

# Summary of evidence: Marine

## 1 General introduction

This summary sets out Natural England's assessment of the evidence relating to the marine environment. It provides a statement of the current evidence base, presenting:

- what we know (with supporting data and key references);
- areas that are subject to active research and debate; and
- what we do not yet know from the evidence base.

It also provides information on Natural England research and key external research programmes to show how we are seeking to fill gaps.

This summary forms part of a suite of summaries covering all of Natural England's remit. The summaries are not systematic reviews, but enable us to identify areas where the evidence is absent, or complex, conflicting and/or contested. These summaries are for both internal and external use and will be regularly updated as new evidence emerges and more detailed reviews are completed.

## 2 Introduction to marine

Here 'marine' includes the intertidal zone, and hence habitats such as rocky shores and salt marsh. Other coastal habitats such as dunes, shingle banks are covered in the Natural England Land Use Summary of Evidence. Natural England's remit extends to 12 nautical miles around the English coast. In addition we have delegated authority from Joint Nature Conservation Committee (JNCC) to provide advice on renewable energy in offshore waters around England.

The coast around England (mainland and principal islands) is about 6,261 miles long ([British Cartographic website](#)). The sea area out to the 12 nautical mile limit covers 5,623,000 hectares and is a quarter of the geographical remit of Natural England.

A substantial body of detailed and up-to-date evidence on the marine environment as a whole has been collated and interpreted in the UK Government report Charting Progress 2 – the state of UK seas (UKMMAS 2010) and the Marine Strategy Part One: UK Initial Assessment and Good Environmental Status (HM Government 2012); this summary includes signposts to some of that more detailed evidence.

Marine is considered in the summary of evidence below under the following headings:

- Importance of the resource.
- Pressures, risks and impacts.
- State of marine biodiversity.
- Protection and management.

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### 3 Importance of the resource

#### We know that:

#### 3.1 The waters around England are very diverse and extremely important for biodiversity.

They are characterised by great biogeographic variation ([www.marbef.org/wiki/Biogeography](http://www.marbef.org/wiki/Biogeography)) and encompass the boundary between cold and temperate-water communities (UKMMAS 2010). The inshore seabed consists of large areas of coarse sediments, sandy sediments and rocky habitat, and recent projects eg UK SeaMap 2010 and Defra research ([Defra project code MB0102](#)) have provided the most comprehensive evidence thus far on the distribution of marine habitats, species and geological and geomorphological features. Many habitats are of European significance (shown by listing in the annexes of the EC Habitats Directive) such as chalk reef and estuaries (Joint Nature Conservation Committee 2007). England's saltmarsh resource is larger than that of Northern Ireland, Scotland and Wales combined, with many extensive stands across a wide range of estuaries and open coast (Environment Agency 2011).

3.2 British seas contain around 8,000 species<sup>1</sup> including over 200 marine species considered to be of conservation concern. These include algae, corals, other invertebrates, cetaceans, fish and birds. England's seas also have internationally important breeding seabird populations which are dependent upon the marine environment for aspects of their life cycle; and internationally and globally important populations of overwintering waterbirds and gulls. England's estuaries are vital stopover points for migratory birds on the NE Atlantic flyway for resting and feeding.

3.3 The oceans, the shore and their biodiversity provide valuable ecosystem goods and services (Watson & Albon 2010). For example the oceans play a major role in **climate regulation**, absorbing 30% of the emitted anthropogenic CO<sub>2</sub> (Intergovernmental Panel on Climate Change 2013) and specific habitats including seagrass beds, intertidal sediments, salt marsh and kelp forests found in England make an important contribution to **carbon management and nutrient cycling** (Jickells *et al.* 2000, Laffoley & Grimsditch 2009, and Shepherd *et al.* 2007). Habitats including salt marshes, seagrass beds and sandbanks make an important contribution to **erosion control and flood risk management** by dissipating wave energy and, thereby, substantially reduce the need for and cost of flood defence measures. Healthy marine ecosystems support fish and shellfish species which are an important **source of food** for British consumers.

3.4 England's seas are important for several sectors of the economy. There are about 200 ports operating in England and, in 2007, the UK **ports** sector (there are around 120 commercial ports in the UK) was estimated to have supported £17.9 billion of UK GDP (Oxford Economics 2009). There were just over 3,100 **fishing boats** in England in 2012, and English vessels land 30% of the UK catch (Marine Management Organisation 2013). Marine **aggregates** provide up to 20% of primary aggregate supply for England and Wales ([www.thecrownstate.co.uk/energy-and-infrastructure/aggregates/](http://www.thecrownstate.co.uk/energy-and-infrastructure/aggregates/)) and, for example, made a substantial contribution to the construction of the Olympic Park. The total potential of **offshore wind** (existing, in development and planned) around England is around 17.5 GW with nearly 2,500 turbines already built or under construction (V Copley pers. comm.) and there is potential for a substantial contribution from wave and tidal energy resources to the UK energy mix. People value a

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<sup>1</sup> UK figure, no precise data available for England only but the majority of species in UK waters also occur in English waters. 8,000 species is approximately 10-15% of total species on land.

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healthy sea and marine biodiversity: there are up to 75 million leisure visits to our undeveloped coast each year (Natural England *et al.* 2006). Marine **leisure and recreation** have a gross added value of approximately £1.3 billion (UKMMAS 2010). According to research, people would be willing to pay additional tax for a UK network of MPAs (McVittie & Moran 2008).

3.5 Around 2% of all adults partake in sea angling activities, £831million (after tax and imports) is spent annually and 399 charter boats for sea angling were recorded in England in 2012 (Armstrong *et al.* 2013).

### We do not know:

**3.6 Enough about the distribution of some features.** We also have significant gaps in our knowledge of the distribution and extent of other marine habitats and species, especially outside of protected areas. For example, less than 10% of the UK seabed has been directly surveyed and most of the area surveyed is within inshore waters (UKMMAS 2010). Two key current gaps are our understanding of the distribution, behaviour and sensitivity of some bird populations and of migratory fish, for example to inform advice on offshore wind developments.

**3.7 Enough about the functioning of marine ecosystems.** Though we have a broad understanding of marine ecosystems, functional pathways, community structures and connectivity, we lack detailed understanding and quantification. We have limited points of reference against which to assess recovery of habitats in the absence of significant anthropogenic pressures. The NERC Marine Ecosystems Programme running 2013 to 2018 is likely to provide significant new knowledge on this topic ([www.nerc.ac.uk/research/funded/programmes/marineecosystems/](http://www.nerc.ac.uk/research/funded/programmes/marineecosystems/)).

**3.8 Enough about the specific ecosystem services provided by different habitats.** There needs to be more detailed and quantifiable information on services provided by different marine habitats (see Fletcher *et al.* 2012). We need a better understanding of the linkages between biodiversity, ecosystems and ecosystem processes, and climate regulation to factor these in to management responses.

### Areas subject to active research and debate:

**3.9 Habitat and species distributions.** Recent and forthcoming surveys, for example in support of new Natura 2000 (N2K) sites and recommended Marine Conservation Zones (MCZs), are increasing our knowledge of feature extent. We've recently increased our understanding of seabird density through mapping work (report /paper in press) and we are currently considering how to apply this to our advice. Natural England is currently producing maps for all designated features and sub-features in Marine Protected Areas (MPA) ([www.gov.uk/government/policies/protecting-and-sustainably-using-the-marine-environment/supporting-pages/marine-protected-areas](http://www.gov.uk/government/policies/protecting-and-sustainably-using-the-marine-environment/supporting-pages/marine-protected-areas)).

**3.10 Valuing nature.** Although there have been recent reports and evidence such as the National Ecosystem Assessment (<http://uknea.unep-wcmc.org/>), we need to go further to fully identify and quantify the 'worth' of marine biodiversity and healthy ecosystems; investing now will save resources in the long-term (and avoid the costs associated with a degraded ecosystem). Defra's Natural Capital Committee is developing evidence, tools and guidance to improve the understanding of the value of natural capital ([www.naturalcapitalcommittee.org/](http://www.naturalcapitalcommittee.org/)).

**3.11 Enhancing biodiversity for ecosystem resilience and recovery.** More diverse ecosystems tend to provide a broader range of services, so restoring biodiversity can increase service provision

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(Worm *et al.* 2006). A more biodiverse ecosystem may have more resilience and potential for recovery (Hughes *et al.* 2005). Hsieh *et al.* (2008) show that unexploited fish species are able to respond more readily to environmental change than exploited fish stocks. However, there are very few robust marine examples to demonstrate this further and more research is needed. Having a resilient ecosystem may be increasingly important in the future when our marine habitats and species are subjected to a more rapidly changing climate.

## 4 Pressures, risks and impacts

### We know that:

**4.1 Historic and ongoing exploitation of the sea** has not only resulted in degradation of the marine environment (see 'State') but also continues to exert pressures and risks to the ecosystem.

**4.2 Fisheries result in pressures and impacts on target stocks, other species and the wider ecosystem:**

- **Removal of target species:** In its 2013 report the Marine Management Organisation (MMO) recorded 36 species of fish and shellfish landed commercially in England (other non-specified species were also landed). This equated to 104.1 thousand tonnes of landed catch in 2012 (compared to 393.1 thousand tonnes in the UK as a whole) (MMO 2013a).
- **Removal of non-target species:** Discard rates vary between target species and between types of fishing gear; in the UK, discard rates are estimated to be up to 70% for flat fish, 60% for round fish, and 20-60% for Nephrops fisheries (European Commission, 2011). As part of the discards trial the MMO has produced more specific data on average discard rates and 2011 figures suggest that discards for cod trawlers in the North Sea were 38% and 28% for Western Channel sole beam trawlers (MMO 2013b). Interaction between bottom-towed fishing gear and the seafloor can also result in mortality of benthic species. For example, a single beam trawl track can lead to 20-65% mortality of bivalves and 5-40% mortality of other taxa (Bergmand and van Santbrink 2000).
- **Physical disturbance of the seabed:** The abrasive contact between fishing gear and the seabed can alter seabed complexity, remove or damage flora and fauna, reduce benthic production and consequently result in changes in benthic community structure and habitat. The magnitude of impact depends on the sensitivity of the seabed and the intensity of fishing pressure (eg Kaiser *et al.* 2006 and references therein). Some habitats, such as reefs, seagrass and maerl, are particularly sensitive to disturbance by bottom-towed fishing gear. It was estimated that between 5.4% and 21.4% of the England and Wales seabed was subject to bottom trawling (by vessels >15 m in length) in 2004 (Eastwood *et al.* 2007).

**4.3 Other extractive uses including aggregate, maintenance and capital dredging** may cause abrasive pressures, as well as physical removal of the habitat. However, only a relatively small area of the English inshore area is exposed to dredging, with 711 km<sup>2</sup> of seabed licensed for aggregate marine dredging across England and Wales (Crown Estate & Mineral Producers Association 2012).

**4.4 High levels of development** including requirements for flood and coastal defences cause pressure on our coastline leading to **habitat loss and changes to dynamic coastal processes**. For example, coastal squeeze reduces habitat extent and impacts on processes which maintain dynamic coastal habitats (Morris *et al.* 2004) (See the Natural England Land Use Summary of Evidence for details).

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**4.5 Non-native species can become invasive, altering local ecology and out-competing native species.** Ninety non-native species have been identified from British marine and brackish environments and 58 of these are established (Minchin *et al.* 2013). Their arrival has been principally due to shipping and imported consignments of cultured species (Minchin *et al.* 2013). Examples of species assessed as being high risk based on the likelihood of entry, establishment, spread and potential level of impact include the slipper limpet *Crepidula fornicata* and the carpet sea squirt *Didemnum vexillum*. To date, there has been no successful complete eradication of a marine non-native species in the UK.

**4.6 Pollution and water quality causes local impacts on the marine environment.** Water pollution<sup>2</sup> has been one of the top two causes of coastal SSSIs being in unfavourable condition (Natural England 2008), and continues to have an impact upon a number of marine Special Area of Conservation (SAC) features (JNCC 2013) and Special Protection Areas (SPAs) (Coyle and Wiggins 2010). Diffuse pollution and a significant historical legacy of pollution, particularly within estuarine sediments, suggests pollution hot spots will remain for years to come (UKMMAS 2010).

4.7 Levels of beach litter doubled between 1994 and 2007, with a current average of over 2,000 items recorded per kilometre. Plastics were the main type of litter found both on and offshore, including increasing quantities of microscopic pieces of plastics (UKMMAS 2010).

**4.8 Underwater noise may cause adverse effects on a range of marine species.** The impact of anthropogenic noise<sup>3</sup> on marine life is of growing concern. Effects on marine life vary greatly from very subtle behavioural changes, avoidance reaction, hearing loss, injury and death in extreme cases. Some underwater noise such as from pile driving can be heard by marine life such as harbour porpoise over distances of at least 80 km (Thomsen *et al.* 2006).

**4.9 Human activities are increasing in our seas, particularly those that are associated with Nationally Significant Infrastructure Projects.** For example, finding room for the planned renewable energy in the UK will add to the pressures on habitats and species such as seabirds, seals and cetaceans. Wave and tidal energy projects are likely to increase in the next 5 - 10 years with commercial scale proposals likely within English waters.

4.10 Other activities such as aquaculture saw an overall increase in the UK of 132% between 2000 and 2006 (UKMMAS 2010). Novel uses with lesser known impacts, such as gas storage, carbon capture and storage (CCS) and fracking, are likely to increase and will need to be considered in marine plans and future licensing.

**4.11 Activities cause cumulative effects and these are hard to assess** (MMO 2013c). The environmental effects of an individual activity can interact with those from other activities and these cumulative impacts are often difficult to assess. This is due to a number of reasons such as uncertainty over how impacts interact, the scale at which the assessment is done and the level of available information on other projects (European Commission 1999).

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<sup>2</sup> Encompassing nutrients, dissolved oxygen, eutrophication, microbial contamination, toxic substances and silt loading.

<sup>3</sup> For example, explosions, shipping, seismic surveys, estuarine, inshore and offshore construction, dredging and drilling, sonar of various types, and acoustic deterrent devices.



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**4.12 Impacts from climate change and ocean acidification are increasing.** Sea surface temperatures around the UK have been increasing since the 1980s (up to about 0.6 - 0.8 °C per decade in the southern North Sea and eastern English Channel (MCCIP 2010)). Ocean acidification is increasing more now than in the last 300 million years, and there is growing evidence of the importance of the interactions between acidification and other stressors such as temperature (MCCIP 2013). The overall effect of ocean acidification on marine ecosystems is likely to be negative, with predicted risks to the growth of shellfish and other groups with calcified structures within 50 years (MCCIP 2013). Warming seas will alter species distribution, with shifts northwards in the range of some species already being observed within both intertidal and subtidal ecosystems. Warmer water species are occurring more frequently in UK waters and the timing of spawning for some fish species is also observed to be shifting (MCCIP 2013).

### We do not know:

**4.13 Where all activities occur, their intensity and frequency, especially fishing and recreational activities.** The use of a Vessel Monitoring System (VMS) is now obligatory for EU commercial fishing vessels over 12 m in length. The use of these monitoring systems has enabled some natural and fishing related disturbances to be compared, allowing estimates of seabed damage to be calculated (Diesing *et al.* 2013). However, in 2012 82% of the English fleet was under 10 m in length (MMO 2013). Other evidence such as landings, MMO and IFCA sightings data (<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=1&ProjectID=18126>) are being used to aid understanding of activity distribution and intensity of the under 12 miles (primarily inshore) fleet. Limitations associated with the spatial and temporal resolution of these data mean that detailed assessments of the interaction between fishing activities and features of MPAs are challenging. We also have limited understanding of and ability to predict how the distribution and intensity of fishing activity may change through displacement of activity, including as a result of MPA management measures. Further, robust evidence of where, when and at what intensity land-based fishing activities such as recreational and commercial shellfish hand gathering, bait digging and seaweed harvesting occur is generally lacking.

4.14 For recreational activities there is some information on the location of marinas, slip ways, clubs and shipping, sailing routes. However, accurate information on participation rates and when and where activities occur is lacking.

### 4.15 The significance of some new pressures and of cumulative impacts:

- **Noise:** whilst we know that levels are increasing, the effects of noise at population levels for marine species and cumulative effects from multiple sources are poorly understood. There are currently insufficient data to provide a quantitative assessment of the current status and trends of underwater noise in UK seas due to a lack of available information from monitoring studies.
- **Pollution:** The combined and cumulative effects of mixtures of toxic pollutants.
- **Litter:** The effects of offshore litter and its breakdown products, in particular microparticles.
- **Acidification:** the effects on biodiversity in England's seas.
- **Displacement of species:** for example, the effects of increasing density-dependent competition on survival and fitness of marine birds following displacement from offshore wind farms.
- **Displacement of activities:** how industry may move to other areas in response to potential restrictions, such as those from MPAs.

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- **Marine non-native species:** there is a lack of evidence on distribution and abundance of these species and the associated risks to protected site features.
- **Collision of mobile species** with new forms of marine renewable energy devices and of birds and other megafauna with wave and especially tidal energy devices.

**4.16 The response to combined impacts of climate change** of ecosystems, habitats and species and how best to ensure effective adaptation. Further research is also required to determine if responses are additive, compensatory or neutral in relation to other anthropogenic impacts. For example, distinguishing between the relative importance of climate change and overfishing is proving difficult in diagnosing the causes of change in some species populations. The combined impacts of ocean acidification and warming on fisheries also remains unclear, as do their effects on nutrient availability and the overall effect on seagrass beds. Isolating impacts of water pollution and nutrient enrichment is also difficult to achieve as changes may also be driven by both climate change impacts and human pressures such as farmland management and rainfall (MCCIP 2013).

### Areas subject to active research and debate:

**4.17 In-combination and cumulative assessment of pressures**, especially with respect to birds and marine mammals and how this is translated into decision making. In discrete areas eg the North Sea in-combination effects are at the forefront of our concerns and pose perhaps the greatest consenting risks. Decisions need to be taken by the regulators on the parameters for in-combination assessment (eg whether “as consented” or “as built” scenarios are used, how schemes can be allocated to different tiers of in-combination assessment and the importance which could be allocated to each tier; how ‘apples and pears’ [eg impact assessments based on different collision risk models] can be combined), and discussions are ongoing as part of the coping strategy.

**4.18 The significance of impacts of activities on species at the population level.** Increased uncertainty associated with effects in data poor areas (eg offshore, wide ranging sea birds) creates challenges to assessing the consequences of impacts. When little or no empirical evidence exists on the effects of interventions then other approaches, such as modelling, are being used. The validation of these models is the subject of active research. However, in these situations there is debate over what acceptable limits of loss might be. For example, ways of collating numbers of birds colliding with turbines is under regular discussion with developers and regulators.

**4.19 The impacts of development and effectiveness of mitigation measures, particularly in regards to renewable energy, on birds, fish and marine mammals.** The Habitats and Birds Directives Implementation Review Marine Evidence Group has identified a series of evidence gaps which the Group are looking at ways of filling (Defra 2013). An expert panel of scientists has provided advice on key marine mammal evidence gaps and Centre for Environment, Fisheries and Aquaculture Science (Cefas) have been commissioned to undertake several reviews looking at impacts of development on migratory fish, mitigation measures being applied by different sectors and post consent monitoring (Defra 2013). How these data from post consent monitoring are used and fed back to inform future debate needs further discussion.

**4.20 The potential effect of fisheries on protected habitats and species.** With the recent change in approach to fisheries management within European marine sites (<https://www.gov.uk/government/collections/fisheries-in-european-marine-sites-implementation-group>) Defra, the MMO, Inshore Fisheries and Conservation Authorities' (IFCAs), Cefas, JNCC and

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Natural England are looking to gather additional evidence to help determine why and where management measures are required to protect habitats and species from the impacts of fishing. For example we are working in partnership with Newcastle University and the Northumberland IFCA, to investigate the impacts of potting gear on benthic habitats in the Berwickshire and North Northumberland SAC and the implications for management of the site and the commercial fishery. Further, the MMO are leading a project ([www.gov.uk/government/collections/inshore-vessel-monitoring-system-project](http://www.gov.uk/government/collections/inshore-vessel-monitoring-system-project)) to develop an inshore Vessel Monitoring System (iVMS) as a potential management solution for fisheries and MPAs in English waters. Inshore VMS would help fill evidence gaps relating to spatial and temporal interaction between fishing vessels less than 12 m in length and protected habitats and species (see also 4.13).

**4.21 The sensitivity of habitats and species to pressures.** Work is ongoing within JNCC, Natural England and others (including Marine Scotland [www.marine.scotland.gov.uk/FEAST/Index.aspx](http://www.marine.scotland.gov.uk/FEAST/Index.aspx)) to fill the gaps in knowledge of sensitivity highlighted in the MCZ Project ([Defra project MB0102](#)). We particularly need to understand the levels of activities which are likely to cause unsustainable damage to habitats and species in order to give better evidence-based conservation advice to regulators and interpret assertions made within Environmental Statements in order to respond to casework. For example, a deeper understanding of the workings of population models for use in assessing offshore wind collision impacts on breeding seabird colonies.

## 5 State of marine biodiversity

### We know that:

**5.1 Many marine habitats are in unfavourable condition, with some in decline.** The most recent assessment for habitats listed in the Habitats Directive (JNCC 2013) reported no marine habitats favourable at the UK level, with three being at 'unfavourable bad' conservation status, three with 'unfavourable inadequate' status and two being unknown. The three in 'unfavourable bad' conservation status are estuaries ('bad-declining'), mudflats and sandflats ('bad-improving') and large shallow inlets and bays ('bad-improving'). Reefs are reported as 'unfavourable inadequate-decline'. The unfavourability is mostly due to habitats failing on the structure and function parameters due to the influence of pressures.

**5.2 Species show a mixed status.** Over 20 species of marine vertebrates in the UK are internationally 'threatened' and an additional four marine species have gone nationally extinct in the recent past from the waters around England (Natural England 2010). Over 30 marine species recorded from English waters are listed as Near Threatened, Vulnerable or Endangered on the IUCN Global Red list and five are Critically Endangered (IUCN 2013). The most recent assessment of Favourable Conservation Status for species listed in the Habitats Directive (JNCC 2013) includes reports of 'favourable' for bottlenose dolphin, harbour porpoise and grey seal, 'unknown' for leather back turtle and maerl species, and 'unfavourable bad-declining' for common seal. There have been improvements in waterbird communities, but the numbers of some seabird species eg terns in the Eastern Channel have been falling (UKMMAS 2010). The England Biodiversity Strategy 'all seabird' indicator' (taken by Government to broadly reflect wider marine biodiversity) is assessed as 'improving' in the long-term; but this masks recent declines in some species, particularly sub-surface feeders including terns and kittiwakes.



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### We do not know:

**5.3 The overall state of England's seas.** Because assessments to date have been made at different scales for different purposes and are generally at the UK or regional seas level it is difficult to make judgements for England's sea area specifically. The 'traffic light' assessment used by Charting Progress 2 (UKMMAS 2010) is broad geographically, varies in confidence and, by aggregating groups of species or habitats, may mask important finer scale variation. Our evidence for the state of features and for sites becomes less comprehensive as we move from the intertidal to offshore and from protected sites to the wider sea. Robust, quantified data to describe trends is often limited to the last few years or decades.

**5.4 How baselines may have shifted.** Baselines are often taken relative to a point in time, frequently within living memory, when data were first collected or quantitative monitoring began, eg of plankton in the 1940s. Qualitative or anecdotal evidence indicates that formal monitoring begins at the tail end of significant historical decline. Thus 'shifting baselines' can arise from each generation (of scientists) viewing the current environmental state as the 'norm'. In addition baselines of activity levels are constantly changing for each new development consented.

**5.5 The state of many features beyond designated sites.** We have inadequate knowledge of the state and trends of many habitats and species, eg subtidal rock/reefs, *Sabellaria spinulosa* reefs, cetaceans and some fish species. Significantly increased knowledge of the wider environment is needed to report on Good Environmental Status under the Marine Strategy Framework Directive (MSFD).

### Areas subject to active research and debate:

**5.6 The condition of every Marine Protected Area.** We are undertaking a 'Condition Assessment' of each Special Area of Conservation (SAC), making judgements on feature condition based on best available evidence, and identifying where confidence in these judgements needs to be improved. Understanding the optimal monitoring frequency and intensity on existing sites, and establishing robust baselines on new sites, will significantly improve our evidence base and ability to undertake assessments. This work will be used to inform how we assess condition for new sites such as MCZs and SPAs. The monitoring information for condition assessment is being gathered through a six-year, risk-based monitoring programme and we are considering how to integrate monitoring across all MPA types (SACs, SSSIs, MCZs and SPAs) in order to look at condition across England's contribution to the MPA network.

**5.7 What Good Environment Status (GES) will look like.** Research is underway to produce new indicators and associated targets where knowledge is currently lacking; this is coordinated by UKMMAS (HM Government 2012). Monitoring programmes are being developed to measure progress towards GES, after which a plan of management measures will be developed. The JNCC marine biodiversity monitoring and surveillance project is looking at developing a monitoring programme to encompass MSFD and other requirements.

**5.8 How to collect data and link different assessments.** There is now a broad range of assessments of features at a national and regional level and assessments at site level, eg Favourable Conservation Status reported across all the UK resource versus SSSI condition at site unit level. These need to be compared, explained and, if need be, rationalised as they are potentially providing inconsistent or misleading results. JNCC's assessment programme is looking at how this harmonisation might work in practice. In order to interpret the assertions made in Environmental Statements there is

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active debate about how to make data more comparable across and between marine developments, for example collision risk modelling in-combination between wind farm developments.

## 6 Protection and management

### We know that:

**6.1 The evidence shows that sustainable use and management of the marine environment are improving.** There is increasing good practice in licensing sustainable developments (eg ABP Green Port Hull). The creation of IFCAs with a wider remit, duties and powers for the management and protection of inshore marine resources has clarified roles. Habitat creation as a result of managed realignment and compensation for development is becoming common at coastal sites ([www.omreg.net/query-database/](http://www.omreg.net/query-database/)).

**6.2 There has been good progress over the last two decades in protecting the marine environment.** The Marine and Coastal Access Act (2009) established the need for a MPA network and the ability to designate and manage MCZs. The area covered by designated MPAs exceeds 1.24 million ha or 24.5% of England's territorial waters. These MPAs include 37 SACs and 45 SPAs designated under the Habitats and Birds Directives (including recent sites designated in 2010 and 2013), 27 MCZs (designated in 2013) and many SSSIs. There are two no-take zones (NTZs) in English waters, at Lundy and Flamborough Head, though the area covered by these zones is quite small. Research and evidence have improved our understanding of criteria to design a network of MPAs (Roberts *et al.* 2010, Hill *et al.* 2010, Jackson *et al.* 2009).

**6.3 108 marine species are afforded some kind of protection around the UK.** ([www.jncc.gov.uk/page-3408](http://www.jncc.gov.uk/page-3408)). There are 18 habitats and 93 species identified as being of principle importance for the conservation of biodiversity under section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

**6.4 The revised approach to commercial fisheries management in European Marine Sites (EMSs)** ([www.marinemanagement.org.uk/protecting/conservation/ems\\_fisheries.htm](http://www.marinemanagement.org.uk/protecting/conservation/ems_fisheries.htm)) is currently being implemented and will lead to well-managed fisheries within EMSs (SACs and SPAs). By June 2014, 13 IFCA and 4 MMO byelaws, confirmed by the Secretary of State, were in place protecting the highly sensitive features (such as seagrass, maerl and *Sabellaria spinulosa* reefs) of 17 EMSs (primarily SACs) from the potential impacts of bottom-towed fishing gear and intertidal fishing activities. The benefits of these sorts of management measures are illustrated by the Lyme Bay closed area, where there are signs of recovery in reef and adjacent communities, including increased abundance of corals and tunicates, in areas where fishing by dredging and bottom trawling has been excluded since 2008 (Attrill *et al.* 2011, Sheehan *et al.* 2013). Work on how to manage interactions between fishing activities and all other protected features of these, and the remaining EMSs is underway. Management measures, where required, will be introduced by the end of 2016.

**6.5 Proposed and planned protection will go further to complete the ecologically coherent MPA network.** Natural England is working with JNCC to complete the protection of birds through the SPA series in English waters to ensure species of European importance receive the required protection. Future tranches of MCZs will help to further protect the marine environment, covering a wider range of important marine habitats and species and filling existing gaps in the network (Defra 2014 and JNCC 2014). Any new fisheries will be subject to Habitats Regulations Assessment which will improve the management of fisheries around European features.

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**6.6 Highly protected areas provide additional benefits.** A study of European marine reserves found that biomass increased on average by 251% and the number of plants or animals increased on average by 121% inside marine reserves (Partnership for Interdisciplinary Studies of Coastal Oceans 2011). Results from the 3.3 km<sup>2</sup> no-take zone (NTZ) at Lundy show that seven years after the NTZ was established, lobsters were up to seven times more abundant in the NTZ. However, there was a significantly higher prevalence of shell disease in the NTZ lobsters than in the surrounding area (Hoskin *et al.* 2011, Wootton *et al.* 2012).

### We do not know:

**6.7 How to define success measures** for an ecologically coherent network of MPAs and how to assess whether the network is delivering benefits to the wider environment beyond sites.

**6.8 What 'recovery' looks like for many habitats,** particularly sediments (a substantial proportion of the inshore resource in England). This is needed in order to be able to put the current condition that we observe into context and to inform target setting for indicators of Good Environmental Status under the Marine Strategy Framework Directive and our conservation advice.

**6.9 The desired outcomes for new habitats and species of principal importance.** Following publication of the revised list of UK BAP priority species and habitats ([www.jncc.defra.gov.uk/page-5705](http://www.jncc.defra.gov.uk/page-5705)) there is a need to work with partners to agree goals for their protection.

### Areas subject to active research and debate:

**6.10 Defining conservation objectives for MPAs using a new approach to providing conservation advice.**

(<http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/our-work/marine/mpa/ems/mpaconservationadvice.aspx>). This involves developing and testing new frameworks for habitats and species describing their ecological needs and setting conservation targets.

**6.11 The level of evidence or burden of proof to effect management interventions or change.**

we know that limitations in the evidence base have required us to advise, and fisheries regulators to develop, precautionary management measures for MPAs. Alongside the review of our conservation advice for designated sites, Natural England is working to improve its evidence management systems which will help identify and focus efforts on the key uncertainties relating to the presence and distribution of protected features. We are also working with Cefas to develop a fisheries evidence database that will help facilitate evidence-based assessments of the potential impacts of fishing activities on protected sites by making relevant peer-reviewed and grey literature more readily available and interpretable. This database will also help us identify key feature- and gear-specific gaps and limitations and tailor our evidence projects accordingly.

**6.12 The effect of different levels of protection within UK MPAs.** Recent reviews (Edgar *et al.* 2014, Partnership for Interdisciplinary Studies for Coastal Oceans 2007 & 2011) set out evidence for the benefit of highly protected MPAs (known as marine reserves) across the world and in Europe. However, the different effects of these and 'non-reserve' MPAs is variable, with evidence showing higher benefits from highly protected than partially protected areas but variable responses between animal groups and most literature focusing on fish (Sciberras *et al.* 2013).

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**6.13 The most effective and most efficient ways to monitor and assess the MPA network and the wider marine environment.** We are partners in a JNCC-led project to design a marine biodiversity monitoring programme that aims to address all drivers for assessment and reporting – both within and outside MPAs. We are working with Defra, the Devolved Administrations, JNCC and the other statutory nature conservation bodies to better understand the ecological coherence of an MPA network.

**6.14 The potential for a marine species recovery programme.** Natural England commissioned work to look at whether some marine species may benefit from a targeted species recovery programme (Hiscock *et al.*, 2011). **This report** was used as a foundation to develop a list of priority actions needed to progress marine species recovery, both inside and outside of MPAs. Further work is needed to deliver these actions in the context of Biodiversity 2020 outcomes (Defra 2011) and species recovery projects; partnerships are being developed to deliver these actions.

## 7 Current and recent Natural England evidence projects

7.1 We are developing a method to make information about our current evidence projects available to everyone. In the meantime information on Natural England's evidence projects relating to the marine environment that were current in 2014 can be seen on the National Archives at:

<http://webarchive.nationalarchives.gov.uk/20140711133551/http://www.naturalengland.org.uk/our-work/evidence/register/marinemonitoring.aspx>.

### 7.2 Extent and importance

- Distribution of habitats, species and important features: substantial biophysical information gathering and interpretation in support of new N2K sites and MCZs (RP1054, RP1041, RP981, RP1053, RP0597, RP1021, RP1027).
- Ecosystem services: further evidence to inform Impact Assessments, complemented by research on services provided by marine features to be protected in MCZs (RP334).

### 7.3 Pressures, risks and impacts

- Distribution of activities and pressures: evidence gathering on socio-economic issues in support of new N2K and MCZ sites (RP1036, RP0600).
- Climate change/acidification: input to wider partnership projects including changes in response to climate change (Marine Climate Change Information Partnership (RP0284), and MarClim detailed monitoring of rocky shore communities), effects of acidification (RP221).
- Sensitivity of mobile species to pressures: assessing the sensitivities of marine birds, fish and mammals to environmental pressures (RP1657).

### 7.4 State of marine biodiversity

- Monitoring: substantial programme (80% of marine evidence budget) covering intertidal SSSIs, existing SACs/SPAs, baselines for new SACs, the wider environment project 'Marine Biodiversity Surveillance and Monitoring Programme' with JNCC and the other country agencies (RP474, RP714, RP609, RP1136, RP1142, RP1048, RP1134, RP0539, RP1044, RP1037).
- There is increasing sharing of resources with other bodies (through MoAs or work on specific projects) to enhance partner arrangements, eg Cefas, EA, JNCC, MCA, SFCs/IFCAs (RP215, RP217, RP335, RP336, RP337).

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### 7.5 Response

- Best practice for managing activities in Marine Protected Areas (RP332).
- Improvement of baseline data of invasive non-native species distribution An audit of available records to identify current risks to Natura 2000 sites (RP1651).
- Connectivity in the marine environment: PhD to assess connectivity by measuring genetic relatedness between populations of sessile benthos (RP286).
- Minimising the footprint. looking at the recovery of intertidal sediments from disturbance (RP0569).
- Restoration of native oyster through the development of broodstock areas. Showing initial findings of the 'reefs' collected from the field and lab work. (RP0479).
- Improvement Programme for England's Natura 2000 sites (IPENS). A programme supported by EU LIFE+ funding. [www.gov.uk/government/publications/improvement-programme-for-englands-natura-2000-sites-ipens](http://www.gov.uk/government/publications/improvement-programme-for-englands-natura-2000-sites-ipens)

## 8 Key external research programmes

**8.1 Defra/Cefas:** Defra's science and research pages lists ongoing and completed research projects. It encompasses most relevant research by Cefas. Current projects cover a huge range of relevant evidence.

**8.2 Academia:** Much of the relevant evidence gathering is undertaken in research institutes, particularly NERC-funded bodies. Current relevant NERC programmes include Marine Ecosystems and Marine Renewable Energy.

**8.3 Sector-related:** In addition to significant evidence gathering for strategic assessments of different sectors, eg oil and gas, there are programmes of research eg the Offshore Renewables Joint Industry Programme aimed at answering current consenting challenges.

**8.4 Marine Science Strategy:** identifies high level priority areas for marine science and tackles cross-cutting barriers to help deliver the science [www.gov.uk/government/publications/uk-marine-science-strategy-2010-to-2025](http://www.gov.uk/government/publications/uk-marine-science-strategy-2010-to-2025). The work of the UK Marine Monitoring and Assessment Strategy (UKMMAS) sits under the marine science strategy [www.gov.uk/government/groups/marine-science-co-ordination-committee](http://www.gov.uk/government/groups/marine-science-co-ordination-committee).

**8.5 Individual organisations and projects:** several partners and individual projects are key to Natural England's evidence, for example:

- UK and Ireland Marine Pathways Project: Establishment of an inshore and offshore recording network to detect new introductions of marine non-native species as well as trialling methodologies for the most effective and cost efficient monitoring methods.
- Assessing the impact of fishing on sub-features of EMS: a project being conducted by Cefas utilising data from the discard database and presenting it in Excel and GIS compatible formats (RP1700).
- Enhancing knowledge of key habitat sensitivities to fishing gear impacts: the development of a database containing current evidence of fishing impacts on fishing features/sub-features in EMS (RP1699).
- JNCC-led Marine Biodiversity and Surveillance Monitoring Programme: JNCC are looking at techniques and options for delivering biodiversity monitoring across the UK for marine habitats, seabirds and cetaceans and MPAs.



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**8.6 European collaborative projects:** several EU INTERREG projects including PANACHE (Protected area network across the Channel ecosystem) and VALMER will enhance Natural England's evidence base.

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### Further information

Natural England evidence publications can be downloaded from the publications and products catalogue: <http://publications.naturalengland.org.uk/>. In particular see **Natural England summaries of evidence**. For information on Natural England evidence publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail [enquiries@naturalengland.org.uk](mailto:enquiries@naturalengland.org.uk).

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