OSPAR)

Monitoring programmes

- Otter trawl surveys
- Beam trawl surveys

Criterion: Productivity

Target: Productivity of each of the representative feeding guilds, characterised by key species, is indicative of a healthy marine food web

Indicators:

- Adaptation of existing OSPAR indicators of grey seal pup production, kittiwake breeding success, and marine bird breeding success/failure; and
- Possible indicators of larval/juvenile abundance of keystone fish species
- (e.g. sandeels and herring/sprat)

Monitoring programmes

- Otter trawl surveys
- Beam trawl surveys
- Dredge surveys for sandeels off the Firth of Forth and around Turbot bank
- Irish Sea young fish MIK net survey (fish and plankton)
- CPR survey for fish larvae (sandeel and clupeids)

Monitoring programme details

Fisheries surveys

A range of trawl, net, dredge and acoustic surveys for adult and juvenile fish and eggs with additional oceanographic, plankton, seabed sampling and bird or mammal sightings data.

Plankton surveys

Plankton surveys include the use of the Continuous Plankton Recorder, point sampling, research vessel data collection and dedicated larval fish surveys.

Seal population monitoring

The UK seal monitoring programme is run by the SMRU at the University of St Andrews and is funded by Natural Environment Research Council (NERC). SMRU undertakes systematic monitoring of a limited number of sites, covering the major breeding colonies for grey seals. Monitoring in other areas is undertaken by a variety of groups with information collated by SMRU. The results are published annually through the Special Committee on Seals. Harbour seal monitoring occurs at each major haul-out site at least once every five years (grey seal summer distribution is included). The major grey seal breeding colonies are monitored at least once every two years. In Northern Ireland, DAERA monitors breeding populations of harbour and grey seal at sites for which they are a designated feature (by land and sea). Aerial surveys of the Northern Ireland coast will be

carried out every three years within the six-year reporting cycle during the harbour seal autumn moult period.

Seabird monitoring programme

The SMP is a partnership of 19 organisations, led by the Joint Nature Conservation Committee (JNCC). It provides year to year trends in abundance and breeding success of seabirds at a sample of breeding colonies in the UK, Isle of Man, Channel Isles and the Republic of Ireland. Monitoring is conducted by volunteers and professionals. It is also used to monitor protected sites, including SPAs.

Volunteer Seabirds at sea monitoring programme (VSAS) (pilot)

Pilot project to assess whether information on the distribution and abundance of seabirds at sea could be collected using volunteers on 'ships of opportunity' (ferries, research cruises, etc.).

Small Cetaceans in European Atlantic waters and the North Sea (SCANS) surveys

SCANS is an approximately decadal multilateral (ship and aerial) survey conducted in Northern European waters to assess cetacean abundance. SCANS was initiated in 1994 and continued in 2005 (SCANS-II) and 2007 (Cetacean Offshore Distribution and Abundance in the European Atlantic, CODA), with the most recent survey taking place in 2016 (SCANS-III).

Regional Cooperation

Many fisheries surveys are international and coordinated by ICES. Beyond fish data, trawl and acoustic surveys also serve to provide data on plankton, benthos, habitats, oceanography, and seabird and mammal sightings. These have facilitated the development of indicators across two ICES working groups (the Working Group on Biodiversity Science and the Working Group on Ecosystem Effects of Fishing Activities) and the OSPAR Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring.

Food web monitoring also creates opportunities for gathering data on species of special interest. For example, underwater televisions (UWTV) surveys have routinely recorded sea pens, a benthic invertebrate species, since 2012, following a special request from OSPAR in 2011. Currently, surveys routinely record the presence of trawl marks and sea pen species (*Virgularia mirabilis*, *Pennatula phosphorea*, and *Funiculina quadrangularis*)³³.

³³ ICES 2018 <https://doi.org/10.17895/ices.pub.4370>

Developments in monitoring since 2014

Routine monitoring has continued with the addition/extension of new surveys:

- Cefas Ecosystem Survey of the Celtic Sea and Western Channel (beam plus grab sampling)
- Cefas Pelagic Ecosystem (Acoustic) Survey for the Celtic Sea/Western Channel
- AFBI Ecosystem Survey of the Western Irish Sea

Issues and opportunities

Key issues identified in relation to monitoring include:

- Knowledge gaps including the extent of changes in predator-prey interactions, the importance of climatically driven changes impacting plankton, and benthic food webs) and the impacts of human activities;
- Incorporating data such as juvenile MIK net surveys (larvae and jellyfish) and plankton research vessel data collection would strengthen and improve confidence in our assessments of food webs.

There are opportunities for addressing these issues, in addition to maximising the use of available data these include:

- We are further developing our indicators to achieve a more robust assessment of human activity impacts on marine food webs to support an ecosystem-based management approach;
- We are supporting science development in this using historical fish data that can be used as a baseline to establish ecosystem change³⁴. We are cooperating within OSPAR and through the EURO-MARINE and ICES networks to make best use of data previously collected and identify gaps for future data collection;
- We intend to address food web data needs through OSPAR, by building on the recent research outcomes from the Defra funded Marine Environmental Research Programme, and by using refined ecosystem models to evaluate food web status under different environmental and management scenarios.

Descriptor 5: Eutrophication

Overall summary

We propose that the monitoring of eutrophication will be carried out largely by existing,

³⁴ Thompson, M.S.A. *et al*, 2020 <https://doi.org/10.1111/1365-2664.13662>

integrated monitoring programmes.

Data on nutrient concentrations, chlorophyll, and dissolved oxygen are collected and the results integrated according to the requirements of the RBMP in coastal waters and the OSPAR Comprehensive Procedure for the assessment of eutrophication status in marine waters.

Environmental status in 2018



The UK had largely achieved its aim of GES for eutrophication in offshore waters. However, a small number of eutrophication problems remained in coastal and estuarine waters.

High level objective for GES

Human-induced eutrophication is minimised in UK marine waters.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Nutrient concentrations

Target: Nutrient concentrations are below the levels which could lead to harmful eutrophication effects.

Indicators:

- Nutrient concentrations of Dissolved Inorganic Nitrogen and Dissolved Inorganic Phosphorus

Monitoring programme:

- Integrated eutrophication monitoring programme nutrient concentrations

Criterion: Chlorophyll concentrations

Target: Chlorophyll a concentrations are below levels which could lead to harmful eutrophication effects.

Indicator:

- Chlorophyll concentrations (OSPAR)

Monitoring programmes

- Integrated eutrophication monitoring programme chlorophyll concentrations

- Coastal fixed point
- Inshore sampling³⁵

Criterion: Dissolved oxygen content

Target: Dissolved oxygen content in coastal waters are above levels which could lead to harmful eutrophication effects.

Indicator:

- Concentrations of dissolved oxygen

Monitoring programme:

- Integrated eutrophication monitoring programme dissolved oxygen content

Operational targets

We will work with other countries to further refine the OSPAR Common Procedure and develop threshold values which take account of regional or sub-regional specificities if this proves to be necessary.

We will work with other countries to develop remote sensing assessments of chlorophyll to provide a real-time picture of nutrient enrichment.

Monitoring programme details

Integrated eutrophication monitoring programme

The integrated programme for the assessment of eutrophication status in UK coastal and marine waters measures the concentrations of nutrients, and the direct and indirect effects of nutrient enrichment (particularly levels of chlorophyll, plankton and oxygen) in UK marine waters, but with a greater focus on coastal waters where eutrophication problems are more likely to occur. This uses the ongoing programme set up to assess eutrophication status in coastal waters under the RBMPs, with coastal and offshore waters and will be supplemented by a UK monitoring programme using the OSPAR Common Procedure for the assessment of the Eutrophication Status of marine waters of the North East Atlantic (COMP). The indicator results will be integrated according to the rules set out in the newly defined OSPAR COMP 4. The Northern Ireland monitoring programme includes data from the Northern Ireland Coastal & Oceanographic Mooring Network supported by integrated catchment monitoring.

³⁵ See the Monitoring Programme Details for coastal fixed point and inshore sampling under Descriptors 1 & 4: Pelagic Habitats for further details

The programme will also check that there is no deterioration in the nutrient status of areas and will check that nutrient concentrations are falling in existing eutrophication problem areas identified in the updated UK Marine Strategy Part One integrated assessment of eutrophication status. These identified 'problem areas' are located in coastal embayments and estuaries. The programme will also monitor the load reductions into UK waters, and look to align closely with existing and developing Program of Measures to ensure load reduction of N and P continue. The programme will continue to investigate the impact of changing nutrient balances and nutrient limitation on inshore plankton communities.

The fixed-point sampling data outlined under Descriptors 1 & 4: Pelagic Habitats also feed into Eutrophication assessments.

Regional Cooperation

The UK is cooperating with other OSPAR countries to further enhance the OSPAR common assessment procedure and to explore the development of a common assessment methodology across the OSPAR Convention Area and an online assessment tool which would deliver national results for nutrients, chlorophyll and dissolved oxygen are assessed against common, but regionally specific standards.

Developments in monitoring since 2014

Monitoring programmes have been adjusted to take account of developments in indicators, methodologies and assessment procedures that have been agreed with other OSPAR countries and with EU Member States through inter-calibration processes undertaken through the RBMP Common Implementation Strategy. The methodologies were tested and applied in the OSPAR Intermediate Assessment 2017 and the updated assessment of eutrophication status in UK waters set out in the updated UK Marine Strategy part One. We continue to work to improve the integration of estuarine and coastal monitoring under the RBMPs and coastal to offshore monitoring under our national monitoring and our requirements under applications of the OSPAR COMP4 and the OSPAR QSR2023.

The UK also engaged in the Joint Monitoring Programme of the Eutrophication of the North Sea with Satellite data (JMP-EUNOSAT) programme which examined the suitability of modelling and the use of remote sensing data for eutrophication assessment in the Greater North Sea. Further validation work under OSPAR workings groups (ICG-EMO, ICG-EUT, TG-COMP and INPUT) is being considered before it is incorporated into routine monitoring.

COMPEAT, an online data assessment tool has been developed through OSPAR and will be used for the next OSPAR-level assessment, ensuring that all appropriate UK data sets submitted to the ICES database can support the assessment of the UK Marine Strategy Part One in 2024.

Issues and opportunities

Key issues identified in relation to monitoring include:

- We have gaps in our understanding of the linkages between nutrient enrichment, algae response and undesirable balance in our estuarine and coastal environment. Criteria that measure these types of changes and contribute to greater understanding of risk would be desirable.

We are taking opportunities to strengthen Eutrophication monitoring and assessments:

- Through the OSPAR Intersessional Correspondence Group on Eutrophication (which the UK currently co-chair), the UK are contributing to the development of a more harmonised approach for common indicators, data integration and assessment areas to achieve greater spatial coverage of all our marine reporting regions;
- Through OSPAR, as well as recent and ongoing research programmes³⁶, we are working to address the challenges associated with calibration and sampling bias to fully integrate new data types with the existing monitoring programme;
- Future OSPAR and UK Marine Strategy assessments will include high spatial and temporal resolution datasets. For example, the UK are contributing to the development of a harmonised OSPAR chlorophyll a data product, which will provide daily chlorophyll data for OSPAR areas I, II and IV and assessed via the online assessment tool (COMPEAT). Chlorophyll a maps from satellite observations will be produced for the OSPAR area giving a coherent dataset for use in future assessments;
- At both the UK and OSPAR level, we are working across different specialist expert groups to consider interlinked pressures and responses, ensuring that pressures from nutrient inputs and eutrophication are also considered in the context of other relevant indicators and descriptors and monitoring programmes are aligned, most specifically D1 Biodiversity: Pelagic Habitats (including consideration of Harmful Algal Blooms) and D4 Food Webs.

³⁶ Including the UK Shelf Seas Biogeochemistry programme (UK-SSB), the AlterEco project– an Alternative Framework to Assess Marine Ecosystem Functioning in Shelf Seas, and the CAMPUS project - Combining Autonomous observations and Models for Predicting and Understanding Shelf seas

Descriptor 8: Contaminants

Overall summary

We propose that the monitoring of contaminants will be carried out by a number of existing monitoring programmes.

Data on concentrations, biological effects, and significant pollution effects are collected by the following programmes:

- i) concentrations of contaminants in water, sediments and biota (fish and shellfish) in coastal and marine waters in areas considered to be at risk;
- ii) biological effects of contaminants in biota in coastal and marine waters; and
- iii) the occurrence and extent of acute pollution effects arising from spills of oil or chemicals likely to have significant effects.

Environmental status in 2018



The UK had largely achieved its aim of GES for contaminants. Concentration of hazardous substances and their biological effects were generally meeting agreed target thresholds. Highly persistent legacy chemicals were the cause of the few failures, mainly in coastal waters close to polluted sources.

High level objective for GES

Concentrations of specified contaminants in water, sediment or marine biota, and their effects, are lower than thresholds that cause harm to sea life, and are not increasing.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Concentrations of contaminants in coastal and territorial waters

Target: Concentrations of contaminants measured in water, sediment or marine biota comply with appropriate threshold values.

Indicators:

- Metals in biota and sediment (OSPAR)
- Polychlorinated Biphenyls (PCBs) in biota and sediment (OSPAR)
- Polycyclic Aromatic Hydrocarbons (PAH) in biota and sediment (OSPAR)
- Polybrominated Diphenyl Ether (PBDEs) in biota and sediment (OSPAR)
- Radionuclides

- Metal inputs from water and air
- Contaminants in coastal waters
- River basin specific pollutants

Monitoring programmes:

- Concentrations of contaminants in water, sediments and biota in coastal and marine waters including areas considered to be at risk.

Criterion: Health of species and condition of habitats

Target: Biological or ecological effects on sea life due to contaminants are below thresholds agreed by OSPAR.

Indicators

- Imposex in dog whelks
- Micronucleus test
- Ethoxyresorufin- O -deethylase (EROD) activity
- Bile metabolite
- Liver neoplasm
- Fish disease

Monitoring programme:

- Biological effects programme

Criterion: Impact of significant acute pollution events on species and habitats

Target: The adverse effects of significant acute pollution events on the health of species and on the condition of habitats (such as their species composition and relative abundance) are minimised and, where possible, eliminated.

Indicator:

- Number and size of spills

Monitoring programme:

- Based on spill reports and ad hoc follow up, including appropriate monitoring where justified, depending on type and significance of the spill

Operational targets

Work nationally and with other countries to establish common threshold values for contaminants and their effects where these pose risks to marine life.

Work nationally and with other countries to identify chemicals of emerging concern which pose risks to marine life and develop common lists and management actions by 2022.

Work nationally and with other countries to investigate the cumulative effects of combinations of contaminants on sea life populations and take appropriate actions.

Refine UK emergency response procedures to ensure that risks from acute pollution events do not significantly impact marine biota or habitats.

Monitoring programme details

Concentrations of contaminants in water, sediments and biota

The programme measures concentrations of a range of contaminants in water, sediments and biota in coastal and marine waters in areas considered to be at risk and assesses whether they are meeting agreed thresholds. It integrates the monitoring of contaminants used to implement the River Basement Management Plans (RBMPs) and other regulations for coastal waters and the monitoring used in the OSPAR Convention Coordinated Environmental Monitoring Programme to address the contaminant status of coastal and marine waters. The chemicals monitored are identified using a risk-based assessment of their usage patterns and pathways to the marine environment and are selected from the list WFD³⁷ of Priority Substances (substances of national concern that represent a risk to human health or ecosystems), and from the OSPAR priority chemicals which have been identified by OSPAR as common indicators.

Biological effects

The programme monitors for biological effects of contaminants. These currently include:

- i) English and Scottish risk-based programmes of biological effects monitoring of fish to supplement chemical monitoring and assess whether pollutant effects are occurring. Determinants include: micronucleus, liver histopathology, external disease, 7-ethoxyresorufin O-deethylase (EROD) activity, biliary polycyclic aromatic hydrocarbon and (PAH) metabolites; and
- ii) UK surveys of imposex/intersex in gastropod molluscs and UK surveys of externally visible fish disease.

Occurrence and extent of acute pollution effects arising from spills of oil or chemicals likely to have significant effects

The UK-wide National Contingency Plan for Marine Pollution from Shipping and Offshore Installations are used to assess the occurrence and extent of significant acute pollution effects. This deploys appropriate monitoring programmes using the associated PREMIAM Guidelines³⁸ to assess the long-term, as well as the short- and medium-term

³⁷ Transposed to The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017, Water Environment and Water Services (Scotland) Act 2003

³⁸ <https://www.cefas.co.uk/premiam/guidelines/>

environmental impacts of any spills which are expected to have significant effects.

Regional Cooperation

There has been a concerted effort to coordinate UK contaminant monitoring programmes with those of other countries sharing the North East Atlantic, to ensure that the assessments carried out are comparable, where possible and common threshold values are used and press for the inclusion of contaminants of emerging concern (CECs) to be adopted in OSPAR's Coordinated Environment Monitoring Programme.

Going forward, it will be necessary to work together with other countries to identify CECs that may have significant impacts on sea life, and to continue to investigate the cumulative effects of combinations of contaminants on sea life populations.

Developments in monitoring since 2014

Monitoring programmes for contaminants have remained largely unchanged since 2014, and data collected in nearly all the monitoring programmes listed above have been used for the OSPAR Intermediate Assessment 2017 and the assessments used for the updated UK Marine Strategy Part One. Maintaining this consistent monitoring programme has enabled us to check the indicators' fitness for purpose, build up comparable data and ensure the confidence that can be assigned to the results together with other countries of the North East Atlantic. It is now possible to carry out regular annual assessments for each substance and the reduction trend over a number of years, indicating which chemicals are showing early evidence of declining over time due to restrictions, banning or source control measures.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Further integration of contaminant monitoring with the development of biological effects methods and measurements being required to better understand the impact of chemicals at individual, and population levels;
- Integration of chemical monitoring in cetaceans into existing assessments to better understand the bioaccumulation of legacy persistent organic pollutants;
- The need to identify and prioritise CECs which may pose risks to marine life;
- The necessity to identify the presence and assess the potential impacts of CECs using a source-to-sea approach;
- An improved understanding needed of the risks that chemical mixtures have, and how impacts from chemicals in combination with other pressures such as physical and nutrient impacts act;
- Projected changes in the hydrological cycle, storm climate, and sea level rise altering the spatial and temporal distribution of rainfall or remobilisation of sediments that could affect the inputs of contaminants into the marine environment;
- Secondary pollution from re-suspended material and from sources outside the UK

Marine Strategy Area now being the major sources of airborne pollution.

There are opportunities for addressing these issues, in addition to maximising the use of available data, these include:

- To address the threat of contaminants being ingested by marine organisms and entering the marine food, we are supporting OSPAR in developing a candidate indicator on PCBs and other persistent chemicals in tissues of marine mammals for the Quality Status Report (QSR) 2023;
- UK agencies are involved in national and international programmes to identify new CECs and their associated risks including the OSPAR Hazardous Substance and Eutrophication Committee, which is updating the OSPAR lists of Chemicals for Priority Action, and Possible Concern, based on updated risk assessments of chemicals likely to reach the marine environment;
- Working towards a source-to-sea approach, we are aiming to align better with coastal and estuarine monitoring (carried out under RBMPs) and will be including WFD³⁹ Priority Hazardous Substances in biota in the 2024 UK Marine Strategy assessment and monitoring programme;
- The UKMMAS community are involved in a National Environmental Research Council (NERC) funded programme of work 'Emerging risks of chemicals in the environment', which aims to address this issue of mixtures and multiple pressures;
- Our ecotoxicology programme will help identify where contaminants are having synergistic effects;
- The Scottish mussel programme should serve to identify areas of concern for contaminant impacts on biota as it integrates contaminant monitoring with a range of general biological effects techniques;
- OSPAR are also integrating contaminants with exposure and effects on biota data to give an overall status assessment, this will be presented as a case study for the QSR 2023;
- We will monitor any trends in contaminant inputs as a result of hydrographical or climatological changes through the OSPAR Riverine Inputs and Direct Discharges and Atmospheric Monitoring Programme;
- Inclusion of sea level information in the monitoring relevant to GES from long-running stations of the UK monitoring network will help us improve our understanding of the consequences of these changes;
- We will monitor secondary pollution from airborne inputs through the OSPAR Atmospheric Monitoring Programme.

³⁹ Transposed to The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017, Water Environment and Water Services (Scotland) Act 2003

Descriptor 9: Contaminants in Seafood

Overall summary

Current monitoring enables us to determine that there is a high level of compliance with agreed safety levels. We propose that further ad hoc surveys be used to check this status.

Environmental status in 2018



The UK achieved its aim of GES for contaminants in seafood. There was a high level of compliance with agreed safety levels.

High level objective for GES

Concentrations of specified contaminants in fish and other seafood caught or harvested for human consumption in UK seas do not exceed agreed safety levels set in Regulation (EC) No 1881/2006⁴⁰ as amended.

⁴⁰ As retained in UK law

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Safe levels of contaminants in seafood

Target: For contaminants where regulatory levels have been set, and a risk assessment has indicated that concentrations in some commonly eaten seafood may be of concern to the public if they exceed current precautionary advice to restrict consumption of certain higher risk species, there should be a high rate of compliance based on relevant surveys and including samples originating from commercial fishing grounds in the Greater North Sea and the Celtic Seas.

Indicator:

- Contaminant concentrations in seafood

Monitoring programme

- Surveys of contaminants in seafood in commercial fishing grounds

Operational targets

The UK will work with other countries at regional level to establish whether risks posed by additional contaminants that are not included in Regulation (EC) No 1881/2006 are sufficient to include them in UK surveys.

Monitoring programme details

Surveys of contaminants in seafood from commercial fishing grounds in UK seas

The Food Standards Agency, Food Standards Scotland and the Environment Agency will consider further ad hoc surveys to determine whether contaminant levels in seafood taken from commercial fishing grounds in the Greater North Sea and Celtic Seas remain below current or proposed maximum levels or alternative safety parameters. These will include contaminants that are presently regulated, together with those that have been identified as emerging risks to human health within UK or international programmes.

Regional Cooperation

The UK will work with other countries at regional level through the relevant liaison forums to ensure that risks from contaminants that might pose significant risks to humans are taken into consideration.

Developments in monitoring since 2014

Further measurements of contaminant concentrations in fish and shellfish from fishing grounds in the Celtic Seas and the Greater North Sea have confirmed the results from the UK Initial Assessment in 2012, showing that there has been a high level of compliance

with the standards set in European food legislation. Also a number of additional substances not currently regulated under regulation 1881/2006 were covered in the original survey and some more recent testing, including brominated flame retardants, brominated and mixed halogenated dioxins and biphenyls, poly- and perfluorinated alkyl substances (PFAS) and polychlorinated naphthalenes, as well as some legacy pesticides and heavy metals.

Issues and opportunities

Key issues identified in relation to monitoring include:

- New chemicals or groups of chemicals with the potential to adversely impact sea life and human health are continually being identified (for example PFAS);
- The growing body of evidence for microplastic and nanoplastics in food, including seafood.

There are opportunities for addressing these issues:

- We will aim to prioritise emerging contaminants of concern identified to cause potential risk to sea life under Descriptor 8: contaminants for future investigation of potential risks to human health and for inclusion in monitoring programmes;
- The UKMMAS community and OSPAR are working to develop approaches to monitor microplastics as a contaminant in seafood.

Descriptor 10: Marine Litter

Overall summary

We propose that the monitoring of marine litter will be carried out by existing programmes.

Data on marine litter on beaches, on the seafloor and in the water column are monitored by the following monitoring programmes, to which citizen science make significant contributions:

- i) OSPAR Beach Litter Monitoring Programme
- ii) OSPAR Seafloor Litter Monitoring Programme
- iii) OSPAR Fulmar Monitoring Programme

Environmental status in 2018



The UK had not yet achieved its aim of GES for litter. Beach litter levels in the Celtic Seas had remained largely stable since the assessment in 2012, whilst beach litter levels in the Greater North Sea had slightly increased.

High level objective for GES

The amount of litter and its degradation products on coastlines and in the marine environment is reducing and levels do not pose a significant risk to the environment and marine life.

How progress towards GES is measured using monitoring, indicators and targets

Criterion: Presence of litter (beaches)

Target: A decrease in the total amount of the most common categories of litter found on surveyed beaches.

Indicator:

- Beach litter common indicator (OSPAR)

Monitoring programme:

- OSPAR Beach Litter Monitoring Programme

Criterion: Presence of litter (seabed)

Target: A decrease in the number of items of litter on the seabed.

Indicator:

- Seafloor Litter/ International Benthic Trawl Surveys (IBTS) common indicator (OSPAR)

Monitoring programme:

- OSPAR Seafloor Litter Monitoring Programme

Criterion: Presence of floating litter

Target: A downward trend in the number of northern fulmars with more than 0.1 g of plastic particles in their stomach.

Indicator:

- Plastic particles in fulmar stomachs (common indicator for North Sea) (OSPAR)

Monitoring programme:

- OSPAR Fulmar Monitoring Programme

Criterion: Presence of microlitter

Target: Develop an appropriate indicator to measure microlitter in the marine environment.

Indicator:

- Microplastics in marine sediment

Monitoring programme:

- Under development - methodology needs to be developed and agreed in OSPAR

Operational targets

We will work nationally and with other countries in OSPAR to:

a) establish the feasibility of setting appropriate reduction targets and/or threshold values for litter on beaches, on the seafloor, sea surface, and microplastics in sediments, taking into account regional or sub-regional specificities;

b) develop an indicator for microlitter in sediment;

c) establish, if practicable, whether the amount of litter and microlitter accumulated by marine animals adversely affects the health of the species concerned; and

d) develop appropriate measures to reduce litter types harmful to the marine environment.

Monitoring programme details

OSPAR Beach Litter Monitoring Programme

This monitoring programme is well developed, comprising of beach surveys carried out on a quarterly basis. OSPAR have produced an agreed set of protocols for this programme. In England, Wales and Scotland the programme is administered by the Marine Conservation Society (MCS), who have collected data for over 10 years. In Northern Ireland the programme is also established and is being run by Keep Northern Ireland Beautiful. Whilst the MCS coordinate hundreds of litter surveys of UK beaches, the UK Marine Strategy monitoring programme is based on the data for a sub-set of OSPAR-designated beaches.

Seafloor Litter Monitoring Programme

Data collected from trawl surveys, typically carried out for fish stock assessments, are used to monitor the amount of litter on the seafloor. The UK benthic litter monitoring programme is based on existing surveys in England, Wales, Scotland and Northern Ireland.

OSPAR Fulmar Programme

Dead fulmars are collected opportunistically and the number of plastic particles in their stomachs is analysed by Wageningen Marine Research in the Netherlands who provide annual reports to the UK. A baseline has already been established for UK fulmars collected from three geographic regions (Northeast England, Shetland and Orkney) and annual assessments will continue to be made over the coming five years.

Candidate programme for microplastics in sediment

The UK is leading work in OSPAR with a view to developing a common indicator and associated monitoring programme for microplastics in marine sediment. Current projections are that this may be operational in 2021/22.

Regional Cooperation

On a regional scale, we work with OSPAR to carry out assessments of marine litter and to implement the OSPAR Regional Action Plan for the Prevention and Management of Marine Litter in the North East Atlantic.

We are working nationally and with other countries in OSPAR to develop an indicator and associated monitoring programme for microplastics in sediment. We will also continue research which aims to improve cross-border capabilities to monitor, prevent and remove marine litter in the North East Atlantic area.

There is substantial work at OSPAR level to harmonise methodology and quality check data for the seafloor litter monitoring programme to further develop the indicator and assessments which can be made.

Developments in monitoring since 2014

Since 2014, data collected in the operational monitoring programmes for the indicators listed above have been used to contribute to the OSPAR Intermediate Assessment 2017 and the assessments used for the updated UK Marine Strategy Part One. This has enabled us to check their fitness for purpose and the confidence that can be assigned to the associated results together with other countries of the North East Atlantic.

Issues and opportunities

Key issues identified in relation to monitoring include:

- The need for an indicator to assess the level of microplastics in the marine environment;
- Limitations of monitoring seafloor litter using trawl surveys: the spatial limitation to softer substrates and a bias towards sampling larger and heavier items.

There are opportunities for addressing these issues, in addition to maximising the use of

available data these includes:

- The UK is co-leading work in OSPAR to develop an indicator to assess the level of microplastics in the marine environment. A case study on microplastics in seafloor sediments is underway as part of the UK's CSEMP surveys. This methodology may be appropriate for extending monitoring into nearshore and riverine sediments to improve the link with terrestrial litter sources;
- Microplastic in biota samples (from a range of pelagic and demersal species) are currently being investigated to assess suitability of biota within a monitoring context for the UK;
- As leaders of the OSPAR Seafloor Litter Expert Group, the UK continues to develop improvements to the assessment methodology to address the limitations of monitoring seafloor litter using trawl surveys. For example, for the next OSPAR assessment the group is working to include additional analysis of litter catchability with different gear types.

Descriptor 11: Underwater Noise

Overall summary

We propose that the monitoring of underwater noise will be carried out by a number of existing monitoring programmes.

Data on impulsive sound and ambient noise are monitoring using the following programmes:

- i) The Marine Noise Registry (MNR)
- ii) Ambient noise monitoring programme.

Environmental status in 2018



The achievement of GES for underwater noise in the UK was uncertain. Research and monitoring programmes established since 2012 provided an improved understanding of the levels of impulsive and continuous noise pollution in UK waters.

High level objective for GES

Loud, low and mid frequency impulsive sounds and continuous low frequency sounds introduced into the marine environment through human activities are managed to the

extent that they do not have adverse effects on marine ecosystems and animals at the population level.

How progress towards GES is measured using monitoring, indicators and targets

Criteria: Safe levels of anthropogenic impulsive sound

Target: Levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.

Indicators:

- Distribution and timing of man-made impulsive sound sources; and
- Impulsive noise impact indicator is under development (OSPAR).

Monitoring programme:

- MNR

Criterion: Safe levels of anthropogenic continuous low frequency sound

Target: Levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals.

Indicator:

- Levels of ambient noise mapped using acoustic modelling techniques and validated using observation stations.

Monitoring programme:

- Ambient noise monitoring programme

Monitoring programme details

Marine Noise Registry (MNR)

Information about impulsive sound sources is submitted to the MNR from mandatory and voluntary contributions. The MNR was designed to gather data in order to monitor cumulative pressure, assess the potential for disturbance impacts, understand the distribution of impulsive sound, and if needed, inform management activities.

Ambient noise monitoring programme

Underwater noise is recorded at monitoring locations around the UK: 12 locations in the North Sea (ten locations in the Northern North Sea by Marine Scotland Science, and two locations in the Southern North Sea by Cefas), two locations in the Celtic Seas (Rame Head and Puffin Island, coordinated by Cefas), and one location in the Irish Sea (Carlingford, coordinated by the Joint framework for Ocean Noise in the Atlantic Sea, JONAS) using autonomous underwater recorders moored to the seabed

Regional Programmes

The COMPASS project helps to build an understanding of how cetaceans use an area of sea and how they may be impacted by or respond to pressure from human activities. Through a network of oceanographic and acoustic moorings across the regional seas of the Republic of Ireland, Northern Ireland and West Scotland, COMPASS provides effective cross-border monitoring of cetaceans.

COMPASS is collaborating with the JONAS project to examine the effects of noise and streamline ocean noise monitoring.

Regional Cooperation

The UK works closely with countries around the North Sea and beyond through OSPAR's expert group on noise. This group is responsible for the monitoring of both impulsive and ambient noise including two projects for joint noise monitoring, one covering the Greater North Sea (the Joint Monitoring Programme for Ambient Noise North Seas, JOMOPANS), the other covering the Atlantic Area (JONAS).

The UK has been a key player in development, monitoring and assessment of the OSPAR impulsive noise common indicator, and the UK data were used in the OSPAR Intermediate Assessment 2017. In addition, MNR monitoring data will be used as part of a regional OSPAR indicator of the risk of disturbance from impulsive noise to marine species and populations, which is currently being developed.

Developments in monitoring since 2014

The MNR collects and stores data on the distribution and duration of impulsive sound in UK waters. It contains data recorded since 2015 and is operational on an ongoing basis. MNR output maps published each year show the extent of impulsive noise in UK waters across space and time. Monitoring and outputs are used to help establish a baseline level of impulsive noise in UK seas, allowing for assessment of patterns and trends.

Defra is funding ambient noise monitoring at four locations in England and Wales, covering both the North Sea and Celtic Seas. UK Marine Strategy monitoring is also ongoing in Northern Ireland and in Scotland. The monitoring programme on ambient noise has provided baseline levels for each of the monitoring locations and is being used to validate spatial models of continuous anthropogenic sound in UK waters. For example, ambient noise measurements are being used to ground-truth spatial maps of shipping noise, which will be used for UK Marine Strategy assessments.

Ambient noise and cetacean monitoring has been a component of the Northern Ireland Coastal & Oceanographic Mooring Network since 2019. It is intended that monitoring will continue at stations in the Irish Sea and the Skerries and Copelands as part of the development of a UK-wide long-term data set.

The COMPASS project was initiated in 2017, establishing a network of oceanographic and

acoustic moorings within and adjacent to cross-border marine protected areas, including extensive deployment of passive acoustic monitoring arrays in the Irish Sea.

The JONAS project was established and has been investigating cumulative noise impacts, developing noise maps and large-scale noise risk mapping, and tools and methodologies for noise monitoring.

Cefas have published the first UK noise assessment, the work that is being carried out across the UK will contribute to these future assessments.

Issues and opportunities

Key issues identified in relation to monitoring include:

- Further research is needed to determine the effects of underwater noise on other species such as invertebrates, fish, and sharks;
- The MNR is an efficient and comprehensive way to collect and collate data on activities generating impulsive noise that uses established consenting regimes to capture data on where and when impulsive noise is generated, but there are still some data gaps that the UK and devolved administrations are seeking to fill.

There are opportunities for addressing these issues, in addition to maximising the use of available data these include:

- JNCC is working with regulators towards the continued improvement of data being submitted to the MNR;
- The outputs of projects such as those arising from Crown Estate's Offshore Wind Evidence and Change Programme (OWEC), Defra's Offshore Wind Enabling Actions Programme (OWEAP), and NERC's Sustainable Management of UK Marine Resources (SMMR) programme will be considered for their contributions towards improving noise monitoring.

Section 3: Monitoring programmes for prevailing conditions used to support the assessment of Good Environmental Status (GES)

This section sets out details of the monitoring and observation programmes that provide the data sources for the ocean processes assessment of prevailing conditions (pH, temperature, salinity, turbidity, waves, and sea level) that may be required to provide contextual support for assessments used:

- a. under the regulatory assessment processes associated with Descriptor 7 “hydrographical conditions” (e.g. EIA and Strategic Environmental Assessment (SEA)); and
- b. to determine whether the quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.

No monitoring programme has been put forward specifically for Descriptor 7 under the UK Marine Strategy, but part of the instruments listed in the Programmes of Measures (UK Marine Strategy Part Three) is relevant to Descriptor 7. This is because data for our assessments are gathered by industry as a requirement of their operational licensing conditions and we will continue to assess significant infrastructure developments and their potential impacts (including cumulative) on hydrographical conditions. These provisions allowed the UK Marine Strategy Part One to find no significant broad scale alterations of hydrographical conditions affecting ecosystems in UK marine waters beyond those currently covered by provisions of the River Basin Management Programme (RBMP), which has its own dedicated arrangements.

As prevailing conditions change in through climate change, we expect there to be an effect on some of the marine indicators of ecosystem dynamics and pressures on our seas. For the next assessment of UK seas in 2024, we aim to better integrate the prevailing conditions information collected in the monitoring programmes set out below into our indicator assessments.

Prevailing conditions/climate change assessments are drawn from outside any specific monitoring programme, relying on many of these non-statutory observing/monitoring programmes.

For each prevailing condition parameter we set out:

Environmental status

This covers what is known about the status of the parameter as reported in the UK Marine Strategy Part One 2019.

Rationale for monitoring

This sets out the main reasons for monitoring and how it helps our assessments of GES.

Monitoring programmes

This sets out the main contributing monitoring and observation programmes that are underway. Many of the parameter assessments will draw upon data sources that are not part of specific UKMMAS monitoring provision, including those recognised as collaborations in the ‘regional cooperation’ section.

Regional cooperation

This describes the main examples of various national, European and international programmes and organisations in which the scientists work together to coordinate and improve understanding, recognising that climate and oceanographic processes act beyond national boundaries.

Issues and Opportunities

This sets out where further work might be needed to get more robust measurements and status assessments.

pH & ocean acidification

Environmental Status in 2018

Between 2010 and 2015, the evidence of ocean acidification for UK waters is consistent with the global trend, which shows the pH of seawater is decreasing. There is strong seasonal, inter-annual, depth and spatial variability in pH across UK waters.

Rationale for pH & ocean acidification monitoring

Coordinated long-term ocean acidification (OA) monitoring is essential to assess variability and trends in the ocean carbon system and support assessment of the risks to and impacts of pH changes on marine ecosystems and services, so that appropriate measures can be taken.

Monitoring, research & observation programmes that contribute to assessment of ocean acidification in UK seas

- Scottish Coastal Observatory sites at Stonehaven and at Loch Ewe
- Smart Buoy programme (OA not ongoing)
- NE Atlantic Hub for the Global Ocean Acidification Observing Network
- UK Integrated Marine Observing Network programme (UK-IMON)
- The Western Channel Observatory is an example of an individual member programme of the UK IMON and links directly to GOA-ON. It is also a key component of the Integrated Carbon Observing System (ICOS: <https://www.icos-cp.eu/>)
- Continuous Plankton Recorder (impacts & future technical development)
- Northern Ireland Coastal & Oceanographic Mooring Network

Regional Cooperation

- Cooperation between countries at European and global level on pH monitoring takes place in the following networks and organisations:

- The Global Ocean Acidification Network (GOAN); and
- The OSPAR Intersessional Correspondence Group on Ocean Acidification (ICG-OA) where countries pool monitoring information at North East Atlantic scale.
- Integrated Carbon Observing System (ICOS) draws together sustained carbon observations across atmosphere, ocean and ecosystem.

Issues and opportunities

Key issues identified in relation to monitoring include:

- There are limited datasets available to contribute to the assessment of local conditions and long-term changes. It should be noted that to differentiate natural seasonal and inter-annual variation from anthropogenic driven impacts, data over a multi-decadal timescale would be required;
- Most ocean acidification measurements are near surface leading to a knowledge gap in understanding change in seasonally stratified areas and at the sea-bed in general.

There are opportunities for addressing these issues:

- New sensors and platforms (like gliders, profiling floats and in-situ sensors) are under consideration for increasing the cost-effectiveness and spatial coverage of UK ocean acidification measurements. Emerging technologies, such as lab-on-chip sensors offer potential solutions for sustained observing of pH and OA. These technologies would need to be validated and calibrated through the collection and analysis of discrete water samples.

Temperature

Environmental Status in 2018

The trend of sea surface temperature in UK waters reflects the warming reported in the Initial Assessment in 2012. A series of cold winters (2011 – 2013) resulted in a slight decrease to this trend, but since 2014 seas have been warmer again.

Rationale for sea temperature monitoring

Sea temperature is a major driver of marine ecosystems and one of the key factors affecting the distribution, physiology and ecology of marine species and habitats. Knowledge of how it is changing is important for how these are managed and protected. Temperature measurements also benefit a wide spectrum of operational applications, including climate and seasonal monitoring and forecasting.

Monitoring, research & observation programmes that contribute to assessment of temperature in UK seas.

- Scottish Coastal Observatory
- Marine Scotland Offshore Long -Term Monitoring
- Smartbuoy
- International Council for the Exploration of the Seas (ICES) coordinated International Bottom Trawl Survey
- UK - Integrated Marine Observing Network (UK-IMON) and includes contributions from UK Met Office Moored Buoys
- Northern Ireland Coastal & Oceanographic Mooring Network
- Sustained observations are also maintained under UKRI research programmes such as NERC-CLASS (Climate Linked Atlantic Sector Science). These include the Extended Ellett Line (SAMS) and Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

Regional cooperation

- Cooperation between countries at European and global level has led to the production of the following reports, programmes and surveys covering sea temperature:
- ICES Report on Ocean Climate,
- Copernicus Marine Environment Monitoring Service Ocean Status Report and North West European Shelf Reanalysis,
- European Global Ocean Observing System,
- Hydrographic surveys (International Oceanographic Commission "Go-SHIP" initiative),
- EU Interreg & H2020 programmes,
- Argo drifting float programme

Issues and opportunities

Key issues identified in relation to monitoring include:

- Our understanding of the inter-annual, decadal and long-term variability of sea temperature is based on long-time-series data which are missing for some places or broken in others.

There are opportunities for addressing these issues:

- Combining models with historical observations provide 're-analyses' of the conditions in recent decades and may be used to as part of future assessments. This work draws together the Integrated Marine Observation Network with the National Partnership for Ocean Prediction partnership.

Salinity

Environmental Status in 2018

The salinity of the upper ocean to the West and North of the UK has decreased sharply from 2011. This probably reflects a change in balance between the subtropical (salty) seawater versus subpolar (fresh) seawater in the North East Atlantic. Lower salinity was also observed in the northern North Sea between 2013 and 2015.

Rationale for salinity monitoring

Salinity is a key factor determining the density of ocean water. Understanding how it is changing is essential for understanding its impact on ocean circulation, the Earth's water cycle, marine ecosystems and climate change.

Monitoring, research & observation programmes that contribute to assessment of salinity in UK seas.

- Scottish Coastal Observatory
- Marine Scotland Offshore Long-Term Monitoring
- Smartbuoy
- International Council for the Exploration of the Seas International Bottom Trawl Survey
- UK Integrated Marine Observing Network (UK-IMON)
- Northern Ireland Coastal & Oceanographic Mooring Network
- Sustained observations are also maintained under UKRI research programmes such as NERC-CLASS (Climate Linked Atlantic Sector Science). These include the Extended Ellett Line (SAMS) and Porcupine Abyssal Plain Sustained Observatory (PAP-SO).

Regional cooperation

Cooperation between countries at European and global level has led to the production of the following reports, programmes and surveys covering salinity:

- International Council for the Exploration of the Seas (ICES) Report on Ocean Climate,
- Copernicus Marine Environment Monitoring Service Ocean Status Report and North West European Shelf Reanalysis
- European Global Ocean Observing System,
- Hydrographic surveys (International Oceanographic Commission "Go-SHIP" initiative)
- EU Interreg & Horizon 2020 programmes,
- Argo drifting float programme

Issues and opportunities

Key issues identified in relation to monitoring include:

- Salinity data are generally sparse in comparison to temperature data and so confidence in the assessments of long-term trends and spatial variability is lower;
- Some long-term series of observations are no longer available, but we are making use of additional new sources of information, e.g. through using autonomous platforms.

There are opportunities for addressing these issues, in addition to maximising the use of available data:

- Research and development programmes, such as UK-SSB, Alter Eco, have and are contributing to making new technologies operational.

Turbidity

Environmental Status in 2018

Satellite observations over 1998-2015 show significant increases in annual average surface suspended particulate matter in 5 out of 10 UK marine regions.

Rationale for turbidity monitoring

The light climate or suspended particulate matter of the marine environment can influence primary production; air-sea heat transfer; sedimentation rates and biogeochemical transfers from the water column to the seabed; productivity of the benthos; and oxygen levels in bottom waters. It is therefore essential to have information on how it is changing.

Monitoring, research & observation programmes that contribute to assessment of turbidity in UK seas.

Monitoring includes both Earth Observation (remote sensing) and *in situ* observations through:

- Scottish Coastal Observatory
- Smartbuoy & Cefas Monitoring Cruise programmes
- UK Integrated Marine Observing Network
- Northern Ireland Coastal & Oceanographic Mooring Network

Regional Cooperation

Cooperation between countries at European level to provide turbidity information takes place through the Copernicus Marine Environment Monitoring Service European Earth Observation Programme and through ICES in the compiling of historic data sets.

Issues and opportunities

Key issues identified in relation to monitoring include:

- The assessment was able to identify trends in suspended particulate matter concentration on a regional sea scale but unable to attribute cause.
- In situ observations are not integrated with remote sensing estimates as matching the observations to the location and timing of satellite overpasses makes direct comparison difficult;
- Knowledge of sub-surface suspended particulate matter and turbidity beyond the reach of satellite sensors relies on in-situ observation

Waves

Environmental Status in 2018

Not assessed in the updated UK Marine Strategy Part One (2019).

Rationale for wave monitoring

Knowledge of the wave regime and how it is changing is important in developing shoreline defence schemes, large infrastructure projects and for flood and coastal management.

Monitoring, research & observation programmes that contribute to assessment of turbidity in UK seas.

- The UK WaveNet Programme, coordinated by the Centre for Environment, Fisheries & Aquaculture Science (Cefas) provides a strategic wave network using a network of wave buoys located in areas at risk from flooding.
- The SIMORC (System of Industry Metocean data for the Offshore and Research Communities) makes available historic wave data from Shell, Total and BP (International Association of Oil and Gas Producers).
- Marine Data Exchange for Renewables - The Crown Estate stores, manages and disseminates offshore survey data provided by offshore renewable and marine aggregates customers.
- Operational Oceanography Special Interest Group & the UK Integrated Marine Observation Network (UK-IMON) bring together many of the organizations making

wave observations and forecasts. These include the UK Met Office network and Western Channel Observatory moorings.

- Copernicus Significant Wave Height from Jason-3 and Sentinel-3A satellite altimeter data.
- Regional Coastal Monitoring programmes.
- The Channel Coastal Observatory⁴¹ have a well-established network of wave-buoys.

Regional cooperation

Cooperation between countries and scientists at European and global level on addressing waves takes place through the following programmes and organisations:

- Copernicus programme
- European Global Ocean Observation System
- European Marine Observation and Data Network

Issues and opportunities

Key issues identified in relation to monitoring include:

- Analysis of waves at the larger spatial and longer temporal scales is needed for UK Marine Strategy purposes.

There are opportunities for addressing these issues, in addition to maximising the use of available data:

- Wave drifters are a potential new source of data for assessments that may build into an international network for in situ wave measurements in the open ocean including adjacent areas of the North East Atlantic.

Sea Level

Environmental Status in 2018

Not assessed in UK Marine Strategy Part One (2019).

⁴¹ <https://www.channelcoast.org/>

Rationale for sea level monitoring

Operational monitoring of sea level and tides helps underpin coastal flood forecasting and risk modelling. Changing mean sea levels have implications for coastal erosion and coastal regions. Over the coming decades sea level-rise is projected to be the main cause of shorter return periods for extreme water levels around the UK and threatens existing coastal ecosystems. Decisions on adaptation measures (e.g. coastal defence or re-alignment) affect coastal communities and ecosystems.

Monitoring, research & observation programmes that contribute to assessment of sea level in UK seas.

- National Tidal and Sea Level Facility (NTSLF) is the UK Centre of Excellence for sea-level monitoring & research, coastal flood forecasting and sea-level extremes
- The UK National Tide Gauge Network is operated by the Environment Agency on behalf of the UK Coastal Flood Forecasting service (UKCFF) formed by the EA, SEPA, RANI and NRW.

Regional cooperation

Permanent Service for Mean Sea Level (PSMSL) based at the National Oceanography Centre, Liverpool is responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges.

The Global Sea Level Observing System (GLOSS) Delayed Mode Data Centre is operated by BODC in collaboration with PSMSL.

Issues and opportunities

Mean sea levels are well observed and modelled with a strong scientific research base in the UK. Sea-level rise is regularly assessed, for example at a global scale as part of the Intergovernmental Panel for Climate Change Assessment Reports, and at national scale in the MCCIP Report Cards.