Department for Environment Food & Rural Affairs

Marine Strategy Part One:

UK updated assessment and Good Environmental Status

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Introduction

Publication of the UK Marine Strategy Parts 1-3 (the Strategy) between December 2012 and December 2015 marked a significant step forward in the protection and management of the waters around our coasts. For the first time, the Strategy set 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 seas.

This report marks the beginning of the second implementation cycle of the Strategy. It shows the progress made towards our shared vision and what further action is necessary. It takes account of the views we received in response to the consultation undertaken between 9 May and 20 June.

Going forward, we will continue to be a strong and influential partner on the international stage and through OSPAR, our regional seas convention, will work to protect and conserve the marine environment of the North-East Atlantic. This approach is enshrined in legislation that will continue when we leave the EU and demonstrates the combined commitments of the four UK Administrations to work together to protect what are some of the most biologically diverse and productive seas in Europe.

Executive summary

Overall conclusions on the achievement of Good Environmental Status

We have made good progress towards achieving Good Environmental Status (GES). The findings of the 60 indicator assessments covering marine species and habitats and the key pressures affecting them have enabled us to assess the extent to which GES has been achieved, helped to identify gaps in our knowledge and identify next steps. These indicator assessments show that:

We have largely achieved GES for eutrophication, hydrographical conditions, contaminants and contaminants in seafood

We need to continue to remain vigilant regarding possible impacts arising from emerging chemicals and new major infrastructure projects that may pose a risk to marine life.

We will continue work with other countries to check that emerging chemicals of concern are screened and possible risks evaluated. We will ensure that new developments likely to affect hydrographical conditions continue to be subjected to robust environmental assessment procedures and that we improve our understanding of cumulative impacts and how to take them into account in decision making processes.

There is a mixed picture for marine mammals, fish populations and food webs

GES has been achieved for grey seals and some populations of marine mammals such as coastal bottlenose dolphins, and minke whale in the Greater North Sea. Populations of demersal fish in the Greater North Sea are recovering from over exploitation and we have seen a significant increase in the number of commercial fish stocks that are being fished at sustainable levels. This mixed picture shows that existing measures are working but that we have not yet fully achieved GES for these ecosystem components. The extent to which GES has been achieved for food webs is uncertain.

For marine mammals we need to improve our ability to assess their status to be able to determine whether they are achieving GES. To achieve this we will continue to work with other countries to develop international capability in this area. For fish populations, existing measures are largely considered to be working but need time to have population-level effects. We will continue to implement measures to support fishing at sustainable levels and to reduce the impact of fishing on the status of commercial and other fish populations. Marine food webs are complex and we still do not fully understand the relationships and links between the various ecosystem components. Currently, we use aspects of fish populations to assess the status of food webs but more work is needed to develop our understanding of this descriptor.

There is a mixed picture for marine habitats

Changes in the make-up of plankton communities (pelagic habitats) are considered most likely to be the effect of changes in prevailing oceanographic and climatic conditions although it has not been possible to rule out human impacts. We therefore consider it likely that GES for this habitat is being achieved but cannot be certain of this. For benthic (seafloor) habitats, the position is clearer. While some benthic habitat types are achieving GES, the majority are not and overall GES for benthic habitats is not being achieved.

For pelagic habitats we will continue to monitor changes in their status and look to improve our understanding of human impacts on this key marine habitat. For benthic habitats we will continue to implement measures to reduce the human impacts on

these habitats, in particular, management measures in Marine Protected Areas (MPAs), and to monitor the impacts of these and other measures on the achievement of GES.

We recognise the crucial role of nature-based solutions for climate mitigation and adaptation, and are investigating the potential for protecting and, where necessary, restoring coastal habitats including seagrass and saltmarsh using various tools such as the designation of MPAs.

More needed to understand and protect bird populations

While some populations of birds are achieving GES, such as wintering waterbirds in the Greater North Sea and breeding populations of seabird species such as gannet, cormorant and auks, most UK marine bird populations are not achieving GES. The reasons for this are poorly understood. It is likely to be a combination of the effects of climate change and human activity.

We will continue to work nationally and through OSPAR to improve our understanding of the reasons why seabird and waterbird populations around the UK coast remain at risk and use appropriate measures to improve their status.

Measures to tackle non-indigenous species (NIS) and marine litter need longer to take effect

For both these descriptors, a key recommendation of the 2012 Strategy was to put in place the necessary monitoring programmes and indicators so that we could assess GES. We have made good progress in addressing these key issues. Additional measures have also been put in place to help prevent the introduction of NIS and to tackle marine litter. The impacts of these measures will take time to take effect. Despite the progress that has been made we do not consider that GES has been achieved for either of these descriptors.

Additional measures to tackle waste are already planned, which should further reduce levels of marine litter. All UK Administrations are developing and implementing waste strategies or plans which play a significant role in reducing, reusing and recycling litter and associated materials.

We will continue to identify other measures necessary to tackle these pressures on the marine environment both nationally, with our regional seas partners and internationally.

We remain uncertain about whether GES has been achieved for underwater noise

In 2012, we identified the need to establish effective indicators to assess the extent and impacts of underwater noise. We have met this target and have now established a noise registry that records impulsive noise (loud short duration anthropogenic sounds e.g. percussive pile diving, sonar, and explosions) in the marine environment and an ambient noise (continuous noise, such as from shipping or fisheries) monitoring programme. These will allow us to better understand the extent, scale and impacts of underwater noise.

We will use the information gathered from our monitoring programmes and the noise registry to establish appropriate targets so that we are able to define more clearly our GES objectives for underwater noise.

We have a better understanding of the main pressures preventing the achievement of GES

The assessments have clearly flagged up that the predominant human pressures preventing GES being achieved include commercial fishing and the introduction of marine litter. Other factors that are affecting the achievement of GES include natural phenomena such as species competition and predation and the impact of changes to the marine environment due to climate change. The risk from NIS also remains high. A common theme that applies to these pressures is that they can only be effectively addressed by working at an international level.

As well as taking action at home, we will press for action to be taken internationally to tackle these pressures.

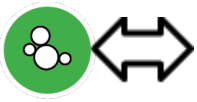
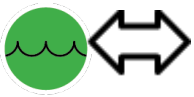
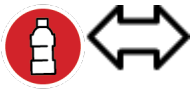
Summary of progress towards achieving GES

The main findings of the assessment of GES flagged up in the conclusions above are set out set out in detail in section 3. The results are summarised in Table 1 below.

Table 1. Updated Assessment 2018 – Current Environmental Status

D1 & D4 CETACEANS		The extent to which GES has been achieved for cetaceans remains uncertain. The status of coastal bottlenose dolphin and minke whale is consistent with the achievement of GES in the Greater North Sea, but unknown/uncertain elsewhere. It is unknown if GES has been achieved for other species.

D1 & D4 SEALS		The UK has achieved its aim of GES for grey seals in the Greater North Sea and Celtic Seas. There was 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 is uncertain. Harbour seals in the Greater North Sea have not yet achieved GES.
D1 & D4 BIRDS		The UK has achieved its aim of GES for non-breeding waterbirds in the Greater North Sea but not in the Celtic Seas. Breeding seabirds have not achieved GES.
D1 & D4 FISH		Demersal fish communities are recovering from over-exploitation in the past, but GES has 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.
D1, D4 PELAGIC HABITATS		Prevailing environmental conditions are likely to be driving the observed changes in plankton communities but human activities cannot be ruled out and it is uncertain whether GES has been achieved.
D1 & D6 BENTHIC HABITATS		The achievement of GES is uncertain for intertidal and soft sediment habitats. The levels of physical damage to soft sediment habitats are 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. For sublittoral rock and biogenic habitats GES has not yet been achieved.
D2-NON-INDIGENOUS SPECIES (NIS)		The UK has not yet achieved its aim of GES for NIS. Our ability to detect new NIS has improved but there has been no significant change in the number of new records of NIS made between 2003 and 2014.
D3 COMMERCIAL FISH		The UK has 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 have either not yet achieved GES or their status is uncertain. The percentage of quota stocks fished below MSY and the proportion of marine fish spawning stock biomasses capable of producing MSY have increased significantly since 1990.

D4 FOOD WEBS		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.
D5 EUTROPHICATION		The UK has largely achieved its aim of GES for eutrophication. A small number of eutrophication problems remain in coastal and estuarine waters, representing 0.03% of the total UK Exclusive Economic Zone, and 0.41% of estuarine and coastal waters.
D7 HYDROGRAPHICAL CONDITIONS		The UK continues to achieve its aim of GES for hydrographical conditions.
D8 CONTAMINANTS		The UK has largely achieved its aim of GES for contaminants. Concentration of hazardous substances and their biological effects are generally meeting agreed target thresholds. Highly persistent legacy chemicals are the cause of the few failures, mainly in coastal waters close to polluted sources.
D9 CONTAMINANTS IN SEAFOOD		The UK has achieved its aim of GES for contaminants in seafood. There is a high level of compliance with agreed safety levels.
D10 MARINE LITTER		The UK has not yet achieved its aim of GES for litter. Beach litter levels in the Celtic Seas have remained largely stable since the assessment in 2012, whilst beach litter levels in the Greater North Sea have slightly increased.
D11 UNDERWATER NOISE		The achievement of GES for underwater noise in the UK is uncertain. Research and monitoring programmes established since 2012 have provided an improved understanding of the impacts of sound on marine ecosystems.

Key :		
GES Achieved	GES Partially achieved	GES not achieved
Improving situation*	Stable or mixed situation*	Declining situation*

*These arrows provide our best judgement of whether there has been progress towards achieving Good Environmental Status (GES) for the descriptor or ecosystem component concerned. 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 assessments.

Progress in working with other countries

Working with other countries is essential for the achievement of GES. Over the last 6 years the UK has played a leading role in OSPAR in developing common approaches to monitoring, assessment and measures. This has improved, in a cost effective way, our ability to assess the state of our seas and to identify the actions needed to achieve GES.

We will continue to work in OSPAR and other relevant international fora to ensure that the key pressures affecting our seas are addressed in the most effective and efficient way possible.

Data transparency

We have made the results and methods for the 60 individual indicators used to assess GES digitally available through a Marine Online Assessment Tool (MOAT)[1]. This makes the science underpinning the assessments readily available and easily accessible to all.

[1] https://moat.cefas.co.uk/

What the Updated UK Marine Strategy Part One covers

Section 1 sets out the context.

Section 2 covers the geographic scope and characterization of UK seas with an economic and social analysis of the uses of the marine environment and the social value and benefits which it provides. It sets out an overview of the pressures and activities affecting UK seas and an assessment of ocean processes such as sea surface temperature and acidification and their relationship to climate change.

Section 3 includes updated objectives and targets which we will use to define and determine progress towards GES over the next 6 years. These build on those set in 2012 and take account of scientific developments. The aim is to ensure that we coordinate our approach with other countries sharing our seas. This is consistent with our wider approach which is to deal with marine environment issues on a transboundary basis working through OSPAR. It will allow us to develop common assessment values and new indicators which will lead to a more effective and efficient approach to the evaluation of the extent that GES has been achieved in 2024.

Section 1: Context

1.1 The UK Marine Strategy

The Marine Strategy Regulations (2010) require us to take action to achieve or maintain GES in our seas by 2020. 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.

It applies an ecosystem based approach to the management of human activities. In doing so, the Strategy 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 One[2]: an assessment of marine waters, objectives for GES and targets and indicators to measure progress towards GES (published December 2012);

b. UK Marine Strategy Part Two[3]: sets out the monitoring programmes to monitor progress against the targets and indicators (published August 2014); and

c. UK Marine Strategy Part Three[4]: sets out a programme of measures for achieving GES (published December 2015).

This updated Marine Strategy Part One provides: An updated assessment of the state of UK seas and the progress made since 2012 towards achieving GES; revised objectives for GES and targets for the next cycle (2018 – 2024); and next steps.

1.2 Good Environmental Status (GES)

GES is defined as the environmental status of marine waters where these provide 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 against GES it is broken down into 11 qualitative descriptors. These are listed below:

- 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)

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

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

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

- D5 - Eutrophication
- D6 - Sea-floor integrity (pelagic habitats and benthic habitats)
- D7 - Hydrographical conditions
- D8 - Contaminants
- D9 - Contaminants in fish and other seafood for human consumption
- D10 - Litter
- D11 - Introduction of energy, including underwater noise

1.3 How we assessed progress towards the achievement of GES

In the Marine Strategy Part One in 2012, we set out high level GES objectives (also known as “characteristics”) to show what GES looks like for each of the 11 Descriptors. For each descriptor we set out a series of specific targets to enable us to assess the extent that the GES objectives had been achieved. In the Marine Strategy Part Two, we set out the specific monitoring programmes and associated indicators for each descriptor and ecosystem component which we would use to assess achievement of GES.

The monitoring and assessment work for the various indicators needed to assess progress towards achieving the GES targets were carried out by experts and scientists working in the UK Marine Monitoring and Assessment Strategy (UKMMAS) Evidence Groups which were coordinated and guided by the UK Monitoring and Assessment Reporting Group (MARG). The monitoring programmes are largely funded by Defra and the Devolved Administrations.

Wherever possible, we developed the indicators and carried out our monitoring programmes together with OSPAR countries through the Joint Assessment and Monitoring Programme (JAMP), using agreed methods and assessment criteria. In 2017, OSPAR published its Intermediate Assessment[5] (IA 2017), which demonstrated progress towards realising the OSPAR vision of a clean, healthy and biologically diverse North-East Atlantic, used sustainably.

[5] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/

A consequence of using the OSPAR common indicator assessments is that some of the resulting conclusions are based on data and information from 2015[6]. Where this is the case, it is flagged in the detailed assessments on the MOAT.

Through aggregating the results of the various indicator assessments, we were able to assess firstly whether the associated targets set for the descriptor or ecosystem component have been met, and secondly the extent that the GES objectives have been achieved. The following diagram (Figure 1) shows how indicators and targets were aggregated to assess progress towards GES for cetaceans in the North-East Atlantic.

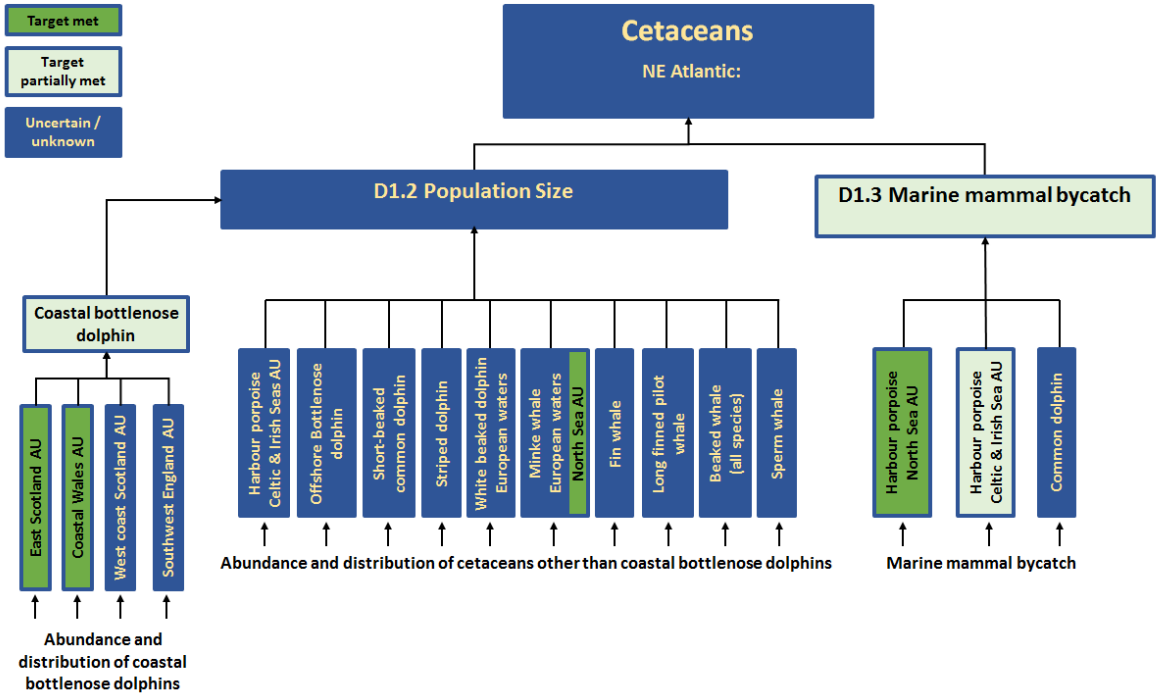


Figure 1: Schematic diagram showing integration of indicators and targets to assess GES for cetaceans.

1.4 Implementing the UK Marine Strategy

Our approach from now to 2024 will be based on our continuing policy commitment to collaborate at UK, OSPAR and at international level.

[6] There is generally a time lag of approximately 2 years between the collection of regular monitoring results and its analysis and review by experts in the UKMMAS evidence groups and OSPAR working groups and the evaluation of trends and whether the targets set in 2012 have been achieved.

It will also be influenced by the extent that we have achieved GES in the first cycle, with effort and resources being focussed more on those descriptors and ecosystem components which are not achieving GES or where status is uncertain.

The revised objectives and targets take account of the new criteria and thresholds published by the EU in 2017[7]. We have also set operational targets which cover particular actions that will help us achieve GES. We have, where appropriate, taken a similar approach to other countries sharing our seas.

In developing this new approach we also took account of the recommendations in the European Commission's evaluation of UK Marine Strategy Part One in 2014[8].

As part of this review, we have tried to simplify the language so the objectives and targets are understandable to all. The updated objectives, targets and operational targets are described in Section 3 for each descriptor and ecosystem component.

Effective assessment and management of the marine environment needs to be carried out at the appropriate geographical scale, which frequently covers the whole of UK marine waters and beyond. A key aim for the UK Marine Strategy 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 the OSPAR Convention.

[7] Set out in Commission Decision 2017/848 which will become part of retained EU law post EU exit.

[8] http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm

Figure 2: Map of the OSPAR Convention Area and the 5 OSPAR regions.

Working at the international level is critical to achieving and sustaining a number of the GES targets, especially global action to tackle impacts related to climate change and pollution, such as marine litter. The UK government's International Ocean Strategy will complement the delivery of GES, aiming for an ocean that will be effectively governed, clean, healthy, safe, productive and biologically diverse.

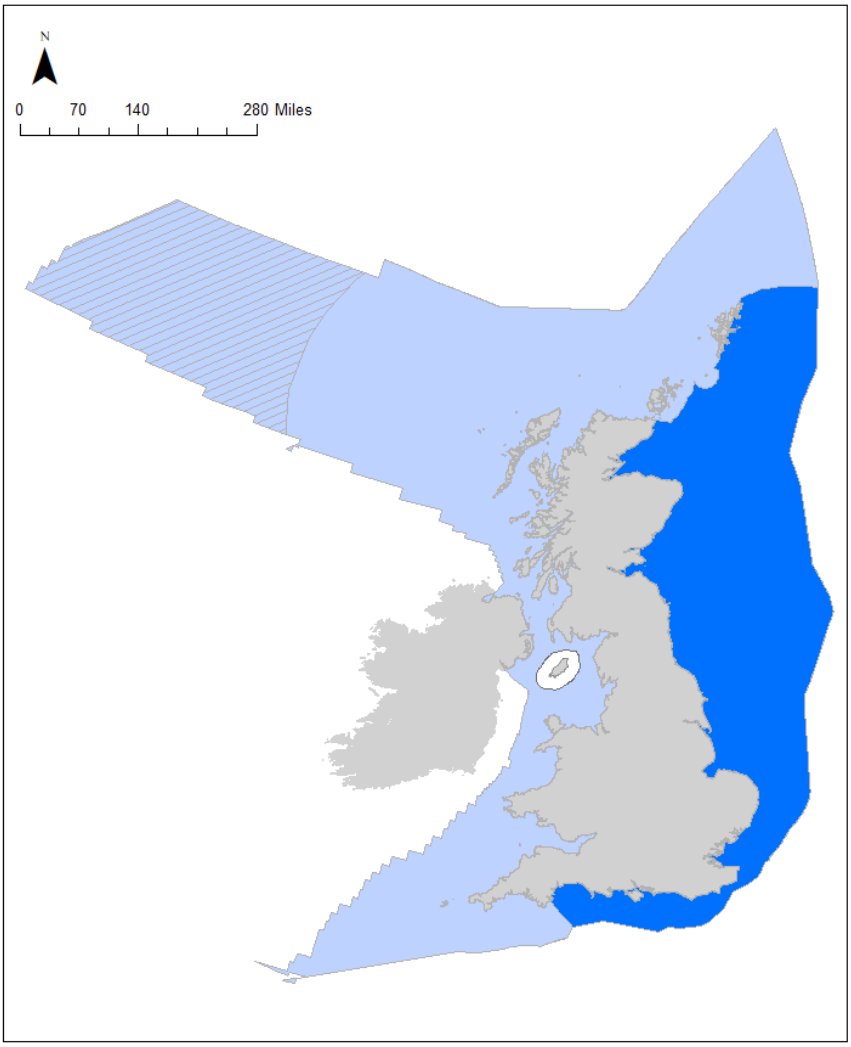
When the UK leaves the EU**,** we will continue to use the UK Marine Strategy to strengthen and enhance the protection of the marine environment.

Section 2: our shared seas

2.1 Geographic and administrative scope

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 shelf[9]. The area of UK waters over which the UK Marine Strategy applies is shown below in Figure 3, 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.



Legend

- MSFD Sub-region: Celtic Seas (seabed and subsoil only)
- MSFD Sub-region: Celtic Seas
- MSFD Sub-region: Greater North Sea
- UK & Ireland

[9] This area is defined by the Continental Shelf Act 1964. In this area the requirements of the Directive (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 3: Area of UK marine waters over which the MSFD applies.

The MSFD also applies to Gibraltar where there is a separate implementation process for British Gibraltar Territorial Waters.

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. None of the countries sharing these regions can resolve all of the environmental problems unilaterally, and for some activities such as fishing and shipping, do not have the full and exclusive jurisdiction to do so. For this reason, and because the North Sea countries are not all EU Member States, the UK coordinates its approach with OSPAR countries.

The updated UK Marine Strategy Part One covers the whole of our marine waters. The updated UK assessment, objectives and determinations for GES and associated targets and indicators have been developed at this scale. However, where there are significant biogeographical differences between the Greater North Sea and the Celtic Seas Sub-regions these have been taken into account. Assessments are undertaken at the scale most relevant to the particular descriptor or ecosystem component. This can be at sub-regional scale or smaller where appropriate.

There are strong links between the UK Marine Strategy and the Water Framework Directive (WFD). The WFD addresses the improvement and protection of the chemical and ecological status of surface waters over the whole river basin ranging from rivers, lakes and groundwater through to estuaries and coastal waters out to 1 nautical mile at sea (3 nautical miles in Scotland and out to 12 nautical miles for chemical status) and overlap with the MSFD in coastal waters.

In order to improve consistency between the approaches for coastal waters and offshore waters, the GES indicators and associated thresholds in this updated Marine Strategy Part One have been aligned with those used for coastal waters under the WFD where this is appropriate.

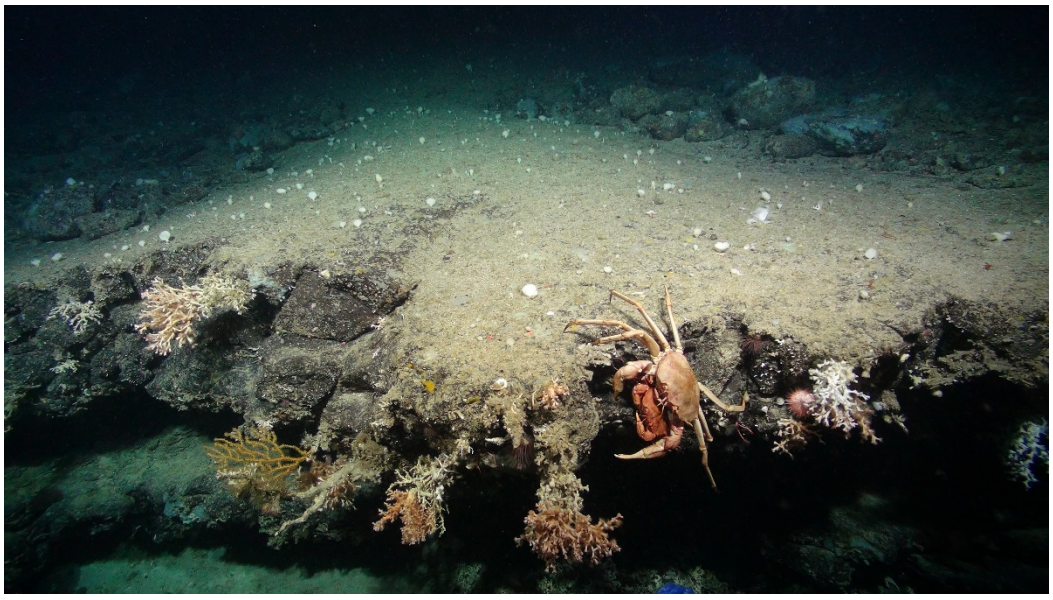
2.2 Characterisation of our seas

UK seas extend to over 880,000 square kilometres, which is more than three and a half times the UK land area. These seas stretch from the coastal seas and estuaries,

through the shelf seas and down to the deep sea beyond the continental slope, which can be thousands of metres deep. The UK has over 30,000 kilometres of coastline, including a myriad of offshore islands. This extensive seascape encompasses a huge variety of physical and chemical conditions, which form the transition between sub-polar waters and the temperate waters found along most of the coasts of Western Europe.

A characteristic feature of the UK waters is the large influence of the major UK rivers ranging from the Dee in Scotland to the Severn in the English and Welsh borders, and supplemented by several hundred smaller rivers. These contain a large quantity of sediment, organic matter and nutrients which through their input to our seas intensifies seabed dynamics and causes natural turbidity. These are essential for the growth of plankton, which forms the basis of the marine food chain. Consequently, by their nature, UK waters are highly productive.

We have an exceptional variety of benthic and pelagic habitats, ranging from highly diverse rocky shores to littoral sediment habitats such as salt marsh, sea grass and mud flats to phytoplankton and zooplankton communities. Our deep sea habitats are also diverse and support features of biological and conservation importance, including deep-sea sponge aggregations, corals and large-scale features such as seamounts and carbonate mounds.



Benthic habit – copyright National Oceanography Centre

These habitats support a huge variety of marine species, with around 330 different types of fish, 29 species of whales, dolphins and porpoises (cetaceans) and around 100 species of seabirds, waders and wildfowl. Deep-sea species of shark are known to exist within Scottish waters. Our seas form an important link in the international network of migration routes for cetaceans and provide breeding and foraging areas

for birds. Many species of turtle have also been observed in our waters, especially in Wales.

Cetaceans (whales, dolphins and porpoises). The diversity of marine habitats in UK waters cater to the different feeding strategies and lifestyles of a wide range of whale and dolphin species. There are deep diving species like the sperm whale, which use the deep waters to the west and north of Scotland and south-west of England. There are also species that prefer shallower water, such as the harbour porpoise and coastal bottlenose dolphin, which are sometimes spotted from the coast. Eleven species of cetacean are considered resident in UK waters. A further 18 species occasionally visit our waters, including the world's largest animal, the blue whale.

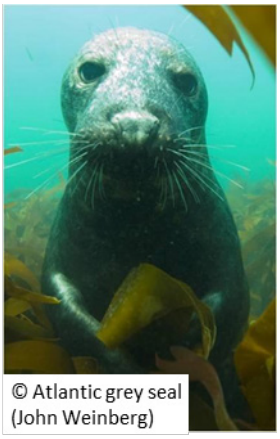
Bottlenose Dolphin – copyright Peter Evans

Seals: Two seal species are found in UK waters: the Atlantic grey seal and the harbour seal (also known as the common seal). The UK is home to the largest concentration of grey seals in north-west Europe, with approximately 38% of the world's population breeding along our coast. Our coastal waters are also an important habitat for harbour seals, with around 30% of the European population using UK waters to breed and forage for food.

Birds: The seas and coasts around the UK hold internationally important numbers of birds including seabirds, waterfowl and waders. The UK's coastline and offshore islands provide safe nesting sites for around seven million seabirds. They can form spectacular 'seabird cities' that contain tens of thousands of birds. The UK supports

80% of the world's breeding population of Manx shearwaters, 56% of northern gannets, and 60% of great skuas. During the autumn and spring migration and over the winter months, large flocks of waders and waterfowl visit the UK coast. They concentrate in and around estuaries, where waders feed on benthic invertebrates in soft intertidal sediments. Geese and some duck species graze on saltmarshes and exposed eelgrass beds and grebes, divers and diving-duck species feed on fish and invertebrates in shallow subtidal areas. Internationally important numbers of many species of bird visit the UK, including the entire Greenland and Icelandic population of around 360,000 pink-footed geese, over 50% of the world population of great northern diver and around 50% of the North-East Canadian and Greenland population of red knot.

© Black-legged kittiwake (Matt Parsons)



© Atlantic grey seal (John Weinberg)

Fish. UK support a large range of fish species ranging from the basking shark which is the largest fish species in the North-East Atlantic, through to sunfish, eels, skates and rays. Our waters are home to commercially important fish such as cod, plaice, haddock and mackerel and shellfish species such as mussels, oysters, scallops and Nephrops (also called Norway lobster or langoustine).

Atlantic Wolffish - copyright Jim Ellis

2.3 Progress with developing the UK MPA network

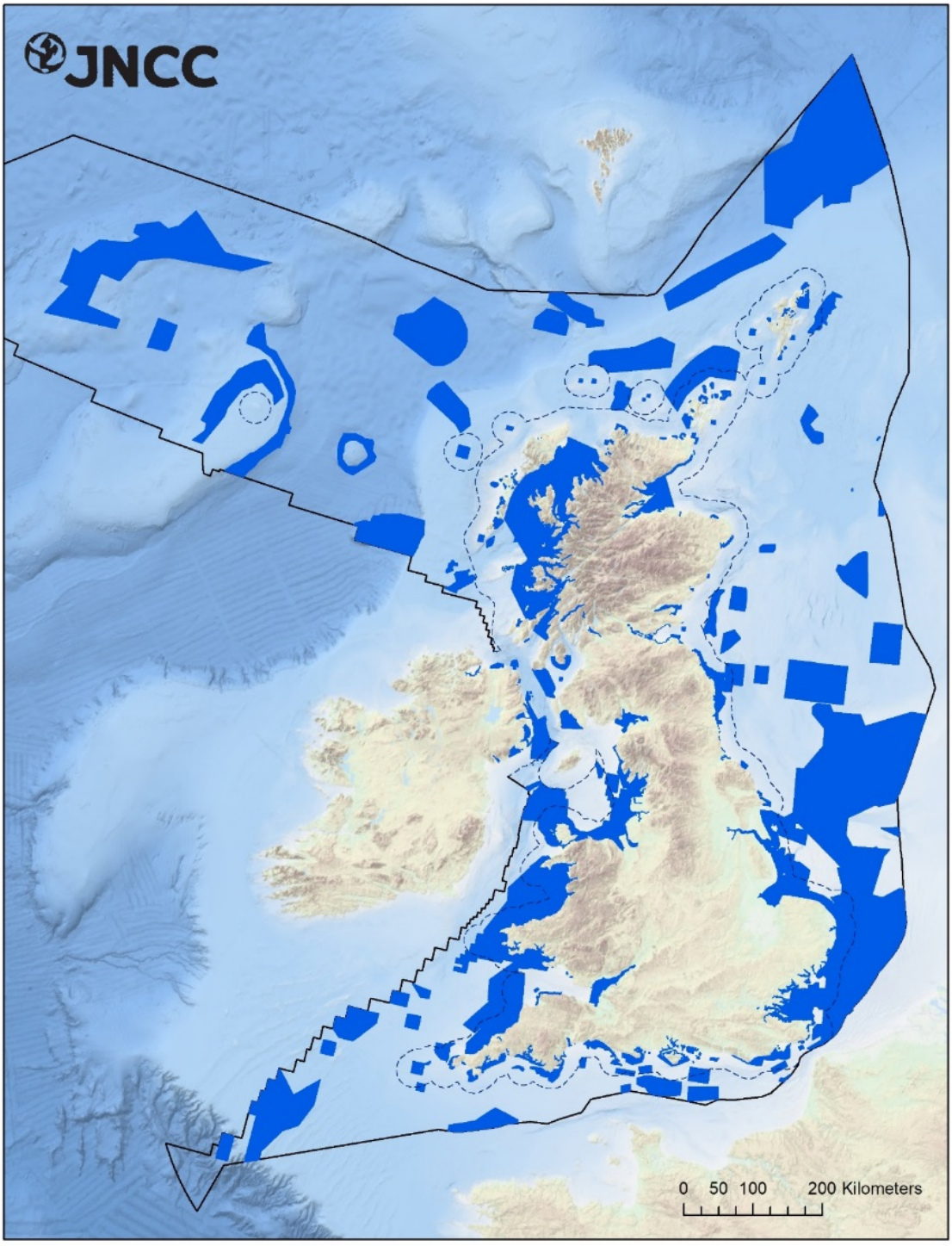
The UK Marine Protected Area (MPA) network (see Figure 3) has progressed substantially over the last six years. We currently have 355 MPAs protecting 25% of UK waters compared to 217 sites covering 8% of UK waters in 2012. The UK's network of MPAs will play a significant role in supporting the achievement of GES for a number of descriptors, in particular descriptor 1 on biodiversity and descriptor 6 on seafloor integrity.

Collectively, the UK will ensure that it leads by example in achieving our joint commitment to ensure that 30 per cent of the world's ocean are protected by 2030. We will achieve this by aiming to surpass this target for the UK Marine Strategy area in 2020, and put in place appropriate management measures by 2024.

We have made progress in applying management measures within MPAs. For example in England, 94 inshore MPAs have management measures in place to protect sensitive features from methods of bottom towed fishing gears, and a review of Highly Protected Marine Areas (HPMAs), is underway.

We recognise the crucial role of nature-based solutions for climate mitigation and adaptation, such as the protection and restoration of coastal habitats, including seagrass and saltmarsh. The primary purpose of MPAs is to protect biodiversity, protecting coastal and marine habitats. In addition they provide a number of climate related co-benefits for mitigation and adaptation, including improved ocean resilience to the accelerating impacts of climate change, providing coastal protection from erosion and storm surge, and the protection of blue carbon habitats and nursery

grounds for species of commercial interest and marine conservation importance. We continue to work on developing methods to assess impacts of climate change on MPAs and with marine industries on environmental net gain.



Map and statistics include SACs, SPAs, MCZs and NCMPAs only. © JNCC 2019
UK Territorial Sea Limit. UK Continental Shelf (Designation of Area) Order 2014.
Contains UKHO data © Crown copyright.
Contains EMODnet Digital Bathymetry (DTM) from EMODnet Bathymetry Consortium (2016).
Contains JNCC Natural England, Scottish Natural Heritage,
DAERA & Natural Resources Wales data © Copyright and database right 2019

Figure 3: Map showing the current extent of the UK MPA network.

2.4 What our seas provide for the UK

As well as being a home to a huge variety of marine species and habitats, our seas provide many important resources, services, and livelihoods of benefit to the UK. Our seas provide us with food (5.3% of all protein consumed in the UK is sourced from fish[10]), they help regulate our climate (storing 30% of the excess carbon dioxide and 90% of the excess heat created by human activities[11]) and they provide much of the oxygen we breathe (over 50% produced by phytoplankton). Our seas also provide a place to live (over half of the UK population lives within 15km of the sea[12]) and many people enjoy recreational opportunities associated with the marine environment (in 2016, over 14 million UK adults participated in water sports and other water-based leisure activities[13]). Our seas also provide an important contribution to the UK economy through providing oil and gas, maritime transport, and renewable energy (see section 2.5 for further detail).

2.5 Uses of the marine environment

This section provides an economic and social analysis of the use of UK waters, highlighting how the economic contribution made by the various marine industries and the numbers of people they employ has changed since the Initial Assessment in 2012. It also provides an analysis of how the main marine activities engage with labour markets, an indicative cost of degradation, and an overview of research on public perceptions towards the UK marine environment.

2.5.1 Goods and services provided by the marine economy

The marine economy for this analysis is defined by the industries covered in Table 2 below. The total Gross Value Added (GVA)[14] of the marine economy was estimated as £27 billion in 2015. This represents roughly 2% of the combined GVA of the UK

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[10] http://www.fao.org/fishery/docs/STAT/summary/FBS_bycontinent.pdf

[11] Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[12] https://ec.europa.eu/eurostat/statistics-explained/index.php/Archive:Coastal_regions_-_population_statistics

[13] Watersports Participation Survey, Royal Yacht Association, 2016, http://www.rya.org.uk/SiteCollectionDocuments/sportsdevelopment/Watersports_Survey_2016%20-%20Summary.pdf

[14] The Gross Value Added (GVA), is a measure of the value of goods and services produced by the sector to the economy.

economy in 2015[15]. The main activities are: the offshore oil and gas industry, excluding the services sector; maritime transport; telecommunications: leisure and recreation; and marine renewable energy. Table 2 also shows the GVA of these industries. The other 11 marine activities that were considered had a total combined GVA of £2.2 billion. The estimated GVA of the marine economy in 2008 was £51 billion, which means there has been a significant reduction (£24 billion) in contribution since then. This arises from a reduction in GVA of £25.5 billion for the offshore oil and gas industry which was due primarily to a reduction in output of North Sea oil and gas.

A very recent report by the Seabed User Developer Group in 2019 provides useful additional information.[16]

2.5.2 Predicted changes to GVA in the coming decade

Two recent horizon-scanning projects (the UK Government Office for Science "Future of the Seas" Foresight project and the OECD "The Ocean Economy in 2030" report[17]) predict a very large rise in the GVA of the offshore wind sector in the coming decades. These reports also predict strong growth in seaborne trade and marine aquaculture industries, and the emergence of a marine autonomous vehicles sector. Revenue from marine biotechnology is also predicted to grow significantly, with a number of applications already in early development which could impact across a range of high profile and important areas such as energy, human health, and food production.

2.5.3 Employment of people in the marine economy

The total number of people employed by the marine economy was estimated at 341,000 full time equivalent (FTE) employees in 2015. This represents roughly 1% of the total number of people employed in the UK in 2015[18]. The sectors with the

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[15] https://www.ons.gov.uk/economy/grossvalueaddedgva/timeseries/abml/pn2

[16] ABPmer and ICF, (2019). Study of the Socio-economic Benefits of Marine Industries, Included in the Seabed User and Developer Group, ABPmer Report No. R.3060. A report produced by ABPmer and ICF for the Seabed User and Developer Group, February 2019.

[17] http://www.keepeek.com/Digital-Asset-Management/oecd/economics/the-ocean-economy-in-2030_9789264251724-en#.WjfOEVVl-Uk#page34

[18] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/timeseries/mgrz/lms

highest employment were: maritime transport; leisure and recreation; defence; oil and gas; and telecommunications (see Table 2). Other marine activities had a combined FTE of 18,000.

Table 2 shows the key economic indicators of GVA, the number of people employed (full time equivalent), and productivity trends for 16 major marine activities[19].Comparisons with 2008 are limited to broad trends due to changes in the way that statistics have been collected for several industries. Where no firm data was available, estimates are used.

Table 2: Principal human activities in UK seas and the Gross Value Added and productivity change.

Activity	Gross Value Added (GVA), £m	Numbers employed (FTE)	Productivity change over recent years[20]	GVA Reference year
Oil and Gas	11,500	38,200	Significant decrease	2015
Maritime Transport	7,868	130,900	No significant change	2015
Telecommunications	3,003	26,750	Increase	2015
Leisure & recreation	1435	86,400	No significant change	2015
Defence - Military	521	42,670	Decrease	2015/16
Fisheries	356	8,135	Increase	2015

[19] Table 2 was compiled by marine consultants ABPmer and has been reviewed by the joint industry - government "Productive Seas Evidence Group" of the Marine Science Coordination Committee. An extended version of the table, which sets out further information on how figures have been derived, and a number of uncertainties in the calculations can be found in the on-line tool socio-economic section.

[20] The base year varies from 2008 to 2012. See full table on MOAT for details

Activity	Gross Value Added (GVA), £m	Numbers employed (FTE)	Productivity change over recent years[20]	GVA Reference year
Aquaculture	409	3,231	No significant change	2015
Water abstraction	167	No data	No significant change	2015
Mineral extraction	60	408	No significant change	2015
Renewable energy	1,124	4,766	Significant increase	2015
Coastal defence	405	No data	Increase	2015/16
Waste disposal	10	No data	Increase	2015
Education	102	No data	No significant change	2015
R&D	163	No data	No significant change	N/a
Power transmission	No data	No data	No data	N/a
Storage of gases	No data	No data	No data	N/a
Total	27,123	341,460		

2.5.4 Analysis of marine activities on labour markets

We also carried out an analysis of the impact of marine activities on the local labour market across a number of UK regions. This examined where key marine activities create employment, and their effects on local labour utilisation (skills, job growth, and unemployment), local labour productivity (wages, new businesses, investment) and if the activity is likely to affect deprivation levels in the local area. This showed that

different activities have differing effects on the local labour market, depending on each industry's particular characteristics. Some industries (such as the energy industry) tend to create jobs that are higher skilled in nature, while other industries (such as the tourism industry) tend to create jobs that are lower skilled in nature and may be part time.

There is also a variation in the effect that marine activities have on wage levels in the local labour market. Industries which draw heavily on local labour resources (such as the marine transport industry) can have a strong positive effect on local wages, while other industries (such as telecommunications and cabling) have a smaller impact from a highly skilled workforce. The impact that marine activities have on deprivation levels in the local area is connected to the effect of marine activities on local labour utilisation and productivity.

The detailed results of this analysis are shown in the "social and economic analysis" tile of the MOAT[21].

2.5.5 Analysis of the indicative costs of degradation

The cost of degradation compares the 'Business as Usual' scenario (BAU) with the "GES scenario". The BAU scenario is the expected state of the marine environment without any additional targets or programmes of measures. The "GES scenario" is the expected state of the environment in 2020 if the goals of the UK Marine Strategy are met and GES is achieved across all descriptors. The gap between GES and BAU scenario is the "cost of degradation" and is estimated by valuing the difference in societal benefits between the two scenarios. This model is illustrated in Figure 4 below. Due to uncertainties associated with how the current measures will meet the GES targets the costs of degradation is presented only indicatively.

[21] https://moat.cefas.co.uk

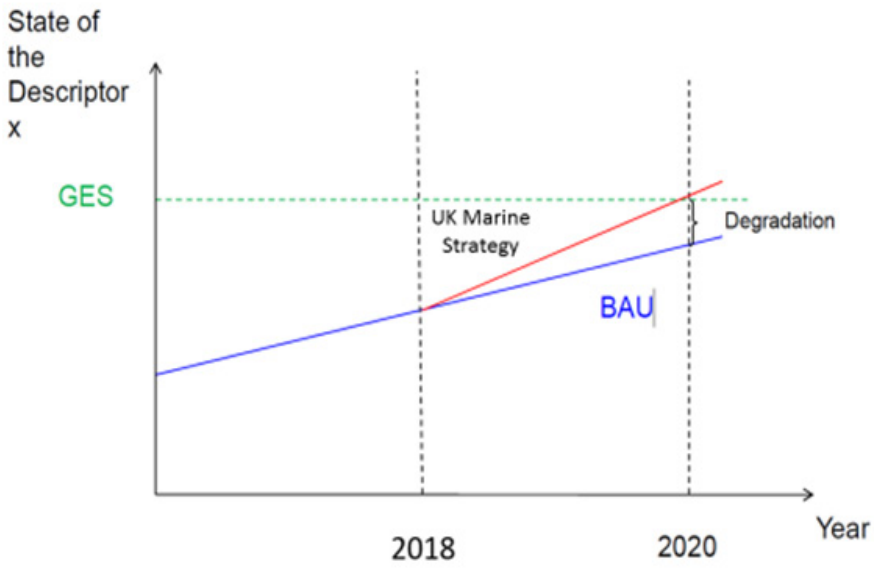

Figure 4: Model demonstrating the relationship between GES and BAU.

The programme of measures set out in the UK Marine Strategy Part Three in 2015 has resulted in some descriptors broadly reaching GES. Where this is the case, there is no cost of degradation.

Based on assumptions around current uncertainties and future progress, it is assessed that this is the case for some elements of the ecosystem components in descriptors D1 and D4, and for descriptors D5, D7, and D9.

For some descriptors, GES is not currently on course to be achieved by 2020, or there is uncertainty about whether GES will be achieved by 2020. Where this is the case, we have sought to identify additional targets, monitoring and research to address uncertainties or to put in place additional measures as soon as possible, and particularly in the next cycle from 2018 to 2024. This applies to several ecosystem components in Descriptor 1, and 4 and to Descriptors 2, 6, 10 and 11. More details can be found in the sections on the individual descriptors and ecosystem components in Section III.

The analysis also revealed that there are a number of difficulties associated with estimating the costs of degradation for this updated initial assessment compared with the situation in 2012. In some cases, GES will not be achieved due partially to natural or climate-related pressures acting on ecosystems which at the moment are difficult to factor into the analysis. Furthermore, in the case of Descriptor 3 on commercial fish, and Descriptor 8 on contaminants, the UK applied for an exception

from achieving GES by 2020 in its Marine Strategy Part Three on programmes of measures, because we have evidence that it will not be possible for GES to be achieved by 2020 for reasons beyond our control. The European Commission assessed the exception for D3 as being grounded, and the application for D8 as being partially grounded. There will be a 'cost of degradation' for both these descriptors, but due to the uncertainties about when GES will be achieved, it is not possible to provide a quantitative estimate of the cost of degradation for these descriptors.

2.5.6 Social value and benefits of the marine environment

In addition to providing economic value, the marine environment provides considerable social and cultural value including recreation, heritage and identity, beauty and inspiration, sense of place, health and wellbeing. Evidence on the size, characterisation and importance of these services is limited, but there is growing interest and research in this area.

In 2017, 222 million leisure trips (3+ hours) were made to the seaside/coast in Great Britain (170 million in England, 18 million in Scotland and 21 million in Wales)[22]. Expenditure on these trips totalled £6,084 million and activities included: visiting a beach (46 million trips); walking (54 million trips), sunbathing (9 million trips), swimming (6 million trips), fishing (4 million trips) and boating/sailing/water sports on or by the sea (3 million trips). Whilst there is no direct comparison in Northern Ireland, 26% of the 2.2 million overnight trips taken by Northern Ireland residents were to beaches or the coast[23]. There is some evidence that coastal activities are undertaken by a wide range of individuals and that, compared to green spaces, they are likely to be visited by both high and low socio-economic groups.

The weather, climate and scenery are perceived as important services derived from the ocean however the marine environment has also been associated with multiple cultural and well-being benefits. This includes the importance of the marine environment to UK traditions (such as visits to the seaside), our sense of place, social bonding and therapeutic and spiritual value. Evidence also suggests that living closer to the coast is associated with good physical and mental health.

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[22] Kantar TNS (2018) Great Britain Day Visitor 2017 Annual Report. https://www.visitbritain.org/sites/default/files/vb-corporate/Documents-Library/documents/England-documents/260139488_-_kantar_tns_-_gbdvs_2017_annual_report_v5r.pdf

[23] NISRA, 2018. Northern Ireland Annual Tourism Statistics 2017. https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/Annual-Tourism-Statistics-Publication-2017%20.pdf

There is increasing awareness of the importance of our underwater cultural heritage and the historic environment which has significant social/cultural value. Plans are in place to consider whether social and cultural indicators and targets could be developed, and this will include a consideration of marine cultural heritage and the historic environment.

2.5.7 Public perceptions towards the UK marine environment

As well as understanding and recognising the value the marine environment brings to individuals and society, we also need to understand individual/societal perceptions towards the marine environment. A greater understanding of what people think and why will help us improve our engagement with the public and stakeholders as well as design and deliver effective policy. This should recognise the diversity of perceptions which exist within the UK population, recognising that the public is not one homogenous group.

In recent years we have seen a significant increase in the media and public engagement with marine issues. In terms of UK public attitudes, studies have shown considerable levels of public pessimism about the biodiversity and health of UK seas, with pollution and specifically marine plastics being key areas of public concern.

Personal experience of marine environments is important for developing interest and supporting conservation. Whilst MPAs are seen to have multiple benefits, local acceptance can vary. The involvement of communities in marine conservation and planning and its local benefits is important, and this is currently being investigated through the Marine Management Organisation-led Marine Pioneer demonstration projects and others.

Public perceptions of the impacts of climate change show low awareness of ocean acidification, a public disconnect with sea level change and the view that mitigation should be prioritised over adaptation. Research into the marine renewable sector has found that attitudes are influenced by local variables and the type of technology installed with particular concerns around wildlife impacts and public engagement.

Further detail on the evidence base for public perceptions towards the UK marine environment, including references, can be found on the “evaluating public perceptions” tile of the MOAT.

2.5.8 Future of marine social science: evidence gaps and priorities

Marine social sciences can provide us with rich and valuable insights into the complexities and diversities of societal relationships with the sea. In doing so, it plays an important role in delivering sustainable management and decision making for our

seas. The field of marine social science is diverse and continues to draw on innovations and techniques from the broader field of social science. As marine social science continues to grow in capacity, we need to work with the research community and institutions to develop a UK wide, longitudinal research programme. The Marine Science Coordination Committee's Social Science Task group has identified some of the key evidence gaps and priorities for marine social science. Further work will be carried out to develop this into a short, medium and long term strategy which it is hoped will provide a starting point for discussion on how to build and strengthen Marine Social Science evidence in the UK.

An area of increasing importance is the use of citizen science where observations from the public and voluntary sector can provide useful additional information to assist assessments and fill knowledge gaps. We will consider how to make best use of the citizen science resource.

2.6 Predominant pressures affecting the marine environment

This chapter provides an overview of the pressures and activities affecting UK seas, and identifies which pressures have prevented or are likely to delay the achievement of GES by 2020.

2.6.1 Pressures and associated activities in UK seas

Table 3 provides a summary of the main anthropogenic pressures and activities per ecosystem component and descriptor considered by the UK in the development of the UK Marine Strategy[24]. In addition to these pressures, ecosystem interactions (e.g. competition, predation) and the effects of changes to prevailing conditions (e.g. rising sea temperatures, ocean acidification, and deoxygenation) will also affect the status of marine species and habitats.

[24] As set out in Directive (EU) 2017/845 which updates Annex III of the original Marine Strategy Framework Directive and provides more comprehensive indicative lists of characteristics, pressures and impacts.

Table 3: Pressures and associated activities in UK seas.

Descriptor or ecosystem component	Relevant pressures	Associated Activities
Birds	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting (discards, sand eel, sprat)
		Renewable energy generation (wind turbines)
	Changes to hydrological conditions	Coastal defence and flood protection
	Disturbance of species (e.g. where they breed, rest and feed) due to human presence	Tourism and leisure activities
		Hunting and collecting for other purposes
		Fish and shellfish harvesting
		Coastal defence and flood protection
		Renewable energy generation (wind, wave and tidal power)
	Input of other substances (synthetic substances, acute events	Transport – shipping
		Extraction of oil and gas
	Input or spread of non-indigenous species	Transfer of non-indigenous species to islands from ships
Mammals	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting (professional, recreational)
	Input of anthropogenic sound (impulsive, continuous)	Renewable energy generation (wind, wave and tidal power), including infrastructure

Descriptor or ecosystem component	Relevant pressures	Associated Activities
		Extraction of oil and gas including infrastructure
		Military operations
		Transport — shipping
	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides)	Agriculture
		Urban uses
		Industrial uses
		Waste treatment and disposal
		Transport
Fish	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting (professional, recreational)
	Changes to hydrological conditions (migration barriers freshwater-seawater)	Coastal defence and flood protection
		Canalisation and other watercourse modifications
	Input of anthropogenic sound (impulsive, continuous)	Renewable energy generation (wind, wave and tidal power), including infrastructure, shipping
	Input of other forms of energy (including electromagnetic fields, light and heat)	Renewable and non-renewable energy generation
Pelagic Habitats	Extraction of, or mortality/injury to, wild species (by commercial and recreational fishing and other activities)	Fish and shellfish harvesting (professional, recreational)

Descriptor or ecosystem component	Relevant pressures	Associated Activities
	Input or spread of NIS	Transport — shipping
	Input of nutrients – diffuse sources, point sources, atmospheric deposition	Agriculture
		Forestry
		Urban uses
		Industrial uses
		Waste treatment and disposal
		Transport — shipping
	Input of other forms of energy (including electromagnetic fields, light and heat)	Non-renewable energy generation
Benthic Habitats	Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate	Land claim
		Extraction of minerals
		Renewable energy generation (wind, wave and tidal power), including infrastructure
		Extraction of oil and gas, including infrastructure
	Physical disturbance to seabed	Coastal defence and flood protection
		Extraction of minerals
		Restructuring of seabed morphology, including dredging and depositing of materials

Descriptor or ecosystem component	Relevant pressures	Associated Activities
		Fish and shellfish harvesting (professional, recreational)
	Changes to hydrological conditions	Restructuring of seabed morphology, including dredging and depositing of materials
		Coastal defences and flood protection
		Land Claim
	Input or spread of NIS	Transport — shipping
		Aquaculture — marine, including infrastructure
	Input of nutrients and input of organic matter	Agriculture
		Urban uses
		Industrial uses
		Transport — shipping
	Input of other forms of energy (including electromagnetic fields, light and heat)	Non-renewable energy generation
NIS	Input or spread of NIS	Transport — shipping
		Tourism and leisure activities
		Aquaculture — marine, including infrastructure
Commercial Fish	Extraction of, or mortality/injury to, wild species (by commercial	Fish and shellfish harvesting (professional, recreational)

Descriptor or ecosystem component	Relevant pressures	Associated Activities
	and recreational fishing and other activities)	
Eutrophication	Input of nutrients and input of organic material	Agriculture
		Urban uses
		Industrial uses
		Waste water treatment and disposal
		Transport — shipping
		Aquaculture
Hydrographical conditions	Changes to hydrological conditions	Offshore structures
		Coastal defences and flood protection
		Restructuring of seabed morphology, including dredging and depositing of materials
		Transport infrastructure
	Input of other forms of energy (including electromagnetic fields, light and heat	Renewable energy generation (wind, wave and tidal power), including infrastructure
Contaminants	Input of other substances (e.g. synthetic substances, non-synthetic substances, radionuclides) – diffuse sources, point sources, atmospheric deposition, and acute events.	Agriculture
		Urban uses
		Industrial uses
		Waste water treatment and disposal

Descriptor or ecosystem component	Relevant pressures	Associated Activities
		Restructuring of seabed morphology, including dredging and depositing of materials
		Transport — shipping
		Extraction of oil and gas, including infrastructure
Contaminants in seafood	Input of other substances	Agriculture
		Urban uses
		Industrial uses
		Waste water treatment and disposal
		Restructuring of seabed morphology, including dredging and depositing of materials
		Transport — shipping
		Extraction of oil and gas, including infrastructure
Marine Litter	Input of litter (solid waste matter, including micro-sized litter)	Land claim
		Urban uses
		Industrial uses
		Tourism and leisure activities
		Transport – land
		Aquaculture – marine

Descriptor or ecosystem component	Relevant pressures	Associated Activities
		Fish and shellfish harvesting (professional, recreational)
		Transport –shipping
Input of Anthropogenic Sound	Input of anthropogenic sound (impulsive, continuous)	Renewable energy generation (wind, wave and tidal power) including infrastructure
		Extraction of oil and gas, including infrastructure
		Military operations
		Transport — shipping

We have also prepared a detailed analysis of the 20 main activities affecting UK seas, their spatial extent and intensity, the associated measures to control them, and an outlook on how these activities will change over the next 10 years. This can be found in the “predominant pressures exerted by human activities” tile of the MOAT.

The pressures identified from Table 3 are managed through the programme of measures in the Marine Strategy Part Three to reduce their impact on the marine environment, and thus enable GES to be achieved. Table 4 highlights the main predominant pressures and activities identified in this updated Marine Strategy Part One which are preventing or likely to delay the achievement of GES by 2020. There are also some pressures where the impacts are uncertain, so it is not clear whether GES will be compromised or not. For example, it is not yet clear whether continuous noise from shipping affects various marine species at a population level.

The assessments have also reported that natural ecosystem interactions, such as competition and predation are probably affecting species such as marine mammals and birds, and that changing temperatures are affecting pelagic and benthic habitats that are leading to changes in the distribution, growth and reproduction of some populations of fish, marine mammals, birds and NIS. Prevailing conditions are described in detail in section 2.7.

Table 4: Pressures and activities which are likely to delay the achievement of GES by 2020.

Pressure preventing or delaying the achievement of GES	Main associated activities or implications	Context
Commercial and recreational fishing for D1, D3, D4 and D6	Fish and shellfish harvesting. Use of certain types of trawling gear	Fishing and use of gear are controlled by the EU Common Fisheries policy. For D1 and D3, UK has an Article 14 exception from achieving GES by 2020 because it will take time for the measures to actually reduce exploitation rates, and allow for fish and shellfish to recover and achieve the desired length and biomass.
Input or spread of NIS for D2	Transport — shipping (ballast water, hull fouling) Natural or climate-related spread of NIS to warming UK seas following their introduction into the wider region	Ballast Water Convention is now in force but needs ratification by more significant flag states, and climate related spread of species is very difficult to control.

2.6.2 Cumulative effects of human activities

The UK Marine Strategy Part One in 2012 noted that improving the evaluation of the cumulative effects of human activities on marine ecosystems was an important priority to ensure that the best possible evidence supports management decisions.

The UK has subsequently undertaken a significant amount of work in this area both nationally and through leading the OSPAR Working Group on Cumulative Effects, which is looking at this from the perspective of the North-East Atlantic.

New developments likely to affect hydrographical conditions continue to be subjected to robust environmental assessment procedures and we aim to improve our understanding of cumulative impacts and how to take them into account in decision making processes.

The Centre for Environment Fisheries and Aquaculture Science (Cefas) has been commissioned to develop a cumulative effects assessment approach.

Further information on the cumulative effects assessment methodology can be found on the “cumulative effects of human activities” tile on the MOAT.

2.7 Status of physical and chemical features

The prevailing physical and chemical characteristics of UK seas help to determine the structure and function of our marine ecosystems; they can affect the potential for ecosystems to meet GES. In the UK Marine Strategy Part One, we reported on the spatial and temporal variation of sea surface temperature, salinity, wave height, turbidity, and pH that together have major effects on our seas. Global climate change is experienced by marine habitats and ecosystems in our waters through change in these local marine climate characteristics. An updated assessment has been carried out to determine whether any trends observed in UK Marine Strategy Part One have continued, and to provide context for observed changes in the ecosystem indicators. The findings of these assessments are summarised in the “assessment summary” column of Table 5, where we have also provided an associated projection on how these variables are likely to be affected by climate change and the associated impacts on marine ecosystems.

Further details of the associated assessments are found in the “ocean processes and climate” tile of the MOAT.

Conditions in UK seas reflect the state of the North-East Atlantic for which the UK led the assessment of marine climate as part of the OSPAR Intermediate Assessment 2017[25].

[25] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/climate-and-ocean-acidification/

Table 5: Assessment summary of ocean processes variables and associated climate change projections and impacts.

Ocean process	Assessment Summary	Climate Change projection[26]	Climate Change impacts
Sea surface temperature	Between 2011 and 2015, the trend in sea surface temperature in UK waters reflects the warming observed in the Initial Assessment. A series of cold winters (2011 – 2013) resulted in a slight decrease to this trend, but since 2014 seas have been warmer again.	Rising sea surface temperatures will continue through the 21st Century, with increases of 2°C - 3°C expected for UK waters.	Sea temperature is a major driver of marine ecosystems and one of the key factors affecting the distribution, physiology and ecology of marine species. Changes in sea temperature also produce changes in the density of seawater, affecting circulation, stratification and mixing.
Ocean acidification	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.	The pH of seawater will continue to decrease as anthropogenic emissions of CO_2 increase. Consequently, the carbonate saturation state will decrease making it harder for marine calcifiers, such as reef-forming corals, molluscs and some species of phytoplankton, to	The overall effect of ocean acidification on marine ecosystems will be deleterious particularly, for organisms that secrete calcium carbonate (e.g. in forming shells). For example, there is a risk of reductions in shellfish growth (and harvest), although some algae and

[26] In future assessments we will use the recently published UK Climate Projections 2018 and the IPPC Special Report on Oceans and the Cryosphere.

Ocean process	Assessment Summary	Climate Change projection[26]	Climate Change impacts
		build their skeletons and shells.	seagrasses may benefit from increased availability of CO_2. Interactions with other stressors (e.g. temperature, toxic metals, oxygen & food supply) and species-specific responses need to be considered to better understand impacts on ecosystems.
Sea surface suspended sediments	Satellite observations over 1998-2015 show significant increases in annual average surface suspended particulate matter in 5 out of 10 UK marine regions.	There are no specific projections of turbidity or suspended particulate matter in UK Seas. Future climate driven changes will likely depend on changes in waves, storms, and river flow.	Changes in suspended particulate matter can influence primary production; air-sea heat transfer; sedimentation rates and biogeochemical transfers from the water column to seabed; productivity of the benthos; and oxygen levels in bottom waters.
Salinity	The salinity of the upper ocean to the west and north of the UK has decreased sharply from 2011. This	The salinity of UK waters is expected to slightly decrease in the future, but this change is expected to be weaker in the	Together salinity and temperature control seawater density affecting circulation patterns and the distribution

Ocean process	Assessment Summary	Climate Change projection[26]	Climate Change impacts
	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.	Celtic and Irish Seas than the North Sea.	and timing of stratification. Changes to circulation and stratification will influence marine species.
Waves	No systematic UK wide assessments of changes in significant wave height, wave period or direction have been undertaken for the period 2011-2015. However, later in 2019 the Marine Climate Impacts Partnership will publish an updated assessment for storms and waves.	Mean significant wave height is expected to reduce over the 21st Century for most of the UK coastline relative to a 1981-2000 baseline. As projections of storm track changes are uncertain, there is a high degree of uncertainty in future changes in extreme waves.	Characterisation of the future wave regime is important in planning shoreline defence schemes and large infrastructure projects. Furthermore, waves control the degree of resuspension and transport of sediments around the UK. Whilst reductions in the mean significant wave height would reduce engineering demands, potential increases in the uncertainly of extreme wave events needs further analysis.

Section 3: Current environmental status, new objectives for GES and new targets

This section is broken down by descriptor/ecosystem component. For each one there are two sections.

The first section provides a narrative on a) indicators used for the assessment b) the current GES status c) the progress made since 2012 towards the achievement of GES based on the associated indicator assessments, and particular initiatives which have been taken to expedite progress, and d) whether GES will be achieved by 2020.

The second section, in the form of a table for each descriptor or ecosystem component, provides a simple statement and traffic light on the extent that GES has been achieved in 2018 and progress made since 2012, and sets out the objectives, targets, and indicators we will use for the 2018 -2024 cycle. The information in the tables is described below.

Current Environmental Status in 2018	Summary of the assessment findings for the descriptor or ecosystem component, and the trend towards achieving GES if available.
High level objective for GES	This sets out the updated high level objective for achieving GES.
Criteria and targets for measuring progress towards GES in future	This sets out the relevant criteria which will be used to assess GES for the descriptor or ecosystem component, and the associated targets that we will use to judge whether the criteria have been met.
Operational targets	The operational targets cover particular management actions identified by the assessments that are needed to move towards GES and work we need to do with other countries, particularly to develop indicators and associated threshold values needed to assess progress in the coming cycle.

Indicators	This section describes the indicators that we are intending to use or hope to develop for the next cycle. This will depend on the extent that they can be taken forward at OSPAR level.
Going forward	This section flags up particular issues which we will focus on in the next cycle

Detailed information about the indicator assessments used to underpin the current assessment of GES can be found in the “pressures from human activities” and “biodiversity, food webs” tiles on the MOAT. Detailed information about the predominant pressures affecting the descriptors and ecosystem components can be found in Section 2.6 of this report.

We have also provided details in Annex 1 about the threshold values or reference levels for the various indicators which will be used in the 2018-2024 cycle of the UK Marine Strategy to assess whether their associated targets will be met.

D1, D4 Cetaceans

Indicators - The assessment of cetaceans was based on three indicators: the abundance and distribution of coastal bottlenose dolphins; the abundance and distribution of other cetaceans; and harbour porpoise bycatch. The assessments below contribute to both Descriptor 1 (Biological Diversity) and Descriptor 4 (Food webs).

Current GES Status - Uncertain. The status of coastal bottlenose dolphin and minke whale are consistent with the achievement of GES in the Greater North Sea. The West Wales population of coastal bottlenose dolphins remains at GES, but status is unknown/uncertain elsewhere. It is unknown if GES has been achieved for other species of cetacean.

Progress and Action since 2012 - Bycatch in fisheries is an ongoing pressure. The target for cetacean bycatch has been met in the North Sea, but in the Celtic Seas it is likely to have exceeded the precautionary threshold. There is low confidence in the cetacean bycatch assessments due to incomplete bycatch monitoring at the North-East Atlantic scale.

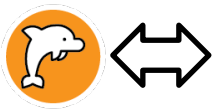
Since 2012 population estimates have been updated by an international survey. It has been determined that the minke whale population has remained stable in the Greater North Sea over the last 20 years. For most other species the new population

estimates of abundance were similar to or larger than previous ones. However, uncertainty in the data means that we cannot draw firm conclusions about any changes in abundance.

With the exception of discrete groups of coastal bottlenose dolphin, the cetaceans found in UK waters are part of much larger North-East Atlantic populations. Therefore the appropriate scale for the assessment of GES for cetaceans is the North-East Atlantic. However, there is insufficient monitoring data to assess the status of cetacean populations at this scale.

In OSPAR, the UK worked with other countries to develop the common indicators on harbour porpoise bycatch and abundance and distribution of cetaceans. UK information was used in the assessments published in the OSPAR Intermediate Assessment 2017.

Achievement of GES by 2020 - The assessments in 2012 and 2018, show that numbers of minke whale are consistent with the achievement of GES in the Greater North Sea, but for other species there is insufficient information available to make a robust judgement on their status. Therefore it is uncertain if GES will be achieved at the North-East Atlantic scale by 2020.

CETACEANS: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The extent to which GES has been achieved for cetaceans remains uncertain. The status of coastal bottlenose dolphin and minke whale is consistent with the achievement of GES in the Greater North Sea, but unknown/uncertain elsewhere. It is unknown if GES has been achieved for other species.
High level objective for GES	The population abundance of cetaceans indicates healthy populations that are not significantly affected by human activities.	
Criteria and targets for measuring progress towards GES in future	Bycatch mortality	The long-term viability of cetacean populations is not threatened by incidental bycatch.

	Population abundance	There should be no significant decrease in abundance caused by human activities.
	Population Distribution	Population range are not significantly lower than favourable reference values for the species.
Operational targets	We will continue existing monitoring of cetacean bycatch in fisheries and continue the use of mitigation measures, for example acoustic deterrents ('pingers') to reduce bycatch and support further work into novel approaches. We will continue initiatives such as the survey of Small Cetaceans in European Atlantic waters and the North Sea (SCANS) and the Collaborative Oceanography and Monitoring for Protected Species (COMPASS) 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.	
Indicators to be used to assess the status	- Abundance and distribution of coastal bottlenose dolphins - OSPAR - Abundance and distribution of cetaceans other than coastal bottlenose dolphins - OSPAR - Cetacean bycatch – OSPAR	
Going forward	We will aim to determine trends in abundance of cetacean species and the impact of human pressures, such as bycatch and noise disturbance, at a North-East Atlantic scale to better assess progress against the UK targets. We will consider increasing the frequency of our SCANS surveys to improve our confidence in our abundance assessments for more species and make better use of citizen science observations.	

	We are developing the UK Bycatch Mitigation Initiative as part of our commitment to deliver the UK Dolphin & Porpoise Strategy.

D1, D4 Seals

Indicators - The assessment of seals is based on indicators covering population size and condition of grey and harbour seals. The assessments below contribute to both Descriptor 1 (Biological Diversity) and Descriptor 4 (Food webs).

Current GES status - Uncertain for harbour seals. Achieved for grey seals.

In the Celtic Seas, there has been a significant increase in the abundance of harbour seals on the west coast Scotland and inconclusive evidence of declines elsewhere. In the Greater North Sea, abundance is stable or increasing along the English coast but has declined along the Scottish coast. The cause of this decline is unclear although a number of potential factors (e.g. fisheries bycatch) have been ruled out.

The status of grey seals in both the Celtic Seas and the Greater North Sea is consistent with GES. Both targets for population size and population condition (i.e. pup productivity) have been met. Abundance and productivity of grey seals have both increased significantly since the initial assessment in 2012 and also over the longer-term, since the early 1990s. This improvement in UK waters is mirrored in the wider grey seal population of the North-East Atlantic.

Progress and actions since 2012 - Determining the impact of human pressure is key to assessing progress against the UK target and to undertaking appropriate management, if the target is not met. Research is ongoing in Scotland to investigate potential causes of the harbour seal declines. While several factors have been ruled out as primary causes, investigations are ongoing into the remaining potential causes such as interactions with grey seals (competition and predation) and exposure to toxins from harmful algae. In addition, research will continue to investigate the life history parameters (e.g. survival and birth rates) and population dynamics of seals in areas of contrasting population trajectories, through focused photo-identification studies and necropsies of stranded dead seals to improve our understanding of what is happening within these populations.

In OSPAR, the UK played a leading role to develop the common indicators for seals and UK information was used in the assessments on seal abundance and distribution and grey seal pup production published in the OSPAR Intermediate Assessment 2017.

Achievement of GES by 2020 - It is evident that GES has been achieved for grey seals. The lack of certainty about the causes of declines of harbour seals means that it is unlikely that GES will be achieved by 2020. However, the research underway in Scotland referred to above may provide an answer and provide the certainty we need to make a robust judgement.

SEALS: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has achieved its aim of GES for grey seals in the Greater North Sea and Celtic Seas. There was 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 is uncertain. Harbour seals in the Greater North Sea have 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.	
Criteria and targets for measuring progress towards GES in future	Bycatch mortality	The long-term viability of seal populations is not threatened by incidental bycatch.
	Population Abundance and Distribution	Population abundance and distribution are consistent with favourable conservation status.
	Grey seal pup production	Grey seal pup production does not decline substantially in the short or long-term.
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) and on 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 improvement where required, and the identification of appropriate mitigation measures.
Indicators to be used to assess the status	- Abundance and distribution of seals - OSPAR - Grey seal pup production - OSPAR
Going forward	Determining the impact of human pressure is key to assessing progress against the UK target. Regular surveys will continue around the UK coast to monitor population abundance and trends. In addition, regions of decline will continue to be surveyed more frequently to establish population trends and abundance. A seals bycatch indicator and target will be developed in collaboration with OSPAR to ensure that the long-term viability of seal populations is not threatened by incidental bycatch.

D1, D4 Birds

Indicators - The assessment of breeding seabirds and non-breeding waterbirds was based on four indicators covering population size and population condition. Two were developed in cooperation with OSPAR. The assessments below contribute to both Descriptor 1(Biological Diversity) and Descriptor 4 (Food webs).

Current GES Status - Not achieved for seabirds. Mixed picture for waterbirds.

In the Greater North Sea the status of non-breeding waterbirds is consistent with the achievement of GES. The status of breeding seabirds is not consistent with the achievement of GES. In the Celtic Seas, the status of non-breeding waterbirds and breeding seabirds were not considered to be consistent with the achievement of GES.

Progress and actions since 2012 - The indicators used were unable to distinguish human impacts from the effects of prevailing environmental conditions. The

assessments mention that milder winters have affected where waterbirds forage and the lower availability of small fish has affected breeding seabirds. Both impacts are partly driven by climate change, and are likely to be affecting population size and condition. However, the impacts from human activities could not be ruled out.

In OSPAR, the UK played a leading role to develop several of the common indicators for birds and UK information was used in the assessments published in the OSPAR Intermediate Assessment 2017.

New measures put in place since the UK programme of measures was published in 2015 include designation of Special Protection Areas and black guillemot MPAs in Scotland.

Achievement of GES by 2020 - The assessments in 2012 and 2018, show that seabirds will not achieve GES by 2020. For waterbird species it is uncertain if GES will be achieved by 2020.

BIRDS: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has achieved its aim of GES for non-breeding waterbirds in the Greater North Sea but not in the Celtic Seas. Breeding seabirds have 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.	
Criteria and targets for measuring progress towards GES in future	Bycatch mortality	The long-term viability of marine bird populations is not threatened by deaths caused by incidental bycatch in mobile and static fishing gear.
	Population Abundance	The population size of marine bird species has not declined substantially since 1992 as a result of human activities.
	Population demographic characteristics	Widespread lack of breeding success in marine birds caused by human

		activities should occur in no more than three years in six.
	Distributional range	There is no significant change or reduction in population distribution of marine birds caused by human activities.
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 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[27].	
Indicators to be used to assess the status	- Marine bird abundance - OSPAR - Marine bird breeding success / failure - OSPAR - Distribution of breeding and non-breeding marine birds - Kittiwake breeding success - Invasive mammal presence on island seabird colonies - Seabird bycatch	
Going forward	Further develop our understanding of the impacts of human pressures on marine birds.	

[27] See section below on marine litter

D1, D4 Fish

Indicators - The assessment of fish (including some commercial fish species) is based on four indicators developed by OSPAR covering: aspects of population abundance; size-structure; and species composition against targets based on population size and ecosystem structure. The assessments contribute to both Descriptor 1 (Biological Diversity) and Descriptor 4 (Food webs).

Current status - GES not achieved.

Demersal fish communities are recovering from over-exploitation in the past. In the Greater North Sea, recovery is underway in terms of abundance and in both species-composition and size-structure. In the Celtic Seas the abundance of sensitive species and size structure are also recovering. Current fisheries management measures are delivering improvements and GES is likely to be achieved in future if these measures are continued.

Only a partial assessment of pelagic shelf fish was possible and the assessment results do not yet provide a clear indication of progress towards the achievement of GES.

Progress and actions since 2012 - The Initial Assessment 2012 of fish communities was based mainly on the Large Fish Index (LFI). Since 2012, the LFI has indicated that targets for the proportion of large fish could be achieved in Northern parts of the Celtic Seas by 2022, but could take significantly longer for the entire ecoregion, if current levels of pressure persist. In the Greater North Sea the LFI has shown recovery in the proportion of large fish and assessment thresholds are close to being achieved.

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

Achievement of GES by 2020 - Compared to the assessments carried out in 2012, the assessments reported in 2018 show that that whilst there have been significant improvements, GES will not be achieved for all fish communities by 2020. Several of the indicator targets may not be achieved for many years and therefore we will continue to improve fisheries management measures to ensure progress towards GES. Stock assessments will also be improved to enable effective assessment of the indicators.

The UK applied for an exception from achieving GES by 2020 in its Marine Strategy Part Three report to the EU in 2015. The grounds were that it would take several years or more for stocks to respond to the various existing and planned measures set out in the UK Marine Strategy Part Three to reduce exploitation rates and protect fish and shellfish species, and to achieve the desired length, or biomass. In its report assessing Member States' programmes of measures under the Marine Strategy Framework Directive (COM (2018) 562 final) the Commission found that the UK request was justified.

FISH : Perspective for 2018 to 2024		
Current Environmental Status in 2018		Demersal fish communities are recovering from over-exploitation in the past, but GES has 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.	
Criteria and targets for measuring progress towards GES in future	Bycatch mortality	Incidental bycatch is below levels which threaten long-term viability and recovery of fish populations.
	Population abundance	The population abundance of sensitive[28] species is not decreasing due to anthropogenic activities and long-term viability is ensured.
	Distributional range	For each fish species listed in the Habitats Directive population abundance and geographic distribution meets established favourable reference values.

[28] Fish species with life history traits such as large ultimate body size, slow growth rate, large length and late-age-at-maturity, which are particularly sensitive to additional sources of mortality, for example fishing mortality.

	Species habitat	For listed fish species the area and the quality of the habitat is sufficient.
Operational targets	We will work together with other countries in OSPAR to establish appropriate threshold values where this is feasible.	
Indicators to be used to assess the status	- Recovery in the population abundance of sensitive fish species – OSPAR - Assessments for listed fish species	
Going forward	Improve future assessments by investigating the impacts of all pressures on the indicators and the effects of warming seas, which will help establish appropriate baselines and thresholds for all indicators. Procedures on how to integrate results from this new suite of indicators will enable targets to be assessed more quantitatively. We will improve stock assessments and develop an indicator for fish bycatch.	

D1, D4 Pelagic habitats

Indicators - The assessment of pelagic habitats is based on indicators covering changes in plankton communities and changes in plankton biomass against targets covering habitat condition and habitat distribution. The assessments below contribute to Descriptor 1 (Biological Diversity) and Descriptor 4 (Food webs).

Current Status - Uncertain. Plankton communities in the Greater North Sea and Celtic Seas are experiencing changes in biomass, abundance, and community structure of plankton that may have consequences on the functioning, dynamics and structure of the whole marine ecosystem. Prevailing oceanographic and climatic conditions are likely to be driving these changes, but the extent of pressure from direct human activities is unclear.

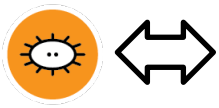
Progress and actions since 2012 - New indicators of zooplankton and phytoplankton community structure and biomass have been developed; these are the first plankton biodiversity indicators operational in the North-East Atlantic.

In OSPAR, the UK led the development of the common indicator on changes in phytoplankton lifeforms and UK information was used in the first assessment of

plankton and pelagic habitats at the sub-regional scale in the North-East Atlantic assessment published in the OSPAR Intermediate Assessment 2017.

Several knowledge and data gaps have been identified in the individual indicator assessments that will need to be addressed. Filling these gaps will increase the confidence of the assessments.

Achievement of GES by 2020 - The assessment in 2012 concluded that although there was clear evidence of regional-scale change in the composition and abundance of plankton communities linked to rising sea temperatures, plankton as a whole were considered healthy and subject to few direct anthropogenic pressures. The more detailed assessment in 2018 largely confirms these findings, but work is underway to improve our understanding of the extent that natural variability, climate change, ocean acidification and cascading effects from anthropogenic activities such as fishing may be contributing to change. Therefore, whilst it is likely that GES will be achieved by 2020, the uncertainty of not knowing the effect of human activities means that we remain uncertain.

PELAGIC HABITATS: Perspective for 2018 to 2024		
Current Environmental Status in 2018		Prevailing environmental conditions are likely to be driving the observed changes in plankton communities but human activities cannot be ruled out and it is uncertain whether GES has been achieved.
High level objective for GES	Pelagic habitats are not significantly adversely affected by human activities.	
Criteria and targets for measuring progress towards GES in future	Habitat distribution and condition	The structure, function, composition and abundance of the plankton community is not significantly adversely influenced by anthropogenic drivers.
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.
Indicators to be used to assess the status	- Changes in plankton communities - OSPAR - Changes in plankton biomass and abundance - OSPAR
Going forward	The methods developed so far mean we can continue to monitor changes in the plankton community. The assessment of GES in pelagic habitats would be improved by research into the effects of the key anthropogenic pressures and climatic drivers on this component of the ecosystem.

D1, D6 Benthic habitats

Indicators - The assessment of benthic habitats is based on indicators covering rock and biogenic habitats, predominant sediment habitats and intertidal habitats against targets covering habitat extent, habitat and community condition and physical damage. The assessments below contribute to both Descriptor 1 (Biological Diversity) and Descriptor 6 (Seafloor Integrity).

Current Status - GES has not yet been achieved for rock and biogenic habitats in either Greater North Sea or the Celtic Seas. In UK waters west of the Celtic Seas levels of physical damage are considered to be consistent with the achievement of GES. The extent of physical loss of biogenic habitats and levels of physical damage on rock habitats is currently not consistent with GES. The extent to which GES has been achieved for predominant sediment habitats remains uncertain. The extent to which GES has been achieved in intertidal habitats is uncertain. Macroalgae and seagrass communities status appears to be consistent with GES, but saltmarsh habitats are not consistent with GES in some areas. Climate change is making some rocky shore communities in the UK less resilient to the impacts of direct anthropogenic pressures.

Progress and actions since 2012 - In 2012, the consensus amongst experts was that the spatial extent of damage to the seabed from fishing gear was greater than any damage caused by other activities. This current assessment uses new indicators, developed since 2012, to assess the damage caused by fishing to sediments, biogenic and rocky habitats. No intertidal indicators were used in 2012

assessments. Since then, new indicators have been developed based on existing tools and data from the long-term monitoring programme MarClim[29].

Due to the limited data and scientific evidence it was not possible to undertake a fully integrated assessment of benthic habitats at this stage.

In OSPAR, the UK played a leading role in developing a concept for a common approach for evaluating the condition of benthic habitats and their communities in order to assess the impact of each human pressure on the condition of each benthic habitat type, along a pressure-impact gradient. This is at an early stage of development and this concept will be further elaborated prior to the next OSPAR Quality Status Report in 2023.

Achievement of GES by 2020 - The assessments carried out in 2012 and 2018 show that it is unlikely that GES will be achieved for benthic habitats by 2020. There are a number of measures in the UK Marine Strategy Part Three which protect benthic habitats from key pressures. The main problem is caused by physical disruption of the seabed from fishing gear which is currently addressed at European and International level. The development of a new fisheries policy when the UK is outside of the EU is expected to improve the situation. We will also assess the feasibility of setting up a partnership working group with key stakeholders to identify solutions for potential fishing impacts on seabed integrity.

BENTHIC HABITATS: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The achievement of GES is uncertain for intertidal and soft sediment habitats. The levels of physical damage to soft sediment habitats are 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.	

[29]The MarClim project assesses and predicts the influence of climatic change using intertidal rocky shore biota.

Criteria and targets for measuring progress towards GES in future	Spatial extent of physical loss	The physical loss of each seabed habitat type caused by human activities is minimised and where possible reversed.
	Habitat condition	Habitat loss of sensitive fragile or important habitats caused by human activities is prevented, and where feasible reversed.
	Spatial extent of habitat type adversely affected by physical disturbance	The extent of habitat types adversely affected by physical disturbance caused by human activity should be minimised.
	Extent of adverse effects	The extent of adverse effects caused by human activities on condition, function and ecosystem processes of habitats is minimised.
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.	
Indicators to be used to assess the status	- Physical loss of predicted habitat - Extent of Physical damage indicator to predominant and special habitat - OSPAR - Benthic communities indicator - OSPAR - Aggregated Rocky Shore Macroalgal Index - Aggregated Infaunal Quality Index - Aggregated Saltmarsh Tool	

	- Aggregated Intertidal Seagrass Tool - Intertidal rock community change indicator (MarClim)
Going forward	Additional data from existing Marine Protected Areas will be included in future assessments. We will develop assessment methods further in order to integrate assessment results, and help to evaluate the effects of human activities in relation to climate change. We will develop indicators to assess the status of sublittoral rock, biogenic reefs and typical species. We will assess the feasibility of setting up a partnership working group with key stakeholders to identify solutions for potential fishing impacts on seabed integrity.

D2, Non-indigenous species (NIS)

Indicators - This first UK-wide assessment of the status of NIS is based on trends of new introductions of NIS into the Greater North Sea or the Celtic Seas over time.

Current Status - GES not achieved. The results suggest, with low confidence, that there was no significant difference in the number of new records of NIS detected between the two six-year periods (2003 to 2008 and 2009 to 2014) used in the assessment. This indicates that no significant reduction in the risk of introduction of NIS over this time period has been achieved in either the Greater North Sea or the Celtic Seas.

Progress and actions since 2012 - Insufficient information was available to enable an assessment in 2012. Since then, a limited assessment of the impact of NIS in the UK has been made and used for this assessment. NIS monitoring has started to be integrated into biodiversity monitoring since 2016, including the development of a target species list and baseline dataset.

Species Action Plans for key NIS, which should aid in implementing controls to reduce the risk of spread and impacts in UK waters, are currently being developed by the UK working non-native group, with the invasive colonial sea squirt Didemnum vexillum, being the first species with an Action Plan in development. The Action Plans are being developed in-line with those already produced for other (freshwater and terrestrial) species by the GB Non-Native Species Secretariat.

In OSPAR, the UK led the development of the common indicators on NIS and UK information was used in the assessment published in the OSPAR Intermediate Assessment 2017.

A number of knowledge gaps were also identified in the individual indicator assessments that will need to be addressed in both in the UK and OSPAR. There is also a need to improve data flow and management in relation to NIS detection. In addition, ensuring that all biodiversity monitoring programmes include the detection of NIS where ever possible will be essential to the continued robustness of this approach to monitoring for NIS both now and in the future.

Achievement of GES by 2020 - The conclusion that there was no significant change of new introductions of NIS between 2009 and 2014, is of low confidence, due largely to lack of consistent monitoring effort and/or reporting. However, on a precautionary basis we estimate that GES will not be achieved in UK seas by 2020. NIS can enter UK waters from ballast water and the accumulation of organisms on ships' hulls. Due to the large volume of international shipping in UK seas, the achievement of GES will be to some extent be dependent on all flag states adopting international controls that prevent the introduction of NIS such as the and international ballast water control standards of the Ballast Water Convention.

NON-INDIGENOUS SPECIES (NIS) D2: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has not yet achieved its aim of GES for NIS. Our ability to detect new NIS has improved but there has 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.	
Criteria and targets for measuring progress towards GES in future	NIS introductions	The number of newly introduced NIS is minimised and where possible reduced to zero.
	NIS distribution	The rate of spread of invasive NIS, as a result of human activities is

		minimised and reduced where possible.
Operational targets	We will develop and implement Pathway Action Plans to reduce the risk of introduction and spread of NIS. We will improve monitoring and surveillance to detect new NIS introductions, particularly at high risk locations.	
Indicators to be used to assess the status	- The number of new NIS introduced - The number of new populations of established invasive NIS	
Going forward	Further development of indicators in OSPAR and associated monitoring and surveillance in key areas of risk are needed. This will increase our understanding of how the pressures resulting from NIS introduction and spread can best be minimised.	

D3 Commercial fish

Indicators - The assessment of commercial fish is based on two indicators which measure, for commercially exploited stocks of UK interest which have MSY assessments, commercial fishing pressure and reproductive capacity.

Current Status - GES has been achieved for some commercially exploited fish, but for most shellfish stocks GES has not yet been achieved or their status is uncertain.

The assessments showed that, for stocks with MSY assessments, fishing pressure has been reduced on marine fish (quota) stocks (including Nephrops) and that the percentage of these stocks fished within maximum sustainable yield (MSY) limits has increased from 12% in 1990 to 53% in 2015.

During this period, improvements have also been observed in the reproductive capacity of these stocks, with the proportion of marine fish spawning stock biomasses capable of producing MSY increasing from 28% in 1990 to 56% in 2016.

As of 2015, we know that at least 37% of national shellfish stocks were exploited beyond maximum sustainable yield and that no assessment was possible in relation to their reproductive capacity relative to the level capable of producing MSY. Assessments for 61% of shellfish stocks had no MSY reference points defined, or

stock assessments were not possible with the available data. Work Is underway to improve this situation.

Progress and actions since 2012 - Since 2012 there has been a further increase in the number of fish stocks that are harvested sustainably. There is also more consistent data for shellfish species. However, whilst these results show further progress towards achieving all populations of commercial fish are within safe biological limits and fished sustainably, our aim for GES has not yet been achieved.

Measures taken include:

- The North Sea Multi-Annual Plan (MAP) which was initiated in August 2016 and was published in July 2018.
- The Western Waters MAP was initiated in March 2018.
- The landing obligation has been phased in on an annual basis since 2015.
- Pelagic species were first to be introduced in 2015.
- Demersal species were then phased in between 2016 and 2018.
- Full implementation of the landing obligation came into force on 1 January 2019. This means all UK vessels will be required to land catches of all species subject to catch limits, unless specifically exempted.
- Exemptions to the landing obligation are set out in delegated acts for both the North Sea and North Western Waters.
- Improvements in gear selectivity.
- Spatial measures such as seasonal closures and real time closed areas.

Achievement of GES by 2020 - Compared to the assessments carried out in 2012, the assessments reported in 2018 show that that whilst there have been some improvements, GES will not be achieved for commercial fish by 2020.

The UK applied for an exception from achieving GES by 2020 in its Marine Strategy Part Three report to the EU in 2015. This was on the grounds that it will take several years or more for stocks to respond to the various existing and planned measures set out in the UK Marine Strategy Part Three to reduce exploitation rates and protect fish, elasmobranch and shellfish species, and to achieve the desired length, or biomass. In its report assessing Member States' programmes of measures under the Marine Strategy Framework Directive (COM (2018) 562 final) the Commission found that the UK request was justified.

COMMERCIAL FISH D3: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has 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 have either not yet achieved GES or their status is uncertain. The percentage of quota stocks fished below MSY and the proportion of marine fish spawning stock biomasses capable of producing MSY have 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.	
Criteria and targets for measuring progress towards GES in future	Fishing mortality	The fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield.
	Reproductive Capacity of the stock	The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing the maximum sustainable yield.
Operational targets	The UK will continue to work towards achieving sustainable fishing at levels consistent with MSY. Our intention is to re-introduce the Fisheries Bill which will put in place a framework to continue making significant progress towards fishing more stocks at MSY, contributing to the achievement of GES. The Bill will set out clear objectives to ensure that fisheries and aquaculture activities are environmentally sustainable in the long-term, that we deliver on MSY in line with our	

	international obligations, and that we apply an ecosystems-based approach to fisheries management measures that accounts for the full range of effects of fishing on ecosystem services, and corresponding societal needs in our decisions.
Indicators to be used to assess the status	Commercial fishing pressure for stocks of UK interest. Reproductive capacity of commercially exploited stocks of UK interest.
Going forward	Indicator targets will be made consistent with multi-annual plans that are adopted for commercial fish stocks. We will seek to improve stock assessments for national stocks, where resources allow, in particular for key commercial shellfish stocks in English waters such as scallops, crabs and lobsters and their MSY reference levels. As the science develops we will work with other countries to establish the feasibility of setting threshold values to show whether the age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population.

D4 Food webs

Indicators - The assessment of the status of food webs is based on indicators and associated targets covering breeding success, species and size composition, abundance and population condition for the ecosystem components included under descriptor 1.

Current Status - Fish communities, which are a key component of the food web are recovering, but GES status for the whole marine food web is uncertain.

The assessments of the status of food webs has been made using the results described in the sections above on “D1, D4” on fish, birds, seals, cetaceans and pelagic habitats. In both the Greater North Sea and Celtic Seas, plankton communities are experiencing changes in biomass, abundance, and community structure. Deterioration in fish populations has been halted and, in some areas, the size and species structure of fish communities are recovering. Trends in the proportion of large fish in the demersal fish community suggest recovery may continue in most of the areas if current fishing pressures do not increase. However, breeding seabird populations are not consistent with GES. This may be the result of

lower availability of small fish (e.g. sandeels, sprat and herring). Grey seal numbers are increasing, while harbour seals are largely stable but declining in some places, and the trends in most cetacean populations are uncertain.

The components of the food web are clearly changing, but it is unclear how these changes are affecting each other. Signs of recovery in fish communities should ultimately lead to improvements in populations of higher predatory species further up the food chain. Prevailing oceanographic and climatic conditions are likely to be driving these changes in productivity, particularly at the base of the food web. In addition, the cumulative effects of pressure from human activities on the food web are unclear.

Progress and actions since 2012 - In 2012 we did not have sufficient knowledge of the complex nature of the relationships between our marine species and habitats and the prevailing conditions and pressures affecting them to be able to carry out a dedicated assessment of food webs in UK seas. However, various assessments covering breeding success, species and size composition, abundance and population condition for cetaceans, seals, birds, fish and pelagic and benthic habitats and more detailed information on the pressures affecting them have provided sufficient evidence to produce this first UK assessment in 2018 and to be able to identify some of the key actions, such as better control of fishing pressures, which have led to improvements.

Achievement of GES by 2020 - We are not able to assess whether the aim of Descriptor 4 (that there should be no significant adverse change in the function of different trophic levels in marine food webs as a result of human activities), will be achieved by 2020. There are some indications that fish communities, which are a key component of the food web, are recovering due to fisheries management measures. It is likely that these changes have contributed to and will continue to contribute to changes in prey availability for seabirds and marine mammals. It is unknown what the full extent of these changes in predator-prey interactions will be, or how climatically-driven changes in the plankton will affect the rest of the food web. There is still a substantial task to develop suitable indicators with other countries that provide a robust assessment of food web health.

FOOD WEBS: Perspective for 2018 to 2024		
Current 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.	
Criteria and targets for measuring progress towards GES in future	Trophic guild diversity	The species composition and relative abundance of representative feeding guilds are indicative of a healthy marine food web.
	Trophic guild balance	The balance of abundance between representative feeding guilds is indicative of a healthy food web.
	Size distribution	The size structure of fish communities is indicative of a healthy marine food web.
	Productivity	Productivity of each of the representative feeding guilds, characterised by key species, is indicative of a healthy marine food web.
Operational targets	We will continue ongoing development of UK food web indicators and will work with other countries in OSPAR to: a) develop and test regional assessment methods that can also be used for assessing the status of food webs and: b) establish the feasibility of setting threshold values for the UK targets.	
Indicators to be used to assess the status	- fish community size structure: Typical Length and/or Large Fish Index - OSPAR	

	- productivity indicators to be developed including adaptation of existing OSPAR indicators of seabird breeding success, seal pup production and primary production of phytoplankton; plus possible indicators of larval abundance of keystone fish species (e.g. sandeels). - mean maximum length of fish – OSPAR
Going forward	To get a more robust assessment of whether marine food webs are not adversely affected by human activities, it will be necessary to address a number of knowledge gaps and to develop suitable indicators than can provide a more robust assessment. This includes consideration of representative species composition indicators including those for bird and marine mammal species, and biomass of predatory feeding guilds for fish, birds and marine mammals. As the food web extends well beyond UK seas, our intention is to do this through OSPAR and build on the recent research outcomes from the NERC/Defra funded Marine Ecosystem Research Programme, which will improve our understanding of the ecosystem processes that underpin the marine food web, how they are responding to environmental change and management scenarios for improving their status. As our monitoring improves for ecosystem components including birds and mammals, the relationships between trophic levels should become clearer. By using refined ecosystem models we will be able to evaluate food web status under different environmental and management scenarios.

D5 Eutrophication

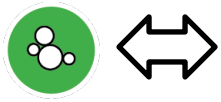
Indicators - The assessment of the eutrophication status of UK waters is based on indicators covering: the inputs of nutrients to the sea; nutrient concentrations; chlorophyll concentrations; and concentrations of dissolved oxygen in marine waters.

Current Status - GES has been largely achieved. The latest application of the OSPAR Common Procedure (which is used to assess eutrophication) showed that since 1990 the introduction of nutrients by rivers into the marine environment has fallen considerably, and that almost 100% of the marine waters in the Celtic Seas

and the Greater North Sea were classified as eutrophication non-problem areas. However, there are still a number of small estuaries and harbours with limited water circulation in estuarine and coastal waters which exhibit eutrophication problems (21 problem areas, and 11 potential problem areas). These areas represent a small proportion of the total area of UK waters (0.03%) and of 0.41% of estuarine and coastal waters.

Progress and actions since 2012 - The Assessment in 2012 showed a similar picture, with GES broadly achieved with eutrophication problems areas restricted to estuarine and coastal waters. There have been some additional small improvements since then.

Achievement of GES by 2020 - The aim of Descriptor 5 is that human-induced eutrophication is minimised, and with only 0.03% of UK marine waters being classified as eutrophication problem areas, we estimate that GES will be achieved by 2020. Nevertheless, our aim is to continue to address the remaining problem areas with appropriate measures. One of the difficulties, is that these small areas frequently contain substantial reservoirs of nitrogen and phosphorus locked in sediments which can take decades to dissipate, long after measures have been put in place.

EUTROPHICATION D5: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has largely achieved its aim of GES for eutrophication. A small number of eutrophication problems remain in coastal and estuarine waters, representing 0.03% of the total UK Exclusive Economic Zone, and 0.41% of estuarine and coastal waters.
High level objective for GES	Human-induced eutrophication is minimised in UK marine waters.	
Criteria and targets for measuring progress towards GES in future	Nutrient concentrations	Nutrient concentrations are below the levels which could lead to harmful eutrophication effects.

	Chlorophyll a concentrations	Chlorophyll a concentrations are below levels which could lead to harmful eutrophication effects.
	Dissolved Oxygen content	Dissolved oxygen content in coastal waters are above levels which could lead to harmful eutrophication effects.
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.	
Indicators to be used to assess the status	- inputs of nutrients - OSPAR - nutrient concentrations of Dissolved Inorganic Nitrogen Dissolved Inorganic Phosphorus - OSPAR - chlorophyll concentrations - OSPAR - concentrations of dissolved oxygen - OSPAR For offshore waters the indicator results will be integrated according to the rules set out in OSPAR	
Going forward	Seeing that eutrophication is only a problem in a few small areas in coastal waters, we will focus on implementing management measures to improve these.	

D7 Hydrographical conditions

Indicators - A number of indicators, such as sea surface temperature, salinity, turbidity, species and habitat condition are available to assess the likely impacts of infrastructure developments.

Current Status - GES continues to be achieved**.**

The assessment covered the potential hydrographical impacts (including cumulative and in-combination environmental effects) on the marine ecosystem arising from large scale infrastructure projects. We undertook a project which assessed a number of case studies of existing or potential future planning applications and determined that the current regulatory regime continues to be sufficiently robust to ensure that any significant long-term impacts are mitigated. The assessment showed that the UK aim for GES continues to be achieved.

Progress and actions since 2012 - The assessment in 2012 showed a similar picture with GES broadly achieved. Since then there has been a strengthening of the associated regulatory regimes through the introduction of Marine Plans for a number of UK areas which, inter alia, help ensure that cumulative effects of different projects in the same area can be better evaluated.

Achievement of GES by 2020 - We expect that GES will continue to be achieved. We will work further to develop more robust methodologies for assessing cumulative effects with OSPAR and continue with long-term monitoring programmes to monitor hydrographical conditions and help assess the impacts of climate change, such as sea level rise, sea surface temperature and turbidity.

HYDROGRAPHICAL CONDITIONS D7: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK continues to achieve its aim of GES for hydrographical conditions.
High level objective for GES	The nature and scale of any permanent changes to hydrographical conditions resulting from anthropogenic activities do not have significant long term impacts on UK habitats and species.	
Criteria and targets for measuring progress towards GES in future	Permanent alteration of hydrographical conditions	All significant marine infrastructure developments must meet licensing conditions to ensure they do not adversely affect the marine ecosystem.
Operational targets	We will further develop our approach to assessing the cumulative effects of major developments.	

Indicators to be used to assess the status	No indicators were developed to specifically assess anthropogenic changes to hydrographical conditions. However, the UK monitors a number of indicators of prevailing conditions, such as sea surface temperature, salinity, turbidity which are relevant to assessing likely hydrographical impacts of infrastructure developments.
Going forward	We will continue to assess significant infrastructure developments and their potential impacts on hydrographical conditions. Marine Plans, when in place, will enhance the regulatory framework for the licensing and consents process in conjunction with other relevant plans, including those relating to freshwater environments. We will continue to work with OSPAR in relation to cumulative effects, and to identify future potential developments likely to be of relevance to this Descriptor. This is particularly important in light of the anticipated increased pressure on the marine environment resulting from larger developments such offshore wind energy generation and the need to plan for this in a way that enhances and protects the environment. We will use the results of on-going monitoring as well as improved understanding of cumulative effects to inform the review of marine plans.

D8 Contaminants

Indicators - The assessment of GES was based on indicators covering: concentrations of priority chemicals in sediments and biota; the biological effects of contaminants; and the number of oil spills against agreed thresholds where available.

Current Status - GES has been largely achieved

The assessments show that concentrations of hazardous substances in the Celtic Seas and the Greater North Sea and their biological effects are generally meeting agreed target thresholds which means they are at levels that should not cause harm to sea life (89% for contaminant concentrations and 96% for biological effects). The few failures are caused by highly persistent legacy chemicals such as PCBs in biota

and marine sediments mainly in coastal waters and often close to polluted sources. PCBs have also been detected in significant concentrations in orcas in UK seas. Whilst a number of small oil spills have been reported, there have been no major significant acute pollution events where habitats and species have been affected at a sub-regional level.

Progress and actions since 2012 - Trends for contaminant concentrations are generally stable or improving, showing that there have been improvements due to our programme of measures since 2012.

Achievement of GES by 2020 - Whilst there is already a high degree of compliance for many of the contaminants assessed, it is unlikely that GES will be fully achieved by 2020 due to the highly persistent nature of the Persistent, Bioaccumulative and Toxic legacy chemicals (for which most uses have been banned for many years). Projections by ICES show that it may be many decades before some of these chemicals fully degrade. For this reason, the UK applied for an exemption from achieving GES by 2020 for this descriptor in its 2015 Marine Strategy Part Three. However, it is encouraging that the biological effects measurements, which measure the actual harm that some of the priority chemicals pose to marine life, already show 96% compliance.

CONTAMINANTS D8: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has largely achieved its aim of GES for contaminants. Concentration of hazardous substances and their biological effects are generally meeting agreed target thresholds. Highly persistent legacy chemicals are 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.	
	Concentrations of contaminants	Concentrations of contaminants measured in water, sediment or marine

Criteria and targets for measuring progress towards GES in future	in coastal and territorial waters	biota comply with appropriate threshold values.
	Health of species and condition of habitats	Biological or ecological effects on sea life due to contaminants are below thresholds agreed by OSPAR.
	Occurrence of significant pollution events	Occurrence and extent of significant acute pollution events are minimised.
	Impact of significant acute pollution events on species and habitats	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.
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.	
Indicators to be used to assess the status	Contaminant concentrations - Metals in biota - OSPAR - Metals in sediment - OSPAR - PCBs in biota - OSPAR	

	- PCBs in Sediment - OSPAR - PAH in biota - OSPAR - PAH in sediment - OSPAR - PBDEs in biota - OSPAR - PBDEs in sediment - OSPAR - Radionuclides - OSPAR - Metals from water and air - OSPAR - contaminants in coastal waters - specific pollutants Biological effects - Imposex in dogwhelks - OSPAR - Micronucleus test - OSPAR - EROD activity - OSPAR - Bile metabolite - OSPAR - Liver neoplasm - OSPAR - Fish disease - OSPAR Oil Spills - Number and size of spills
Going forward	We will continue to work with other countries to develop and adopt common targets and threshold values for contaminants of concern, particularly through the OSPAR Convention. We will also work both nationally and with other countries to identify emerging chemicals likely to pose significant risks to marine life.

	We will also continue to refine our monitoring programmes nationally and in OSPAR to focus on areas where there is the greatest risk of exceeding threshold values in order to check whether existing measures are working, and whether new measures might be needed, and to target emerging contaminants.

D9 Contaminants in seafood

Indicators - The assessment of GES was based on an indicator covering concentrations of contaminants in seafood.

Current Status - GES has been achieved.

Surveys carried out since 2012 show that the levels of contaminants in fish and other seafood for human consumption do not exceed the limits set in Regulation (EC) No 1881/2006, and have generally met the agreed safety levels, indicating that GES has continued to be achieved.

Progress and actions since 2012 - The assessment in 2012 already showed a high degree of compliance and that GES was already achieved and this has been confirmed by recent surveys. Also, the scope of the monitoring surveys has been expanded to provide better geographical coverage and information regarding the fishing grounds in UK seas.

Achievement of GES by 2020 - We expect that GES will continue to be achieved. 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.

CONTAMINANTS IN SEAFOOD D9: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has achieved its aim of GES for contaminants in seafood. There is 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 1881/2006.	
Criteria and targets for measuring progress towards GES in future	Safe levels of contaminants in seafood	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.
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.	
Indicators to be used to assess the status	Contaminant concentrations in seafood.	
Going forward	We will continue to carry out appropriate periodic risk-based surveys to check that agreed safety levels continue to be met. We recognise that new chemicals or groups of chemicals of concern are continually being identified and we will prioritise these for future investigation subject to resource availability.	

D10 Marine litter

Indicators - The assessment of marine litter was based on an indicator covering beach litter surveys, and surveillance indicators covering floating litter and sea floor litter.

Current Status - GES has not been achieved.

The surveys of UK coastlines showed that trends of beach litter were stable in Celtic Seas, but slightly increasing in the Greater North Sea. The predominant marine litter material is plastic.

The surveillance indicators for sea floor litter and floating litter have been developed, tested and both indicate that litter is present in significant amounts, but we will need to refine these indicators to give us more accuracy.

Progress and actions since 2012 - The surveillance indicators on sea floor litter and floating litter are now up and running. We are also working with other countries to develop an indicator to measure microplastics in marine sediment, and have conducted research programmes to establish the extent to which microplastic debris are present and might cause harm to organisms in the marine environment.

Nationally, the “Litter Strategy for England” (2017), the “Towards a litter-free Scotland: National Litter Strategy ” (2014), the “Marine Litter Strategy for Scotland” (2014), the Wales Marine Litter Action Plan (2017) and the Northern Ireland Marine Litter Strategy (2013) will all help to reduce the amount of litter reaching the marine environment over time. The Resources and Waste strategy for England (2018), the Northern Ireland Waste Strategy (2012), Scotland’s Zero Waste Plan (2014) and the Welsh Towards Zero Waste initiative (2017) are all playing a significant role in reducing litter through reducing, reusing and recycling associated materials. Also, a minimum 5p plastic bag charge is now in place across the UK and a ban on the sale of products containing plastic microbeads in personal care products is now in force. Through the Industrial Strategy Challenge Fund programme on Smart Sustainable Plastic Packaging, businesses are expected to jointly invest up to £149m, alongside a £60m government investment, to help fight the global battle against single use plastics. Policies that address marine litter are being included in statutory marine plans.

The UK also encourages Fishing for Litter (FFL), a voluntary, unpaid litter bycatch removal scheme by commercial fishermen which provides fishing boats with large bags to collect marine-sourced litter.

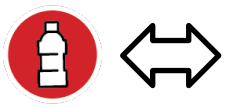
On the regional scale, we work with OSPAR to carry out assessments of marine litter and to implement the OSPAR Regional Action Plan for the Prevention and

Management of Marine Litter in the North-East Atlantic. We will continue research which aims to improve cross-border capabilities to monitor, prevent and remove marine litter in the Atlantic area.

On the international scale the UK has joined the UN Clean Seas Campaign and made voluntary commitments to join the Global Partnership on Marine Litter and the Global Ghost Gear Initiative. Also, the UK continues to tackle marine plastic pollution through the Commonwealth, with up to £66 million of UK Aid committed to stop plastic waste entering the oceans. These programmes aim to transform habits, practices, standards and policies around the globe to reduce marine plastic pollution and the harm it causes.

Achievement of GES by 2020 - Based on the evidence from monitoring programmes, it is unlikely that the UK will achieve GES for marine litter by 2020. The main reason is that the reductions in marine litter needed cannot be achieved in such a short timescale. Also the large reservoirs of litter and plastic in the marine environment cannot be easily be removed, and we have evidence to show that a significant percentage of marine litter found on UK beaches originates from other countries and can only be tackled by concerted action at international level. Furthermore, the lack of knowledge regarding the harm posed by plastics and microplastics on various species makes it difficult to determine whether GES has been achieved.

For the reasons outlined above it is unlikely that we will achieve GES by 2020 despite implementing the programmes of measures, as outlined in 2016 in the Marine Strategy Part Three, and in many cases going beyond what was committed to, such as the ban on microbeads in rinse-off personal care products. The UK did not apply for an exemption from achieving GES, as allowed under Section 15 of the Marine Strategy Regulations 2010, under paragraph 2a, however our assessments have shown that an exception would have been justified in this case. The UK remains committed to reducing levels of marine litter.

Marine Litter D10: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The UK has not yet achieved its aim of GES for litter. Beach litter levels in the Celtic Seas have remained largely stable since the assessment in 2012, whilst beach litter levels in the Greater North Sea have 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.	
Criteria and targets for measuring progress towards GES in future	Presence of litter (beaches)	A decrease in the total amount of the most common categories of litter found on surveyed beaches.
	Presence of litter (seabed)	A decrease in the number of items of litter on the seabed.
	Presence of floating litter	A downward trend in the number of northern fulmars with more than 0.1 g of plastic particles in their stomach.
	Presence of micro-litter	Develop an appropriate indicator to measure micro-litter in the marine environment.
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 sea floor, sea surface, and micro plastics, taking into account regional or subregional specificities; b) develop an indicator for micro-litter in sediment; c) establish, if practicable, whether the amount of litter and micro-litter ingested 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.	
Indicators to be used to assess the status	- Beach litter surveys - OSPAR - Floating litter using plastic in fulmar stomachs - OSPAR	

	- Seafloor litter surveys - OSPAR
Going forward	We will work both nationally and with other countries in OSPAR to develop clearer quantitative definitions of GES if feasible, and continue to develop appropriate measures building on the OSPAR Litter Action Plan to reduce the input of different litter types. We will also work internationally with the relevant organisations (IMO, UNEP, FAO) and Commonwealth Countries to develop marine litter action plans and measures worldwide We will work in OSPAR to develop an indicator for microplastics in sediment. We will investigate the feasibility of using more robust alternatives to the fulmar indicator for the assessment of floating marine litter.

D11 Underwater noise

Indicators - The assessment of underwater noise was based on developing a noise registry to record the distribution and timing of man-made impulsive sound sources, and a surveillance indicator designed to monitor trends in ambient noise the sea.

Current Status - Uncertain.

The noise registry is now in place and has been used to record and log impulsive sound from various activities in the Greater North Sea and the Celtic Seas. The surveillance indicator for ambient noise has established recent noise levels at several sites in the Greater North Sea and Celtic Seas. However we are still uncertain regarding what levels and frequencies of man-made marine noise lead to effects at a population and ecosystem level, particularly for vulnerable/threatened species and key functional groups, and how to quantify the risk of impact at these scales.

Progress and actions since 2012 - In 2012, the extent to which the impacts of both impulsive and continuous noise posed a serious problem to marine life was unclear, and there was also no means of systematically recording this pressure and assessing its potential cumulative effects.

The establishment of the noise registry and the operationalizing of the ambient noise surveillance indicator has helped to address the gaps in knowledge regarding the impacts of underwater noise. The need to take account of noise impacts and contribute to the registry is being included in marine plan policies. Going forward we will continue to work with OSPAR to develop an impulsive noise registry for the North-East Atlantic and a broader ambient noise monitoring programme that enables us to better address the risks posed by underwater noise at the broader regional sea scale.

UK participation in several research programmes and initiatives are helping to provide a more robust picture of the impacts of sound on marine ecosystems and animals. These include a Defra project to analyse underwater noise data from subsea sound recorders located around the UK coast, and two European cross-border cooperation (Interreg) projects. The Joint programme for Ocean Noise in the Atlantic Seas (JONAS) has set up a joint monitoring programme in the Atlantic area with aim of using the results to produce tools for management and policy purposes and the Joint Monitoring Programme for Ambient Noise North Sea (JOMOPANS) aims to develop a framework for a fully operational joint monitoring programme for ambient sound in the North Sea. The UK has also supported activities to reduce noise at the international level, for example at the International Maritime Organization through its Guidelines for the Reduction of Underwater Noise from Commercial Shipping.

Achievement of GES by 2020 - Currently we do not have enough knowledge of the impacts of anthropogenic sound in the marine environment to provide a robust assessment of the extent that GES may have been achieved by 2020. Furthermore, we currently have no national controls to prevent underwater noise from shipping from other flag states using UK waters, and if this proves to be harmful, we will not be able to achieve GES by 2020.

As it will not be possible for the UK to take measures to prevent the continuous noise from non-UK ships in UK waters, exception from achieving GES by 2020, as allowed by Section 15 of the Marine Strategy Regulations would be justified.

Underwater Noise D11: Perspective for 2018 to 2024		
Current Environmental Status in 2018		The achievement of GES for underwater noise in the UK is uncertain. Research and monitoring programmes established since 2012 have provided an improved

		understanding of the impacts of sound on marine ecosystems.
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.	
Criteria and targets for measuring progress towards GES in future	Safe levels of anthropogenic impulsive sound	Levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.
	Safe levels of anthropogenic continuous low frequency sound	Levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals.
Operational targets	We will work nationally and with other countries, particularly in OSPAR to: a) conduct research to establish relevant information on the impacts of noise on marine animals; and b) establish and apply threshold values for levels of anthropogenic impulsive sound and anthropogenic continuous low frequency sound taking into account research on impacts and regional or subregional specificities.	
Indicators to be used to assess the status	- OSPAR Impulsive noise impact indicator (under development) - Surveillance indicator for ambient noise	
Going forward	We will work with other countries sharing our seas to develop threshold values for levels of impulsive and continuous sound which are likely to cause harm at	

	population so that common quantitative targets can be established in the future. We will explore the feasibility of developing a marine noise management strategy with relevant competent authorities, scientists and stakeholders. We will work in international forums such as IMO to ensure that continuous underwater noise from shipping is robustly controlled at global level.

Annex 1: Threshold values or reference levels for the various indicators which the UK plans to use for the 2018-2024 cycle of the UK Marine Strategy to assess whether the associated targets will be met.

Target	Associated Indicator	Threshold value / reference level
Cetaceans		
The long-term viability of cetacean populations is not threatened by incidental bycatch.	Marine mammal bycatch (OSPAR)	Currently, estimates of annual total bycatch are compared against limits agreed by ASCOBANS: 'total anthropogenic removal' of harbour porpoises (mortality resulting from all pressures caused by human activities) should not exceed more than 1.7 % of the best available estimate of abundance; and to achieve this, bycatch should ideally be less than 1% of the best available abundance estimate and ultimately, be reduced to zero (ASCOBANS resolution No. 5, 2006).
There should be no significant decrease in abundance caused by human activities.	Abundance and distribution of coastal bottlenose dolphins (OSPAR) Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)	The UK target for abundance is considered to be achieved for each species, if there is no statistically significant decrease in abundance of 5% or more, over a 10 year period. This threshold is derived from the IUCN criterion to detect a 30% decline over three generations for a species, which equates to slightly less than 0.5% per year for odontocetes. This assessment requires at least three abundance estimates from different years.

Target	Associated Indicator	Threshold value / reference level
Population range is not significantly lower than the favourable reference value for the species.	Abundance and distribution of coastal bottlenose dolphins (OSPAR) Abundance and distribution of cetaceans other than coastal bottlenose dolphins (OSPAR)	Favourable Reference Values (FRV) for population range are currently set for 11 species (under Habitats Directive). The UK target for population range is met if, for each species, there is no statistically significant contraction in their distribution caused by human activities. NB. The FRV for the population range of UK coastal bottlenose dolphins needs to be determined. The FRV for this species is currently set (under Habitats Directive) for all bottlenose dolphins in UK coastal and offshore waters.
Seals		
The long-term viability of seal populations is not threatened by incidental bycatch.	Marine mammal bycatch (OSPAR)	No threshold value currently available.
Population abundance and distribution are consistent with favourable conservation status.	Seal abundance and distribution (OSPAR)	Favourable conservation status will be achieved if seal populations do not decline substantially in the short or long-term and are not significantly lower than favourable reference values. Favourable Reference Values (FRVs) for population size are currently set (under Habitats Directive) using abundance estimates for each species in the whole of the UK. Short and long-term trends in the abundance of harbour seals are assessed in 14 geographical Assessment Units (AU). Grey

Target	Associated Indicator	Threshold value / reference level
		seals are assessed in the single AU and includes data from other countries. The target for population size in each AU is met when a) seal abundance during the preceding 6 year period had declined by less than an average of 1% per year, and/or b) seal abundance decreased by less than 25% since the baseline year (1992 or start of time series, if later). The status of harbour seals is determined by summing AU scores within the Celtic seas and within the Greater North Sea. Metrics to describe seal distribution were included in the UK 2018 assessment, but thresholds are still under development.
Grey seal pup production does not decline substantially in the short or long-term.	Grey seal pup production (OSPAR)	This indicator uses counts of grey seal pups at major breeding sites ('colonies') to estimate total pup production at each colony. The European population of breeding grey seals has been subdivided into geographical Assessment Units (AU) of which 14 are in the UK. The target for pup production in each AU is met if a) grey seal pup production during the preceding 6 year period has not declined by more than an average of 1% per year, and/or b) grey seal pup production has not decreased by more than 25% since the baseline year (1992 or start of time series, if later). These thresholds are based on those used by OSPAR in its Intermediate Assessment 2017. The achievement of the target for pup production in each sub-region is determined by

Target	Associated Indicator	Threshold value / reference level
		summing AU scores within the Celtic seas and within the Greater North Sea.
Birds		
The long-term viability of marine bird populations is not threatened by deaths caused by incidental bycatch catch in mobile and static fishing gear.	Seabird bycatch	No threshold value currently available. Under development as Part of the UK Plan of Action on Seabird Bycatch
The population size of species has not declined substantially since 1992 as a result of human activities.	Marine bird abundance (OSPAR)	a) For each species, annual abundance is expressed as 'relative abundance', which is a proportion of baseline abundance. Relative abundance should be greater than 0.8 for species that lay one egg; or 0.7 for species that lay more than one egg (OSPAR assessment value). Baseline abundance is taken from the start of the time series (1992) or can be set at a time in the past when human impacts were considered to be low. Breeding abundance is assessed separately from non-breeding abundance (i.e. during migration and/or over winter). b) For each functional group of species, the population size of at least 75 percent of the species is above the threshold values. (OSPAR assessment value).
Widespread lack of breeding success in marine birds caused by human activities should	Marine bird breeding success/failure (OSPAR)	a) OSPAR currently equates 'lack of breeding success' to breeding failure, which is defined when almost no chicks (0.1 or less chicks per pair,) are

Target	Associated Indicator	Threshold value / reference level
occur in no more than three years in six.		produced at a seabird colony in a year. 'Widespread' breeding failure occurs if the percentage of colonies failing per year are more than 5% (or, for tern species: the mean percentage of colonies failing over the preceding 15 years). Widespread failure is considered to occur 'frequently' if it occurred in more than three years out of six. c) For each functional group of species, a widespread and frequent lack of breeding success may only occur in 25% or less of species assessed.
	Kittiwake breeding success	a) In addition, annual breeding success of black-legged kittiwakes should not be significantly different, statistically, from levels expected under prevailing climatic conditions (i.e. sea surface temperature). b) The UK target is met if, at a significant proportion of kittiwake colonies, breeding success was not significantly lower than the baseline in at least five years out of six. The baseline is different for each colony and varies between years. The baseline is the annual mean breeding success at a colony in a given year as predicted by the annual mean winter SST (measured during February and March) of the preceding year (i.e. SST^{-1}). If breeding success is significantly lower than the baseline, it is considered not to be in line with prevailing climatic conditions.
There is no significant change or reduction in population distribution	Distribution of breeding and	a) For each species, there are no major shifts or shrinkage in their population distribution. 'Major shrinkage' occurs if

Target	Associated Indicator	Threshold value / reference level
caused by human activities.	non-breeding marine birds	'occupancy rate' decreases, with statistical significance by 10% or more; Where 'occupancy rate' – is equal to the percentage of available tetrads where the species was present. 'Major shift' occurs when the 'shift index' = 0.7 or more. Where 'shift index' - the extent to which the species' distribution has shifted from one area to another. If the shift index = 1, there has been a complete shift in distribution; but if the shift index = 0, there has been no shift in distribution, i.e. the same sites are occupied in both periods. b) For each functional group of species, in at least 75% of species there is no significant change or reduction in population distribution.
Fish		
Incidental bycatch is below levels which threaten long-term viability and recovery of fish populations.	To include bycatch numbers of vulnerable species and catch rates per fishing fleet	No threshold value currently available.
The population abundance of sensitive species is not decreasing due to anthropogenic activities and long-term viability is ensured.	Recovery in the population abundance of sensitive fish species (OSPAR)	Threshold values per species are currently used with the sensitive species metric developed for OSPAR. Two targets are given, one for "Recovery" and one aimed to "halt further decline". The target for recovery is set as: the abundance in the assessment year must lie in the upper 25th percentile of all

Target	Associated Indicator	Threshold value / reference level
		abundance values observed throughout the time series. The target to “halt further decline” is set as: the abundance in the assessment year must lie in the upper 75th percentile (not in the lower 25th percentile) of all abundance values observed throughout the time series.
For listed fish species population abundance and geographic distribution meets established favourable reference values.	UK assessments of listed fish species	The UK conducts assessments of four species of anadromous fish, which return to freshwater to spawn, for article 17 reporting under the Habitats Directive. UK Favourable Reference Values for their freshwater range and abundance have been set for 1-2 species.
For listed fish species, the area and the quality of the habitat is sufficient.	UK assessments of listed fish species	The UK conducts assessments of four species of anadromous fish, which return to freshwater to spawn, for article 17 reporting under the Habitats Directive. UK Favourable Reference Values for their freshwater habitat area have been set for 2 species.
Pelagic habitats		
The structure, function, composition and abundance of the plankton community is not significantly adversely influenced by anthropogenic drivers.	Changes in plankton communities (OSPAR)	No threshold value currently available. The assessment methods for the indicator are being developed to determine if the plankton community distribution is significantly adversely influenced by anthropogenic drivers.
	Changes in plankton biomass and abundance (OSPAR)	No threshold value currently available. The assessment methods for the indicator are being developed to determine if the condition

Target	Associated Indicator	Threshold value / reference level
		of the plankton community is significantly adversely influenced by anthropogenic drivers.
Benthic habitats		
The physical loss of each seabed habitat type caused by human activities is minimised and where possible reversed.	Physical loss of predicted habitats	Within prevailing environmental conditions: **Predominant habitats only:** - Physical loss (permanent change) on the regional extent and distribution of predominant habitats is minimised. **Listed habitat types:** - Physical loss is below the baseline value for listed habitats (Favourable Reference Range and Area for Habitats Directive habitats).
The extent of habitat types adversely affected by physical disturbance caused by human activity should be minimised.	Extent of Physical damage indicator to predominant and special habitats (OSPAR)	**Predominant habitats:** Qualitative threshold: Level of exposure to pressure should not result in more than 'Moderate Impact' (as defined by the disturbance categories). Quantitative threshold: the area of seafloor in poor condition is less than 15% for each of the assessment areas within the Celtic and Greater North Sea. **Listed habitat types:** Qualitative threshold: Level of exposure to pressure should be less than 'Moderate Impact' (as defined by the disturbance categories). Quantitative threshold: the area of habitat in poor condition (as defined by condition indicators) must not exceed 5% of the baseline

Target	Associated Indicator	Threshold value / reference level
		value (Favourable Reference Area for Habitats Directive habitats).
	Benthic communities indicator (OSPAR)	Condition of the benthic community (including biotic and abiotic structure and functions) at risk from physical disturbance is stable or recovering. There should be no adverse impacts through changes in species composition and their relative abundance by physical disturbance. **For all predominant habitat types:** The area of habitat in poor condition (as defined by condition indicators) must not exceed 15% of total available habitat area.
Habitat loss of sensitive, fragile or important habitats caused by human activities is prevented, and where feasible reversed.	Physical loss of predicted habitats indicator (Extent of benthic habitat)	**Listed habitats:** The extent and distribution of sensitive or representative seabed habitats, and the associated species that they support, is stable and/or increasing, and not smaller than a baseline value for listed habitats (Favourable Reference Range and Area for Habitats Directive habitats). WFD extent targets for saltmarsh and seagrass will be used within WFD boundaries as appropriate. **Predominant habitats:** The loss of particularly sensitive or fragile species or habitat providing a key ecosystem function, caused by physical loss should be prevented and where feasible such species or habitat should be restored.

Target	Associated Indicator	Threshold value / reference level
The extent of adverse effects caused by human activities on the condition, function and ecosystem processes of habitats is minimised.	Benthic communities indicator (OSPAR)	**Listed habitats:** The extent of adverse effects from anthropogenic pressures on the condition of the habitat type, including alteration to its biotic and abiotic structure and its functions does not exceed their baseline value (Favourable Reference Area for Habitats Directive habitats) and shows sustained reduction. And benthic ecosystem functioning and seafloor integrity are stable or recovering. WFD Ecological Quality Ratios for saltmarsh and seagrass will be used within WFD boundaries as appropriate. **Predominant habitat types:** Damaging human impacts on predominant sediment habitats (biotic and abiotic components), individually and cumulative, are reduced: The extent of adverse effects on the condition of habitats and associated ecological processes caused by human activities is reduced and the precautionary principle is applied to the most sensitive habitat types and/or those which are most important for ecosystem functioning, and ecosystem services. WFD Ecological Quality Ratios should be used within WFD boundaries as appropriate.
	Aggregated Infaunal Quality Index	
	Aggregated Saltmarsh Tool	
	Aggregated Rocky Shore Macroalgal Index	
	Aggregated Intertidal Seagrass Tool	
	Intertidal rock community change indicator (MarClim)	
D2 NIS		
The number of newly introduced NIS is minimised and where possible reduced to zero.	The number of new NIS introduced.	No threshold value currently available.

Target	Associated Indicator	Threshold value / reference level
The rate of spread of invasive NIS, as a result of human activities is minimised and reduced where possible.	The number of new populations of established invasive NIS.	No threshold value currently available.
Commercial fish		
The Fishing mortality rate of populations of commercially-exploited species is at or below levels which can produce the maximum sustainable yield.	Commercial fishing pressure for stocks of UK interest.	The overall proportion of stocks with fishing mortality rates at or below the level capable of producing maximum sustainable yield (F_{MSY} or its proxies) should be increasing and ultimately all stocks should be at or below their targets.
The Spawning Stock Biomass of populations of commercially-exploited species are above biomass levels capable of producing the maximum sustainable yield.	Reproductive capacity of commercially exploited stocks of UK interest.	The overall proportion of stocks with spawning stock biomass estimates ≥ MSY $B_{trigger}$ (or proxy values) should be increasing and ultimately all stocks should be above their targets.
Food webs		
The species composition and relative abundance of representative feeding guilds are indicative of a healthy marine food web.	Mean maximum length of fish (OSPAR). Other representative species composition indicators of seabirds and marine mammals could be	No threshold value currently available.

Target	Associated Indicator	Threshold value / reference level
	developed using current data.	
The balance of abundance between representative feeding guilds is indicative of a healthy marine food web.	An indicator of biomass of predatory feeding guilds for fish is currently under development using current data. This could be expanded to seabirds and marine mammals.	Development of this indicator is being led by the UK in OSPAR. The indicator is likely to be used as a surveillance indicator with a lower limit that could be used to triggeraction (e.g. management or more research). It is not appropriate to set thresholds that are indicative of good status.
The size structure of fish communities is indicative of a healthy marine food web.	Fish community size structure: Typical Length (TyL - OSPAR) and/or Large Fish Index (LFI - OSPAR)	Thresholds identified for LFI Further development by the UK in OSPAR is required. But these will require revisiting in light of new data. For TyL, current trends-based assessment approaches can be complemented with lower limits identifying the point at which action (management or more research) is required – these limits are in development by ongoing Cefas project.
Productivity of the representative feeding guilds, characterised by key species, is indicative of a healthy marine food web.	D4C4s required information on multiple components (seabirds, marine mammals, fish and pelagic habitat). Indicators will be developed	Existing thresholds under D1 for seabirds and seals require revisiting under the context of D4. Thresholds for primary production and fish production (larval abundance) require development work.

Target	Associated Indicator	Threshold value / reference level
	building on existing D1 indicators for seabird breeding success and seal pup production. An existing D4 OSPAR pilot assessment for Primary production of phytoplankton can support this indicator. Previous Cefas/MBA projects investigating larval abundance including the keystone fish species (sandeels).	
D5 Eutrophication		
Nutrient concentrations are below the levels which could lead to harmful eutrophication effects.	nutrient concentrations of DIN and DIP	Eutrophication assessed by combining indicator results according to OSPAR Common Procedure Nutrients: Coastal water: 18uM Nitrogen Offshore water:15 uM Nitrogen
Chlorophyll a concentrations are below	Chlorophyll in the water column	Chlorophyll: 90th percentiles of growing season (March to October, inclusive) chlorophyll

Target	Associated Indicator	Threshold value / reference level
levels which could lead to harmful eutrophication effects.		concentration in the water column. Assessment thresholds are 15 µg L^{-1} for coastal waters and 10 µg L^{-1} for offshore waters.
Dissolved oxygen content in coastal waters are above levels which could lead to harmful eutrophication effects.	Oxygen saturation	Oxygen: 50-75% oxygen saturation.
D7 Hydrographic conditions		
All significant marine infrastructure developments must meet licensing conditions to ensure they do not adversely affect the marine ecosystem.	No specific indicators for D7	
D8 Contaminants		
Concentrations of contaminants measured in the most suitable compartment (water, sediment or marine biota) comply with the appropriate threshold values which indicate harm to sea life and are not increasing. (Environmental Quality Standards in the WFD, OSPAR Environmental Assessment Criteria and	Metals in biota	The concentrations of cadmium, mercury and lead in biota are assessed against OSPAR "proxy Environmental Assessment Criteria" based on the food standards for humans set out in EC regulation No 1881/2006.

Target	Associated Indicator	Threshold value / reference level
UK values for river basin specific pollutants).		
Concentrations of contaminants measured in the most suitable compartment (water, sediment or marine biota) comply with the appropriate threshold values which indicate harm to sea life and are not increasing. (Environmental Quality Standards in the WFD, OSPAR Environmental Assessment Criteria and UK values for river basin specific pollutants).	Metals in sediment	Effects Range Low (ERLs) are used as proxy assessment criteria. For further details of ERLs see[i].
	PCBs in biota PCBs in Sediment	OSPAR Environmental Assessment Criteria (EAC) For details see[ii].
	PAH in biota (shellfish)	OSPAR Environmental Assessment Criteria (EAC). For further details see[iii].
	PAH in sediment	PAH concentrations in sediments were assessed against the Effects range-Low (ER-L) values which were developed by the United States National Oceanic and Atmospheric Administration (NOAA), for the US Environment Protection Agency[iv].
	PBDEs in biota PBDEs in sediment	No assessment threshold developed. Trend used. SEDIMENTS: Canadian Federal Environmental Quality Guidelines (FEQGs) were developed under the Canadian Environmental Protection Act 1999 for BDE28, BDE47, BDE66, BDE99, BDE100, BDE153, BDE154, BDE183 and BDE209. OSPAR are using these on a trial basis. (http://dome.ices.dk/osparmime2018/help_ac_sediment_organo-bromines.html)

Target	Associated Indicator	Threshold value / reference level
		BIOTA: OSPAR Environmental Assessment Criteria (EACs) have not been developed for PBDEs in biota, and are unlikely to be developed in the near future. However, Canadian Federal Environmental Quality Guidelines (FEQGs) were developed under the Canadian Environmental Protection Act 1999 for BDE28, BDE47, BDE99, BDE100, BDE153 and BDE154. OSPAR are using these on a trial basis.
	Radionuclides	UK regulatory limits of dose based on the International Commission on Radiological Protection (ICRP). For further details see[v].
	Coastal water contaminants in water column	Environmental quality standards set in Directive 2008/105/EC.
	Inputs of metals from air and water	Trend assessment used.
	River basin specific pollutants	Values developed by UK Technical Advisory Group.
Biological or ecological effects on sea life due to contaminants are below thresholds agreed by OSPAR as appropriate for MSFD purposes.	Imposex in dogwhelks	OSPAR Environmental Assessment Criteria (EACs) for imposex in dogwhelks For further details see[vi].
	Micronucleus in fish	OSPAR species-specific background assessment criteria (BAC) to assess genetic damage in fish blood cells using the micronucleus assay.

Target	Associated Indicator	Threshold value / reference level
		For further details see end note[vii].
	EROD activity	OSPAR species-specific Background Assessment Concentrations (BACs) to assess the activity of EROD in fish liver. For further details see end note [vi].
	Bile metabolite	OSPAR species-specific Background Assessment Concentrations (BACs) and Environmental Assessment Criteria (EACs) to assess PYR1OHEQ concentrations in fish. For further details see end note[vi]
	Liver neoplasm in fish	The assessment thresholds were classified into three responses of background, elevated and significant, by separating the total observable range of liver neoplasm prevalence corresponding to MSFD sub-Region. For further details see end note[vi]
	Fish disease	OSPAR and ICES Environmental Assessment Criteria (EACs) are used. For further details see end note[vi]
Occurrence and extent of significant acute pollution events are minimised.	Oil spills	For the purposes of this assessment, a spill volume of >1t is used for trend analysis.
D9 Contaminants in Seafood		
For contaminants where regulatory levels have been set, and a risk assessment has	Contaminant concentrations in seafood	Maximum Levels set out in EC Regulation 1881/2006 are used, where available.

Target	Associated Indicator	Threshold value / reference level
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		
D10 litter		
A decrease in the total amount of the most common categories of litter found on surveyed beaches	Litter types on beaches	Trends used. No threshold value currently available.
A decrease in the number of items of litter on the seabed.	Litter on the seabed	Trends used. No threshold value currently available.
A downward trend in the number of northern fulmars with more than 0.1 g of plastic particles in their stomach	Floating litter	OSPAR goal is that fewer than 10% of fulmars should have more than 0.1g of plastic in their stomachs.

Target	Associated Indicator	Threshold value / reference level
Develop an appropriate indicator to measure micro-litter in the marine environment.	Micro-litter in the sea	Micro-litter threshold values not currently available.
D11 underwater noise		
Levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals.	Impulsive sound in the sea	Impulsive sound threshold values not currently available.
Levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals.	Continuous low frequency sound (ambient noise) in UK seas	Continuous sound threshold values not currently available.

[i] US EPA, 2013. http://www.epa.gov/emap2/maia/html/docs/Est5.pdf

[ii] OSPAR, 2009. Background document on CEMP assessment criteria for QSR 2010.

Publication Number: 461/2009. pp. 23 and OSPAR (2016). OSPAR Coordinated Environmental Monitoring Programme (CEMP). Agreement 2016-01

[iii] OSPAR Publication 2009-461 Background Document on CEMP Assessment Criteria for the QSR 2010

[iv] See OSPAR Publication 2009-461 Background Document on CEMP Assessment Criteria for the QSR 2010 for details.

[v] ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4).

[vi] OSPAR Commission. 2009. Background Document on Assessment Criteria used for assessing CEMP Monitoring Data for the Concentrations of Hazardous Substances in Marine Sediments and Biota in the Context of QSR 2010. OSPAR Publication 461/2009. ISBN 978-1-907390-08-1. Available via 'Publications' on www.ospar.org

[vii] OSPAR, 2013. Background document and technical annexes for biological effects monitoring, Update 2013. ISBN 978-1-909159-22-8 Publication Number: 589/2013