Annex L from Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas. 2012. *Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations.*

Annex L The Potential Benefits of Marine Conservation Zones

Contents

1 Benefits to conservation

L.1 This section includes a discussion of the conservation status, and therefore need, of the features to be protected by MCZ, followed by a discussion of the potential benefits of an ecologically coherent network of MPAs and the degree to which MCZs may enable such a network to be established.

1.1MCZ habitats and species

L.2 The Marine and Coastal Access Act (Defra, 2010b) allows for the protection of any species, habitat or geological or geomorphological feature to be designated in Marine Conservation Zones. Specific features to be protected via Marine Conservation Zones (MCZs), including habitats, species and geological features, are set out in *The Ecological Network Guidance* (ENG) (Natural England and JNCC, 2010b).

L.3 Habitats and species that are known to be rare, threatened or declining in our marine area, identified from existing multi-lateral environmental agreements and national legislation, are thought to require protection and were put forward for protection by MCZs via the ENG. These are termed 'features (habitats and species) of conservation importance' (FOCI) (Natural England and JNCC, 2010b). They are on the Oslo and Paris Convention (OSPAR) List of Threatened and/or Declining Species and Habitats, the UK List of Priority Species and Habitats (the UK Biodiversity Action Plan or UK BAP) and Schedule 5 of the Wildlife and Countryside Act 1981 (WCA). The specific conservation need for habitats and species of conservation importance are as follows:

- **OSPAR –** features that are considered to be under threat or in decline, and may be rare or particularly sensitive;
- **UK BAP –** features of national or international importance, at high risk or in rapid decline, as well as habitats that are important for key species; and
- **The Wildlife and Countryside Act (1981) –** species likely to become extinct from the UK unless conservation measures are taken, and species subject to an international obligation for protection.

L.4 In addition to those features identified above, features to be protected by MCZs (as listed in the ENG) also include broad-scale habitats which aim to represent the range of marine biodiversity as required by the Marine and Coastal Access Act 2009. These are broad-scale habitats in the European Nature Information System (EUNIS) Level 3 classification[1] that are of relevance to the UK's seas. While these habitats themselves may not be rare or endangered, the broad-scale habitats act as surrogates for biodiversity at finer scales and capture the coarse biological and physical diversity of the UK sea bed. Their protection therefore affords protection to the associated species and biotopes. Their inclusion incorporates a precautionary principle approach, allowing for conservation of features for which there is limited information, and provides a broad representative approach to protection.

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[1] The EUNIS Habitat types classification is a comprehensive pan-European classification system; it covers all types of habitats from natural to artificial, and from terrestrial to freshwater and marine. http://eunis.eea.europa.eu/habitats.jsp

L.5 Geological and geomorphological features of interest were identified from the geological conservation review and a mapping exercise carried out by ABP Marine Environmental Research Ltd (ABPmer). The ABPMer work calculated a conservation importance percentage index in order to identify the features to be included in the ENG.

L.6 Appendix 1 of this annex summaries the lists and Acts that each ENG habitat and species is identified on which indicate the reason why the features need conserving, and the UK's commitment to deliver that conservation. The coverage of each feature within the suite of recommended Marine Conservation Zones (rMCZs), by regional MCZ project area, is set out in Annex B.

L.7 It is expected that rMCZs will conserve and aid the recovery of the protected habitats and species (Natural England and JNCC, 2010b). Draft conservation objectives[2] are specified for each feature in each rMCZ, requiring either a recovery to, or maintenance at (depending on the assumed baseline condition), favourable condition.[3] The designation and management of MCZs should result in protection levels that ensure the favourable condition of the MCZ features and no further degradation. The regional MCZ projects submitted recommendations for 108 rMCZs, and a further 65 areas that were recommended for a higher level of protection, known as rMCZ reference areas. Taking into account the overlaps between some of these sites, the total number of sites recommended for designation is 127 (an rMCZ Reference Area that is located within an rMCZ is part of the rMCZ and not a separate designation).

1.2An ecologically coherent network of MPAs

L.8 An ecologically coherent network of Marine Protected Areas (MPAs) will deliver widespread ecosystem protection, which is central to the ecosystem-based approach to environmental management (Natural England and JNCC, 2010b). An ecologically coherent network of MPAs is one that reflects the biogeographic variation across the marine area. By protecting features within different biogeographic regions, the MPA network is more likely to conserve a representative range of the ecological variation and biological diversity present in the UK's seas; thereby contributing to the aim of conserving the range of UK biodiversity (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011) (OSPAR, 2006). By representing (and replicating) all habitat types across their geographical ranges, the MPA network will be more resilient, as it spreads the risk of disturbance, thereby helping to ensure the long-term sustainability of the protected features (Natural England and JNCC, 2010b). The anticipated benefits of the network are summarised in Moffat (2012), which is included in Appendix 2.

L.9 The ecologically coherent network of MPAs will be made up of MCZs and other existing and planned designations..There are five existing types of statutory conservation designations already in place in the UK, which are either fully or partially focused on the marine area. These are Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs), Marine Nature Reserves (MNRs)[4] and Ramsar sites.[5] Further MCZs and MPAs

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[2] Draft conservation objectives are identified at this stage. Following designation, further evidence-gathering will be undertaken to establish the final conservation objectives.

[3] See Annex H5 for a definition of unfavourable, favourable and reference condition.

[4] The Lundy MNR was redesignated as the UK's first MCZ in January 2010.

are currently being/will be planned and designated in the remainder of UK waters outside the MCZ project area by the devolved administrations[6].

L.10 Ecological coherence of the network of MPAs is still an evolving concept. Defra's Network design principles (Defra, 2010a) are described in the ENG along with further guidance on implementing them for the planning of MCZs. These principles, if met, along with other ecological considerations, should aid the achievement of an ecologically coherent network. The design principles are:[7]

- **representativity** – national broad-scale habitats and rare and threatened habitats and species of conservation importance must be represented within the network;
- **replication** – at least two examples of the listed features must be protected;
- **viability** – MPA sizes must ensure long-term population survival;
- **adequacy** – sufficient area of all habitats must be included within the entire network;
- **connectivity** – linkages between areas must be considered;
- **protection** – ensuring the favourable condition of MCZ features through a range of protection levels; and
- **best-available evidence** – lack of scientific certainty should not be a reason for delaying network design, and MCZ identification should be based on best-available data, taking account of local and lay knowledge.

L.11 As ecological coherence is a holistic concept, identifying the degree to which MCZs aid the delivery of the network is difficult. The network will only be considered to be ecologically coherent if the design principles set out above are satisfactorily met. Scientific advice on the ecological coherence of the MPA network (with the inclusion of rMCZs) and on the contribution of individual rMCZs (to the extent that this is possible) is being provided by JNCC, Natural England and the Science Advisory Panel.[8] However, this advice was not available at the time of writing this Impact Assessment (IA). Statistics and illustrations that attempt to demonstrate the degree to which each regional suite of rMCZs meets the ENG guidelines can be found in the regional MCZ project final recommendation reports (Balanced Seas, 2011; Lieberknecht and others, 2011; Net Gain, 2011; ISCZ, 2011).

L.12 A crude illustration of the relative importance of rMCZs to the delivery of the MPA network is shown in Table 1. This presents the percentage of the total area of each regional MCZ project area that is protected by existing MPAs and that would be protected by the rMCZs if designated.

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[5] Further explanation on the purpose of each type of designation can be found at www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/default.aspx

[6] The suite of MCZs considered in this Impact Assessment cover the English inshore area and the offshore area around England and Wales. MCZ planning and designation in the remainder of UK waters is being undertaken separately by the devolved administrations.

[7] Further details on the design principles can be found in JNCC & Natural England (2010).

[8] Natural England and JNCC are two of the UK Government's statutory nature conservation advisors. The Science Advisory Panel is a panel of leading academics set up specifically to provide scientific advice to the MCZ Project – further details can be found at: www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/mcz/default.aspx

Table 1: Proportion of regional MCZ project marine area protected by MPAs and rMCZs

Project Area	By existing MPAs	By rMCZs	Total
Balanced Seas	17%	22%	35%
Finding Sanctuary	2%	18%	19%
ISCZ	11%	23%	31%
Net Gain	20%	11%	30%
MCZ Project total area	12%	15%	26%

Note: Some MCZs overlap with existing MPAs, therefore the figures may not sum to the total.

2 Ecosystem processes and services provided by MCZ habitats and species

L.13 This section provides a summary of the ecosystem processes and services that are provided by broad-scale habitats and features of conservation importance (FOCI) to be protected by MCZs. The summary is based on a literature review by Fletcher and others (2012) that was commissioned by JNCC and Natural England to inform the regional MCZ projects work for the impact assessment. Where there was no information in the literature, the contractors drew on the opinion of experts (from their organisations and a few from other organisations).

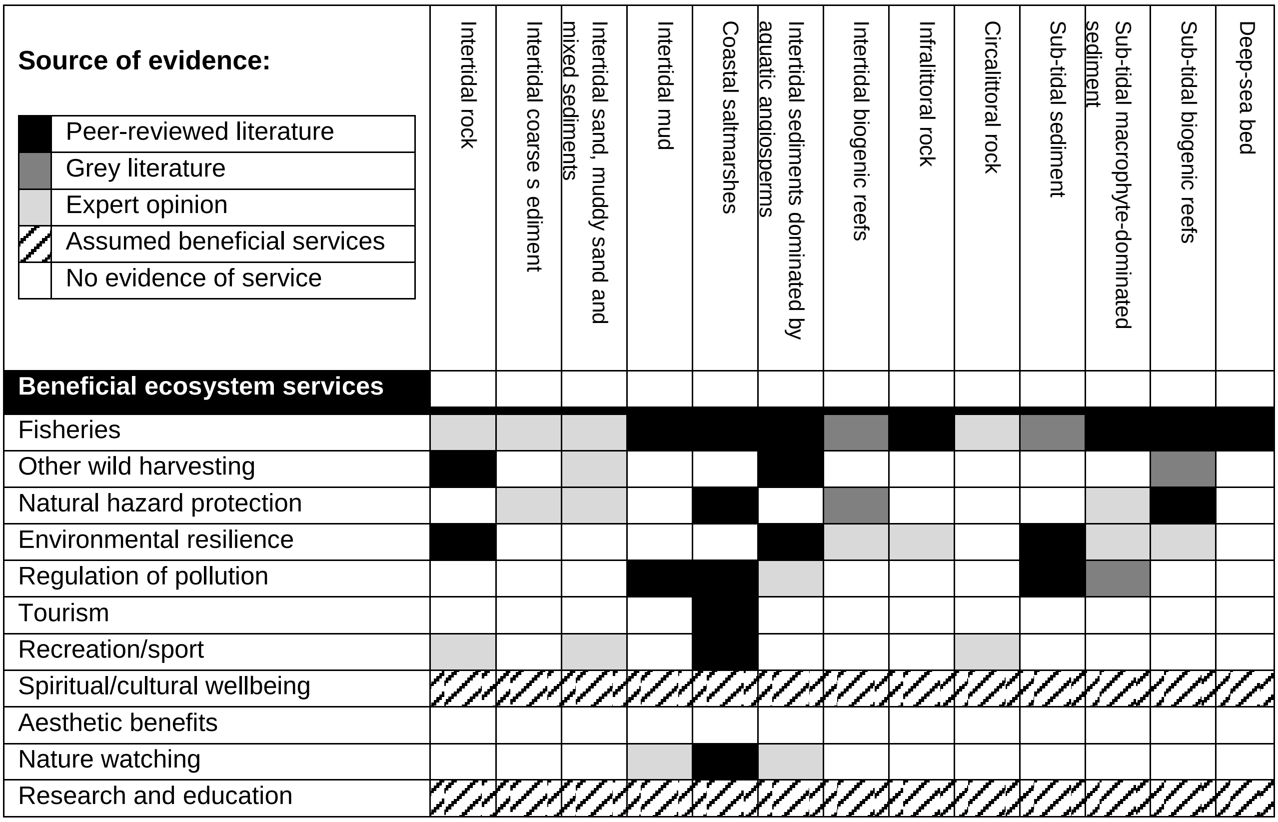
L.14 The review found that the strength of evidence for the existence of beneficial ecosystem processes and services varies considerably. For some features, the evidence was relatively strong, whereas for others it was relatively weak. The study's conclusions are therefore extremely tentative and potentially unreliable. It is important to note that if the study's authors found little or no evidence on the ecosystem processes or services provided by features this does not equate to the features not providing processes or services (Fletcher and others, 2012).

L.15 Substantially more evidence was available relating to habitats than species, and with respect to beneficial ecosystem processes than beneficial ecosystem services. In particular, Fletcher and others (2012) identified a strong evidence base for the beneficial ecosystem processes of primary and secondary production, larval/gamete supply, food web dynamics, formation of species habitat, and species diversification. The beneficial ecosystem service provided by habitats that had the strongest evidence base was fisheries. For individual species, the evidence base for beneficial ecosystem processes and services was very limited, with no evidence available at all for many species.

L.16 Despite the limited evidence base for some MCZ features, there is sufficient evidence to show that most MCZ features provide beneficial ecosystem processes and services, and therefore there is a clear link to aspects of human wellbeing. Fletcher and others (2012) assume that several beneficial ecosystem processes are universally provided by all habitats. These are: larval/gamete supply; biological control; food web dynamics; species diversification; and genetic diversification. In addition, they assume that two beneficial ecosystem services are provided by all features (both habitats and species): spiritual/cultural wellbeing; and research and education.

L.17 Tables 2–4 below summarise the evidence base for a sub-set of the ecosystem services delivered by MCZ features.

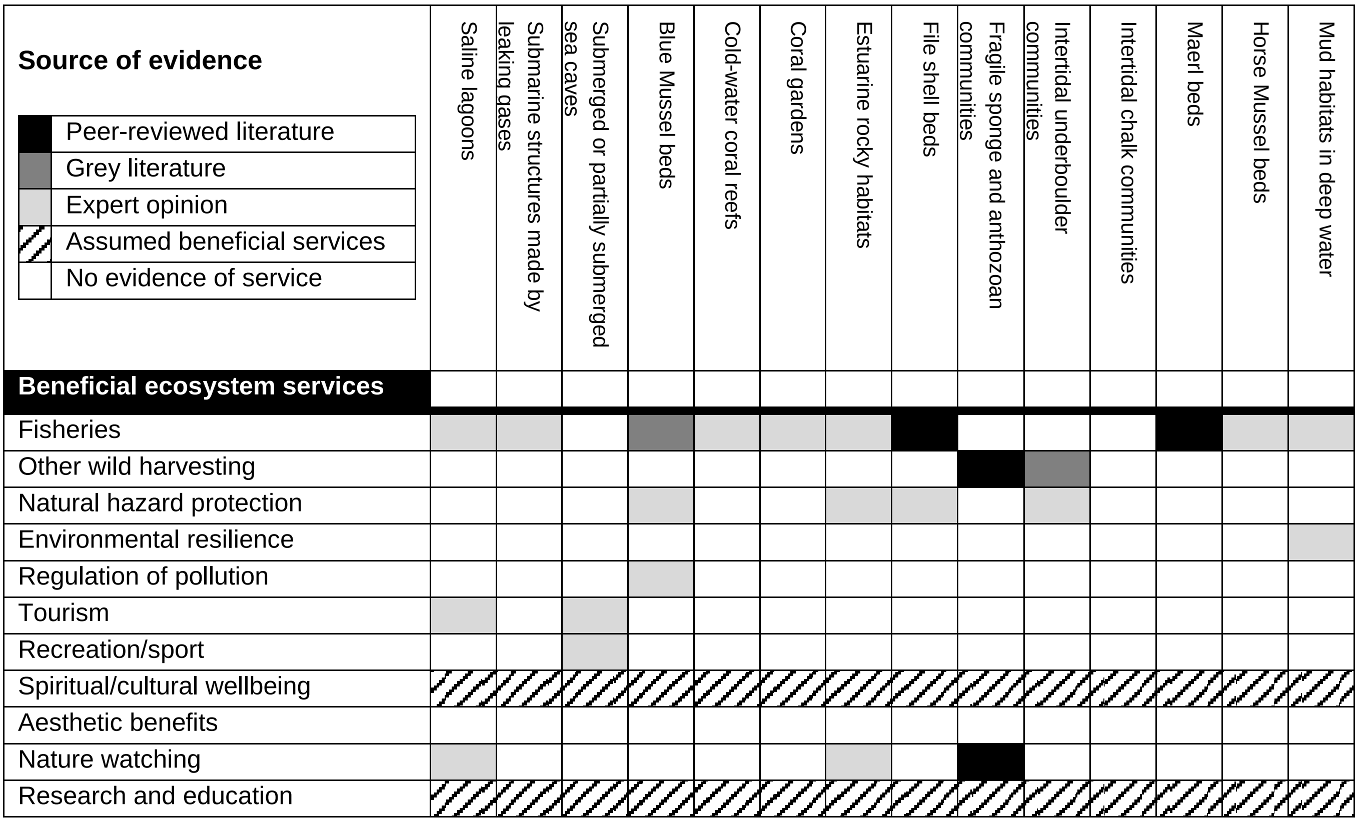
Table 2: Evidence base for ecosystem services delivered by broad-scale habitats



Source of evidence: ■ Peer-reviewed literature ▓ Grey literature ░ Expert opinion ▨ Assumed beneficial services □ No evidence of service	Intertidal rock	Intertidal coarse s ediment	Intertidal sand, muddy sand and mixed sediments	Intertidal mud	Coastal saltmarshes	Intertidal sediments dominated by aquatic angiosperms	Intertidal biogenic reefs	Infralittoral rock	Circalittoral rock	Sub-tidal sediment	Sub-tidal macrophyte-dominated sediment	Sub-tidal biogenic reefs	Deep-sea bed
Beneficial ecosystem services													
Fisheries	░	░	░	■	■	■	▓	■	░	▓	■	■	■
Other wild harvesting	■		░			■						▓	
Natural hazard protection		░	░		■		▓				░	■	
Environmental resilience	■					■	░	░		■	░	░	
Regulation of pollution				■	■	░				■	▓		
Tourism					■								
Recreation/sport	░		░		■				░				
Spiritual/cultural wellbeing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Aesthetic benefits													
Nature watching				░	■	░							
Research and education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

Table 3: Evidence base for ecosystem services delivered by habitats of conservation importance



Source of evidence ■ Peer-reviewed literature ▓ Grey literature ░ Expert opinion ▨ Assumed beneficial services □ No evidence of service	Saline lagoons	Submarine structures made by leaking gases	Submerged or partially submerged sea caves	Blue Mussel beds	Cold-water coral reefs	Coral gardens	Estuarine rocky habitats	File shell beds	Fragile sponge and anthozoan communities	Intertidal underboulder communities	Intertidal chalk communities	Maerl beds	Horse Mussel beds	Mud habitats in deep water
Beneficial ecosystem services														
Fisheries	░	░		▓	░	░	░	■				■	░	░
Other wild harvesting									■	▓				
Natural hazard protection				░			░	░		░				
Environmental resilience														░
Regulation of pollution				░										
Tourism	░		░											
Recreation/sport			░											
Spiritual/cultural wellbeing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Aesthetic benefits														
Nature watching	░						░		■					
Research and education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

Table 3 (continued): Evidence base for ecosystem services delivered by habitats of conservation importance

Source of evidence

■	Peer-reviewed literature
▓	Grey literature
░	Expert opinion
▨	Assumed beneficial services
□	No evidence of service

Beneficial ecosystem services	Deep-sea sponge aggregations	Seapens and burrowing megafauna	Native oyster (*Ostrea edulis*) beds	Peat and clay exposures	*Sabellaria* reefs	Seagrass beds	Sheltered muddy gravels	Sub-tidal chalk	Sub-tidal sands and gravels	Tide-swept channels
Fisheries	░	▓	■			■	▓		▓	
Other wild harvesting							▓		▓	
Natural hazard protection			░			▓				
Environmental resilience	░		░				░		░	
Regulation of pollution						▓	░		░	
Tourism						▓				
Recreation/sport										
Spiritual/cultural wellbeing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Aesthetic benefits										
Nature watching		░				▓				
Research and education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

Table 4: Evidence base for ecosystem services delivered by species of conservation importance

Source of evidence

■	Peer-reviewed literature
▓	Grey literature
░	Expert opinion
▨	Assumed beneficial services
□	No evidence of service

Beneficial ecosystem services	Sea-fan anemone *Amphianthus dohrnii*	Stalked jellyfish *Haliclystus auricula*	Stalked jellyfish *Lucernariopsis*	Stalked jellyfish *Lucernariopsis*	Starlet sea anemone *Nematostella vectensis*	Sunset cup coral *Leptopsammia pruvoti*	Timid burrowing anemone *Edwardsia timida*	Lagoon sandworm *Armandia cirrhosa*	Tentacled lagoon-worm *Alkmaria romijni*	Amphipod shrimp *Gitanopsis bispinosa*	Gooseneck barnacle *Mitella pollicipes*	Lagoon sand shrimp *Gammarus insensibilis*	Spiny lobster *Palinurus elephas*	Defolin's lagoon snail *Caecum armoricum*
Fisheries											■		■	
Other wild harvesting														
Natural hazard protection														
Environmental resilience														
Regulation of pollution														
Tourism														
Recreation/sport						■								
Spiritual/cultural wellbeing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Aesthetic benefits														
Nature watching						■								
Research and education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

Table 4 (continued): Evidence base for ecosystem services delivered by species of conservation importance

Source of evidence	
■	Peer-reviewed literature
▓	Grey literature
░	Expert opinion
▨	Assumed beneficial services
□	No evidence of service

Beneficial ecosystem services	Fan mussel *Atrina pectinata*	Lagoon sea slug *Tenellia adspersa*	Ocean quahog *Arctica islandica*	Pink sea-fan *Eunicella verrucosa*	Tall sea pen *Funiculina quadrangularis*	Couch's goby *Gobius couchi*	European eel *Anguilla anguilla*	Giant goby *Gobius cobitis*	Long-snouted seahorse *Hippocampus guttulatus*	Short-snouted seahorse *Hippocampus hippocampus*	Smelt *Osmerus eperlanus*	Undulate ray *Raja undulata*	Bearded red seaweed *Anotrichium barbatum*	Burgundy maerl *Cruoria cruoriaeformis*
Fisheries	░		■				■				■	░		
Other wild harvesting														
Natural hazard protection														
Environmental resilience								░						
Regulation of pollution														
Tourism														
Recreation/sport							░	░			■			
Spiritual/cultural wellbeing	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Aesthetic benefits														
Nature watching						░			░	░				
Research and education	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

Table 4 (continued): Evidence base for ecosystem services delivered by species of conservation importance

Source of evidence	
■	Peer-reviewed literature
▓	Grey literature
░	Expert opinion
▨	Assumed beneficial services
□	No evidence of service

Beneficial ecosystem services	Common maerl *Phymatolithon calcareum*	Coral maerl *Lithothamnion corallioides*	Grateloup's little-lobed weed *Grateloupia montagnei*	Peacock's tail *Padina pavonica*
Fisheries				
Other wild harvesting				
Natural hazard protection				
Environmental resilience				
Regulation of pollution				
Tourism				

Recreation/sport				
Spiritual/cultural wellbeing	▨	▨	▨	▨
Aesthetic benefits				
Nature watching				
Research and education	▨	▨	▨	▨

Extracted from Fletcher and others (2012)

3 Potential impacts of MCZs on ecosystem services

L.18 This section summarises some of the key available evidence, of relevance to UK environmental conditions, on the extent to which management for MPAs (and other non-conservation-derived marine closed or managed areas) can change the value of beneficial ecosystem services provided by the marine environment. It seeks to provide a general overview of available evidence that could indicate the potential benefits of MCZs to ecosystem service provision. It has been used to inform the assessment of impacts on beneficial ecosystem services presented in Annex I, Table 4s. The review covers the following broad ecosystem service categories (as defined in Annex H5):

- fish and shellfish for human consumption;
- recreation;
- research and education;
- non-use values;
- natural hazard protection;
- environmental resilience;
- regulation of pollution; and
- gas and climate regulation.

3.1 Fish and shellfish production for human consumption

L.19 The management of MPAs may have a number of potentially beneficial effects on some fish and shellfish populations. Potential effects that can arise within MPAs include (from Sweeting and Polunin, 2005):

- reduction or elimination of fishing mortality;
- reduction of gear interaction with the sea bed;
- higher density of species;
- higher mean size/age of species;
- higher biomass of species; and
- higher reproductive output (eggs/larvae) per unit area.

Potential effects outside MPAs include (Sweeting and Polunin, 2005):

- spillover – the net export of adult fishes from the reserve; and
- larval export – net export of eggs/larvae from the reserve.

L.20 This section first discusses the likely on-site effects of MPAs (and therefore, MCZs) and the potential on-site benefits to fisheries. In then looks at the potential for spillover-benefits and the potential benefits to static gear fishers of the removal of mobile fishing gears from MPAs. Finally, some conclusions and implications of the potential benefits to fish and shellfish for human consumption from MCZs are set out.

On-site effects and potential benefits to fisheries

L.21 Evidence suggests that shellfish and finfish stocks can potentially benefit from additional fisheries management in MPAs. However, evidence of this is largely skewed to tropical MPAs. Few MPAs in temperate areas have been studied for their impacts on fisheries resulting in a more limited evidence base (Sweeting and Polunin, 2005). Stewart and others (2008) consider there to be insufficient data available regarding impacts of MPAs on biomass, species richness, pelagic fish species and soft sediment systems and in particular, impacts on algae and invertebrates are understudied.

L.22 However, Fitzsimmons and others (2011) consider that there is strong evidence that the management of MPAs results in enhanced shellfish stock biomass within the MPA boundaries (although poor design or location and inappropriate use can result in failure) (Sweeting and Polunin, 2005). With a few exceptions, establishment of even small (<10km^2) MPAs leads to increased abundance/density of relatively site-attached invertebrate species (Sweeting and Polunin, 2005). In most cases, MPAs that include no-take zones achieve higher densities, biomass and species richness of marine biota within the boundaries of the no-take zone than outside (Stewart and others, 2008; Partnership for Interdisciplinary Studies of Coastal Oceans, 2011). A review of studies of marine reserves (no-take areas) in Europe showed the following average increases within the protected area, compared to the baseline (without MPA) situation (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011):

- 'biomass, or the total weight of animals and seaweeds, increased by an average of 251%;
- density, or the number of seaweeds or animals in a given area, increased by an average of 121%;
- body size of animals increased by an average of 13%;
- species diversity, or the number of species, increased by an average of 19% in the sample area; and
- heavily fished species often showed the most dramatic increases [in biomass or density]. Some fished species had more than ten times higher biomass or density inside the marine reserve. Species that are not fished can also increase [in terms of biomass or density] if their habitat is protected. Species diversity and body size have less opportunity for change, but even small increases can be important.'

L.23 Specific examples in the UK where prohibition of catching target species has resulted in improved populations include: scallop populations in closed areas at the Isle of Man and lobster populations in the Lundy No-Take Zone (NTZ) (Sweeting and Polunin, 2005). In the waters surrounding Lundy Island, a 2007 survey found an average of five times more landable-sized lobsters in the No Take Zone (established in 2003, an area where no fishing or harvesting is permitted) than in adjacent and distant sites (Hoskin et al, 2009). The number of lobsters that were smaller than landable size was double in the No Take Zone, more than doubled in adjacent areas and unchanged in distant sites. Further evidence can be seen from the Lyme Bay Designated Area. In the area that is closed to bottom trawls and dredges, increasing abundance of species with high and medium recoverability (such as king scallops and velvet swimming crabs) and a few species with low recoverability (ross coral and dead man's fingers) has been recorded within 2 years compared with areas that are fished in the vicinity (Attrill et al., 2011). On-site benefits to fisheries may only be realised if some level of fishing is permitted within the site to target the stocks that have improved. This is not the case in the no-take area examples cited here.

L.24 Management of MPAs, including small MPAs, particularly benefits site-attached species or particular life stages of finfish, both for target and to non-target species (Fitzsimmons and others, 2011). Increases in density and/or biomass of site-attached species have been noted in a number of small rocky-reef MPAs (Sweeting and Polunin, 2005). For mobile finfish, such as North Sea cod *Gadus morhua,* the evidence is mixed (Le Quesne and Codling, 2009). This is partly because MPAs rarely significantly reduce mortality of the fish stock, either because high protection exists over only a small area only or because, where MPAs are large, protection is not intense enough to reduce mortality significantly (Sweeting and Polunin, 2005).

L.25 In the case of mobile finfish species, which provide the bulk of the catch of the UK bottom trawling fleet, there is limited evidence to suggest that small isolated MPAs provide benefits to stocks (Fitzsimmons and others, 2011). MCZs are not usually suitable protection mechanisms for highly mobile species (including some fish species) and as such most commercial finfish species are not included in the ENG (Natural England and JNCC, 2010b). Fitzsimmons and others (2011) showed that species size, abundance and diversity were greater in a small (8.6km^2) no-trawl area than in a trawled area (8.6km^2) (both in the Whitby inshore area). However, they concluded that there was insufficient evidence to attribute these differences to the absence/presence of trawling.

L.26 The evidence of positive effects to fish and shellfish populations is stronger for large MPAs (Sweeting and Polunin, 2005), networks of MPAs (Laurel and Bradbury, 2006) and for stocks that are overexploited (Le Quesne and Codling, 2009). A well-designed network (one where the individual MPAs are effectively connected to each other and to outside areas through the movement of adults and young) of several small or medium-sized MPAs in a region may accomplish the same goals as a single very large reserve (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011). MCZs, when combined with other existing and planned MPAs, will form a network.

L.27 Sweeting and Polunin (2005) identify the smallest MPA in which an increase in abundance of mobile species is unambiguous as the 200km^2 trawl exclusion zone in the Gulf of Castellammare, Italy. Benefits to groundfish species were seen as a result of the 4,000–7,000km^2 mobile-gear closures on the Georges Bank in the Gulf of Maine, North America (Roberts, Hawkins and Gell, 2005). On a particularly large scale, the de facto closure of the North Sea to commercial fisheries during World War I and World War II – which covered the entire range of even highly mobile species – resulted in dramatically increased fish abundance. Over the closure during World War I, plaice stocks doubled; whilst during World War II they tripled (Sweeting and Polunin, 2005). However, even large MPAs do not guarantee increases in abundance of mobile finfish (Sweeting and Polunin, 2005), and sufficiently large experimental MPAs on which to base firm conclusions have not yet been established in Europe (Hoffmann and Perez-Ruzafa, 2008). There is stronger evidence for no-take marine reserves in temperate waters providing benefits to some fish populations (Roberts, Hawkins and Gell, 2005).

L.28 MPAs are more likely to lead to stock recovery when the scale of the MPA is enough to materially affect fishing mortality. For small MPAs, this may occur when considered in combination with other fisheries management measures, the combined effect of which may ensure that there is a net reduction in fishing effort (Kraus and others, 2009; Gell and Roberts, 2003; Le Quesne and Codling, 2009).

L.29 Recovering and conserving the 'structural integrity and productivity of habitats important to fishery species can help sustain fisheries' (Roberts, Hawkins and Gell, 2005). Reversal of habitat degradation by MPAs is habitat-dependent. In most cases, protection leads to development of more complex habitat, which has a number of benefits to fish. The strongest benefits will be for species that use complex habitats. The weakest benefits are likely to be for fish resident in habitats that are naturally highly disturbed (Sweeting and Polunin, 2005). Evidence from the area of the South Devon Inshore Potting Agreement (IPA) demonstrates how the condition of habitats and fauna can improve through the removal of potentially damaging fishing gears: Biogenic fauna such as soft corals and hydrozoans were more prevalent in areas exclusively fished by static gear; and species diversity within IPA static-gear-only zones was higher than in seasonal-access (for mobile gear) zones, which in turn was higher than in areas outside the IPA system where towed gear was used without seasonal restrictions (Kaiser, Spence and Hart, 2000, quoted in Blyth and others, 2002).

L.30 It is likely that degradation of habitat will be halted if anthropogenic pressures causing habitat degradation are removed, or sufficiently reduced, as a result of an MPA (Sweeting and Polunin, 2005; Le Quesne and Codling, 2009). The rate of recovery will vary, depending on the feature. For biogenic features, the recovery rate depends on the rate of recruitment and/or immigration from elsewhere, and on whether impacts are short term or chronic. Recovery can be rapid for some epibenthic assemblages (<6 months); for habitats dominated by emergent fauna, the period is likely to be somewhat longer, i.e. at least 2 years or more. Slow-growing calcareous biogenic habitats, such as maerl beds or deep-water corals, would require recovery times of several decades, if not centuries, emphasising the need for long-term protection of such vulnerable features. The rate of recovery may have implications for the rate at which any fisheries benefits occur.

The potential for spillover benefits to fisheries

L.31 While the effects of MPA management on finfish, invertebrates and other species are most apparent inside MPAs, spillover of individuals into areas outside the protected areas as a result of boosts in growth, reproduction and biodiversity inside an MPA can benefit fish population and fishermen outside MPAs (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011). In general, the potential for spillover benefits is largely dependent on biomass build-up in MPAs and species mobility (Sweeting and Polunin, 2005). It is reasonable to expect biomass build-up for shellfish, partly because their mobility is low (Sweeting and Polunin, 2005). In addition, the potential for spillover benefits is aided if the MPA overlaps with suitable habitats (Sweeting and Polunin, 2005).

L.32 While spillover of more mobile species from an MPA, excessive rates of movement may render the protective benefits of MPAs ineffective (Kramer and Chapman, 1999, quoted in Roberts, Hawkins and Gell, 2005), as they will preclude the necessary build-up of finfish biomass (Sweeting and Polunin, 2005). However, there are case studies to show that beneficial spillover effects can occur for mobile commercial species – scientists have documented spillover from marine reserves (no-take zones) in many locations around the world, including reserves in Spain, France and Italy (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011).

L.33 MPAs may be useful tools for protecting nursery and spawning grounds (Fitzsimmons and others, 2011), and spatial fisheries management restrictions to achieve this are already implemented in a number of such instances. At Spain's Cabrera marine reserve, the density of grouper eggs was lower in surrounding fished waters than in the reserve; such data provide mounting evidence that reserves can benefit local fisheries, by protecting important spawning grounds for commercial fish species (Partnership for Interdisciplinary Studies of Coastal Oceans, 2011).

L.34 Benefits to larval export are reliant on accruement of benefits inside the MPA, which cannot be guaranteed. Larval export benefits are almost exclusively documented for shellfish only. The strongest evidence comes from scallop fisheries, both on Georges Bank and in the Isle of Man, where increases in recruitment of scallop in adjacent fished areas was attributed to increased scallop population inside the area that is closed to fisheries and a downstream export of larvae (Sweeting and Polunin, 2005; Reid, 2011). Various other examples and citations of on-site and spillover benefits of spat distribution and settlement are provided in Blyth and others (2002).

L.35 There is also evidence of the benefits of closed areas to *Nephrops* fisheries (Bennett and Hugh, 2007). In 2000 the Scottish Executive implemented a 'Closed Area' in Loch Torridon and the Inner Sound of Rona on the west coast of Scotland (Scottish Statutory Instrument 2001 No. 174). This area was closed to all mobile fishing gear for an initial five-year period, which has subsequently been extended. Since the closure, higher levels of fishing effort have been observed around the boundaries of the closed fishing area, and fishers associate the area with higher catch rates of larger *Nephrops*. This is anecdotal evidence of a spillover effect from the unfished *Nephrops* in the closed area (Bennett and Hugh, 2007).

Provision of new ground for static gear fishing

L.36 Gear-specific benefits may arise where a competing gear type is prohibited from fishing within the area of an MPA. Typically this involves the removal of competition for space between mobile and static gears. Such benefits hare arised from the Lyme Bay Designated Area (Fishing Restrictions) Order 2008 (henceforth Lyme Bay Designated Area) (Mangi and others, 2011) and the South Devon IPA (Blyth and others, 2002). Notably such on-site benefits may come at the expense of the closure of the site to vessels deploying mobile gears and increased off-site conflicts between vessels displaced by the closure and other fishers may arise, as has been observed as a result of the Lyme Bay Designated Area (Mangi and others, 2011). The benefits of the Lyme Bay Designated Area to static-gear fishers have largely arisen through a reduction in the amount of their gear lost as a result of conflict with mobile-gear fishers, rather than any increase in landings of catch per unit effort (CPUE) (Mangi and others, 2011).

Summary and conclusions

L.37 In order to understand the likely impacts of MCZs on fish populations, we need to know the management regime, information on the current and expected habitat condition, as well as the interactions between larval dispersal, adult mobility and fishing mortality (Le Quesne and Codling, 2009). There are a growing number of studies that are starting to document this, although more detailed information on these factors is needed for a full assessment for rMCZs.

L.38 At the individual rMCZ level, benefits to fisheries are most likely to accrue where the designation and subsequent management will result in: an improvement in the condition of the habitats and species within it (as indicated by the conservation objectives); and reduction in the mortality of fish populations that is caused by fishing and subsequent improvement in the stock's characteristics. Moreover, reduction in mortality is likely to be required at the stock level to be beneficial to highly mobile species, and if fishing effort is simply displaced elsewhere as a consequence of closures, this is unlikely to be achieved. If the management entails a reduction in effort this will reduce the on-site value of fisheries.

L.39 The suite of rMCZs considered in this IA will cover a combined area of 37,760km^2, the management of which will affect a potentially significant level of commercial fishing activity (see Evidence Base for more details). As the rMCZs will form part of an ecologically coherent network of MPAs, the combined effect of the suite of rMCZs (and other MPAs) is likely to be greater than the total effect of individual rMCZs, when considered in isolation from each other.

L.40 Species that have relatively low mobility, such as shellfish (including crustaceans), are likely to benefit as a result of the management of rMCZs where this improves habitat condition and/or decreases fishing mortality. Evidence (as set out above) for this is relatively strong. A reduction in fishing mortality of a low mobility species is most likely to arise where the fishing gear targeting that species is subject to additional management within the rMCZs. For most rMCZs, the extent to which such gears (typically pots and nets) will be subject to additional management is unclear[9], so it is difficult to conclude on the potential impact on fishing mortality. In some cases, additional management may be focussed on reducing fishing effort that targets commercial species listed as MCZ FOCI, such as crawfish. In these cases, the management can be expected to reduce fishing mortality.

L. 41 Improvements in habitat condition that arise as a result of reduced fishing effort with gears that have bottom contact (or other human activities that damage the seabed) may also contribute to the health of on-site fish and shellfish populations.

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[9] A wide range of potential management scenarios – from 'no additional management' to 'full closure of rMCZ' are being considered. See Annex H7 for further discussion and Annex I for site-specific management scenarios.

L.42 Evidence of benefits for mobile finfish species is less certain. However the suite of rMCZs cover a significant area of sea, and depending on the level of management adopted within rMCZs, the suite of rMCZs may result in benefits to mobile finfish species (through reduced fishing mortality and improved habitat conditions).

L.43 It has not been possible to establish the likely net effect on fishing effort and fishing mortality that may result from the additional management for rMCZs and the resultant displacement and redistribution of fishing effort. However, the concerns raised by UK and non-UK fishing organisations regarding MCZs during the MCZ planning process and in providing feedback on draft material for the IA indicate that, for most gear types, there is a significant chance of reduced landings. This implies that there is a significant chance of reduced fishing mortality for a number of shellfish and finfish species, including mobile finfish species. In turn, it may therefore be assumed that a general reduction in fishing mortality will enable an improvement in fish stocks, including mobile finfish stocks. Any such benefits to fish stocks are likely to be highly species-specific.

L.44 The on-site economic value of improved fish and shellfish populations will only be realised where fishing is still permitted within an rMCZ (possibly at a reduced level compared to the baseline). Where fishing is not permitted within an rMCZ, increased value may be captured through spill-over benefits but it cannot be realised within the site. When the impacts (costs) of the additional management on fisheries are added to the potential benefits there may be a net loss of value to fisheries.

L.45 Evidence outlined earlier indicates that fish stock benefits may be greatest for those species that are overexploited. Catches of the most overexploited species in UK waters are typically governed by Common Fisheries Policy (CFP) quota policies. Given this already suppressed level of fishing effort, many fishers interviewed for this IA thought it unlikely that MCZs would result in any decline in catch rates to below quota levels for such species (various vessel skippers and owners, pers. comms., 2011). As such, it is uncertain whether any benefits to overexploited fish stocks that are subject to quota will arise as a result of the management for MCZs. Based on the rationale provided by fishers, it may be more likely that management of MCZs will benefit stocks of overexploited species that are not subject to quota.

L.46 Off-site benefits from the spillover of less mobile species from the rMCZ may benefit fishers outside the rMCZ, regardless of whether fishing is permitted within the rMCZ or not. Benefits are likely to be greatest closer to the rMCZ, in instances where the rMCZ covers only part of a known fish or shell fish habitat and/or fishing ground. For low-mobility species, such as scallops, off-site benefits may occur as a result of increased larval export.

L.47 The value of the benefit to fish and shellfish consumption from any increase in fish stocks will also depend on: the species that are positively affected; markets for these species; and the ability of fishers to catch them (given rMCZ management of fishing activity).

L.48 The potential benefits described above do not consider the potential net effect on fish and shellfish for human consumption. This is the effect once the reductions in effort or loss of fishing grounds required for MCZ management are taken into account and the and potential impacts on fish and shellfish populations of fishers responses to that management, which may involve displacement of effort, changing gears and/or target species, or vessels leaving the fleet. For MCZs to generate a net benefit, the gross benefits will need to be greater than the costs of reductions in effort, lost fishing grounds, displacement effects and the effects of fishers' other responses.

L.49 Potential benefits to static-gear fishers within rMCZs as a result of a cessation or reduction in mobile-gear fishing effort has been identified by fisheries stakeholders for a number of rMCZs (see Annex I). It is assumed that benefits are most likely to accrue through reduced loss of static gear (which reduces the cost of fishing for those affected), rather than through any increase in landings or catch per unit effort for fishers deploying static gears.

L.50 It is not anticipated that the price of fish or shellfish caught from within pMCZs will increase as a result of MCZs, for example through marketing of a premium product (JNCC and Natural England, pers. comms., 2011 and 2012). Management of MCZs may assist fishers to obtain Marine Stewardship Council certification in a few locations, although it is unlikely that many MCZs will coincide with the footprint of the entire fishery, which is the unit that is assessed for certification.

3.2 Recreation

L.51 The recreational activities that most typically benefit from MPAs are those most directly related to the marine environment, including angling, recreational diving, and wildlife watching (Murry, Medio and Gubbay, 2007). Benefits to recreation from MCZs are expected to stem both from changes to the ecological condition of the marine environment as well as from the act of designation, regardless of any ecological changes. Via their conservation objectives, all MCZs seek to provide natural areas that are in favourable condition. Recreational benefits are more likely to be derived from coastal and inshore rMCZs compared to offshore rMCZs, due to their relative ease of access.

L.52 This section considers, in turn, the potential benefits to angling, diving, wildlife watching and other recreational activities.

Angling

L.53 Drew Associates (2004) estimated that 1.1 million households in England and Wales contained at least one person who had been sea fishing in the last year[10]. Drew Associates (2004 found that the benefits to people's welfare, as measured by consumer surplus, from sea angling were considerable. They estimated that aggregated consumer surplus (mean value) from sea angling for the population of England and Wales was £594m/yr (2003 prices).[11] The total value of welfare from the angling experience, measured by summing expenditure and consumer surplus,

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[10] The survey was carried out in summer 2003 and asked households about sea angling activities over the last year.

[11] Shore anglers: £5.70/day to £35.50/day; charter boat anglers: £18.40/day to £90.90/day; own boat anglers: £14.30/day to £108.70/day.

was estimated to be between £600m/yr and £1,300m/yr (2003 prices)[12] (Drew Associates, 2004). Angling occurs in the majority of coastal and estuarine rMCZs, and some further from shore.

L.54 Benefits to anglers may occur as a result of improvements in the size and abundance of their target species. Whilst such species are not listed as features for conservation in rMCZs, populations may benefit from reduced fishing pressure, through management of commercial fishing activity in rMCZs, and through improvements in habitat conditions (as implied by conservation objectives for habitats of 'recover'. (Discussion of how fish populations may benefit from rMCZ is set out in Section 4.1).

L.55 There is evidence to suggest that where management of rMCZs results in increases in the size of fish caught by anglers (assuming that angling is permitted within the rMCZs), an increase in the diversity of species caught, or the number of fish caught, the angling experience may be improved. Drew Associates (2004) found that all types of angler were willing to pay more for larger fish (£0.22 per 1% increase in size) and for greater diversity in the catch. Shore anglers also benefit from catching increased numbers of fish (they were willing to pay £0.81 per extra fish caught) (Drew Associates, 2004). European Commission (2007) highlights that the angling experience may be improved as a result of an increase in the size of fish caught. Such benefits may occur within the boundaries of an rMCZ, and may occur outside its boundary as a result of spillover effects.[13]

L.56 Evidence from Mangi and others (2011) shows that as a result of the Lyme Bay Designated Area there was an increase in the number of anglers who had not previously fished in the area specifically visiting there, and of anglers fishing more frequently with the area. However Mangi and others (2011) does not state whether the increase in activity within the Lyme Bay Designated Area represents a net increase in the number of angling trips in the UK or a change in the locations where anglers prefer to fish (with no increase in the overall number of anglers or angling trips). rMCZ may result in similar responses by sea anglers, particularly if there is an improvement in the angling experience due to the factor identified earlier. In stakeholder discussions (during the MCZ planning process), anglers often wanted commercial fisheries reduced or halted, as their perception is that the angling will be improved if they are not competing with commercial fishers.

L.57 Angling, including catch-and-release angling, will not be permitted in rMCZ reference areas as the activity is considered to be 'extractive' (Natural England and JNCC, 2011). However, potential benefits to anglers may still occur where spillover effects result in increases in the size of fish caught, diversity of species caught or number of fish caught.

Diving

L.58 Divers may benefit from MCZs where they result in improved marine biodiversity. This may result in an improved diving experience, divers specifically visiting an MCZ not previously visited, or diving a site within an MCZ more frequently (Mangi and others, 2011). Mangi and others (2011) reported evidence of this as a result of the Lyme Bay Designated Area. Mangi and others (2011)

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[12] Shore anglers: £224m/yr to £473m/yr; charter boat anglers: £102m/yr to £189m/yr; own boat anglers: £329m/yr to £635m/yr.

[13] See section 4.1 for further discussion on spillover effects.

does not state whether the increase in activity within the Lyme Bay Designated Area represents a net increase in the number of dive trips in the UK or a change in the locations where divers prefer to visit (with no increase in the overall number of divers or dive trips). Chae and others (2011) estimated the benefit (mean consumer surplus) of a dive visit to Lundy Marine Nature Reserve (MNR)[14] to be between £540 and £871 per trip. However they were not able to distinguish between the benefits derived as a result of the inherent features of Lundy's marine environment and the benefits that arose from its designation as a protected area.

L.59 A review of peer reviewed literature identified only one study that identified characteristics that recreational divers value or the benefits of marine protected areas when diving in temperate waters in Europe. The study of 12 marine protected areas in Southern Europe (Roncin and others, 2008) identified that the existence of a marine protected area positively influenced the decision about where to dive for the majority of the SCUBA divers who were surveyed. The abundance of fish was an important characteristic that determined selection of sites for their diving trips, and the underwater scenery and presence of spectacular species also played major roles. However it should be noted that the sites researched for the study were all in the Mediterranean, or off the Canary Islands and the Azores, the conditions of which may differ from those found in the UK.

L.60 Diving is known to take place in a number of rMCZs. Those with conservation objectives of 'recover to favourable condition' are most likely to result in improved biodiversity and quality of diving experiences. This may result in increased numbers of dives at these sites and/or in improved dive experiences and associated increase in the value attached to those dives by participants. Local economic benefits may arise for dive firms, particularly where these rent equipment or operate trips to the rMCZ, although increased diving does not necessarily result in increased local dive business activity (Mangi and others, 2011). In rMCZ with conservation objectives of maintain, no change in biodiversity is anticipated. However, there may still be an increase in the number of dive visits to such sights due to the perceived benefit of diving in an MCZ and through marketing of dive such within MCZs.

Wildlife watching

L.61 Wildlife watching is a popular activity in the UK. Based on data from 2002, Cunin and Wilkes (2005) estimate that approximately 13m holiday trips in England include some sort of wildlife watching or nature study. It is estimated that approximately 2.85m adults go bird watching in the UK (BRMB International, 2004, cited in Dickie, Hughes and Esteban, 2006). The species and habitats listed in the ENG are all seabed habitats and species that live on or close to the seabed (other than 3 fish species) and thus not generally suitable for 'wildlife watching'. However, several are found in the intertidal zone and are extremely attractive, and could contribute to the enjoyment of rock-pooling, a popular leisure activity for adults and children. Protection of sea bed habitats that contribute to the provision of good foraging grounds for larger, more charismatic species, such as birds, will also potentially result in benefits from MCZs in terms of wildlife watching. Many of the rMCZs are in, or adjacent to, locations that are important seabird foraging grounds. Protection of habitats in these areas is likely to benefit seabird populations and therefore also benefit the people who enjoy watching the seabirds that feed in these grounds .

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[14] Now Lundy MCZ.

L.62 Protected area designations may make wildlife watching more accessible, by providing a specific destinations for viewing particular species, and by providing viewing schemes (RSPB, 2010) (which can enhance the wildlife watching experience). They can also increase accessibility through provision of on-site interpretation and wardens to answer questions (Dickie, Hughes and Esteban, 2006).

L.63 Popular charismatic species, such as birds, seals and whales, that people enjoy watching are not listed in the ENG as species for protection in rMCZs, but have been identified by the regional MCZ projects as site features and as supporting evidence for the importance of sites. Although many of these species are highly mobile, wildlife watching is generally location-specific, as people generally watch these species at haul-out, roosting, feeding sites, etc. The desire for MCZs in locations frequented by wildlife watchers is highlighted by the MCZ 'Your Seas Your Voice' survey (Ranger and others, 2012).

L.64 In some instances, MCZ management recommendations for charismatic species, providing codes of practice for wildlife watching, have been included in regional MCZ project recommendations reports. Management of the MCZs may help to improve people's enjoyment of wildlife watching if as a result, people using the marine environment adopt better practice and there is increased public awareness of best practice for interacting with marine wildlife. This can help to prevent disturbance of sensitivie species, such as rare nesting birds, from disturbance by wildlife watchers (Dickie, Hughes and Esteban, 2006).

Other recreational activities

L.65 There are over 250 million visits per year to the UK coast, of which around one third are to natural habitats. Cultural services provided by the coast are valued at £17bn (Beaumont and others, 2011).

L.66 MCZs may generate additional public interest and attract increased visitor numbers to an area (Murry and others, 2007). For example, MCZs may be used in marketing material for tourism and recreation destinations (South West Tourism, pers. comm., 2010) and to provide interesting information and interpretation to visitors (Copeland Coastal Partnership, pers. comm., 2011). This may improve the experience of visitors to these areas.

L.67 MCZs may support local economies, particularly where they encourage an increase in recreational visitors. The RSPB (2010) identified that local economies can benefit significantly from visitor expenditure associated with protected areas. Almost 50% of respondents to a visitor survey conducted at Bempton Cliffs RSPB reserve cited seeing seabirds as their main reason for visiting the area, and 80% said that either seabirds or wildlife were influential in their decision to visit (RSPB, 2010). During 2008, the reserve at Bempton received 48,786 visits, which increased to 67,490 visits in 2009. There is a clear link between the number of visitors and the opportunity to see seabirds: just over half of the visits were made between May and July, the period in which breeding seabirds are present. In 2009, an estimated income of over £750,000 to the local area was attributable to visits to see the seabirds, supporting 21.5 full-time equivalent (FTE) jobs. However, as the RSPB study does not set out a baseline it is not possible to establish how many people visited the area to see seabirds and wildlife and what their local expenditure was prior to such protected areas being established, and therefore what the net effect of the protected area has been.

L.68 The 'Your Seas Your Voice' campaign, which the Marine Conservation Society (MCS) ran through its website, identified the reasons why people would like specific areas of the marine environment to be conserved by protected areas[15] (Ranger and others, 2012). Reasons provided by participants reflected a range of beneficial recreational use values: participants who use the sites for recreation thought protection would improve the quality of their experience and the experience of others; participants suggested that protection could deliver knock-on benefits to local economies, by attracting more tourism and creating employment; and for some sites, participants expressed the view that the site had amazing scenery. These values may or may not be enhanced by the designation or rMCZs.

L.69 To try to understand the potential effect that the designation of an rMCZ may have on recreation benefits, European Marine Site (EMS)[16] managers were asked by the regional MCZ projects whether existing EMSs had provided recreational benefits. Many did not feel that EMS designation on its own had provided any increases in visitor numbers. However, this was largely because the designations were in areas where the environment was already in good condition and was already popular with visitors, and is not therefore evidence that benefits cannot arise.

L.70 Because of their greater accessibility, any recreation benefits are most likely to occur as a result of rMCZs that are in coastal or estuarine locations. The presence of a designation offers a focal point that can enable recreation and tourism infrastructure to develop. Where such development is appropriate, MCZs may act as a catalyst. The extent of development may depend on available funding and existing infrastructure provision (EMS managers, pers. comm., 2011). An impact on the national economy will arise if MCZs result in an overall increase in people's recreational experiences and/or their expenditure on recreation and leisure in the UK, which would be very difficult to assess.

3.3 Research and education

Research

L.71 The UK National Ecosystem Assessment highlights the need for more research on the marine environment: 'Although recent national assessments (e.g. Charting Progress 2, State of Scotland's Seas) have gathered a lot of evidence, extensive data gaps remain. Such knowledge would support more effective marine planning and licensing of activity in UK waters for the sustainable use of marine habitats and the maintenance of clean, healthy, productive and biologically diverse seas' (Austen and others, 2011). The UK National Ecosystem Assessment published a list of research gaps concerning the marine environment that includes: 'the role of biodiversity in providing resilience in the provision of ecosystem services'; and 'defining the best mechanisms to afford the protection of goods and services' (Austen and others, 2011).

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[15] Participants were able to vote for specific areas identified by the MCS or to nominate and vote for new areas in addition to those already identified by the MCS.

[16] European Marine Sites include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

L.72 While MPAs have become an established part of marine conservation programmes around the world,as there are a limited number of existing MPAs in temperate waters, there remain significant research gaps in the evidence of their effectiveness in temperate waters, particularly the potential benefits for the delivery of certain ecosystem processes and services. The designation of MCZs in UK waters will generate significant investment in research activities, including mapping of the sea bed, feature condition assessments and ongoing monitoring of MCZ areas (see Annex J2 for further details). MCZ-related research will help to improve the evidence base, and will contribute to our understanding of marine ecosystems, anthropogenic impacts on the marine environment and the effects of management interventions, which may in turn lead to the more efficient use and management of the marine environment in future.

L.73 Further to this, research benefits are anticipated as a result of the designation of MCZ reference areas. MCZ reference areas will provide an opportunity to demonstrate the state of a broad range of marine features in the context of prevailing environmental conditions but in the absence of many anthropogenic pressures (Natural England and JNCC, 2010a). They will provide control areas, in which features are not impacted by human activities and against which the impacts of pressures caused by human activities can be compared as part of long-term monitoring and assessment (Natural England and JNCC, 2011).

Education

L.74 Interpretation of the marine environment can provide education benefits to visitors. Education benefits can include visitor learning and knowledge from information presented about marine species and environments (Zeppel and Muloin, 2008). Interpretation activities or education programmes in marine areas typically involved talks by tour guides, interpreters and rangers onboard boats or at shorelines and also visitor centres, displays, signs and brochures (Zeppel and Muloin, 2008).

L.75 Stakeholders interviewed to inform this IA noted that any increase in value derived by visitors to MCZs will depend significantly on the quality of public education and interpretation material that is provided. Evidence from existing UK EMSs that include marine, coastal or estuarine areas indicates that a nature conservation designation can help managers to access additional funding for the development of education and interpretation material (EMS managers, pers. comms., 2011).

L.76 MCZs, including the research and monitoring activities occurring within them, may act as a focal point around which to develop education events and facilities, either as new ventures or as extensions to existing programmes.

L.77 Education benefits for visitors will be constrained by ease and costs of visitors accessing MCZs. The benefits are likely to be greatest for MCZs that are suited to the provision of new or improved shore-side interpretation at locations that are visited by high numbers of people. The number of visitors that may benefit from interpretation activities onboard boats is likely to be low (due to the increased cost of doing so), and only MCZs within easy reach of the coast (say 1nm) are likely to be visited.

L.78 People who do not visit MCZs may benefit through education resources delivered to the public through television programmes, the internet, articles in magazines and newspapers, and educational resources developed for use in schools.

3.4 Non-use values

L.79 Non-use value is the value that people derive from the knowledge that the natural environment is being maintained (Defra, 2007). Many people may therefore gain satisfaction from knowing that rare, threatened and representative marine species, habitats and features of geological or geomorphological interest are being conserved by MCZs (McVittie and Moran, 2008). These non-use benefits include: the existence value that people assign to nature; the altruistic value of conserving habitats and species for use by others in the current generation; and the bequest value of conserving habitats and species for use by future generations. Nature also has non-anthropocentric intrinsic value; it has value for its own sake, which is beyond human knowledge (as explained in Defra, 2007)

L.80 A significant proportion of the total value that society derives from the conservation of nature may be non-use value.[17] Given that many MCZs are offshore and mostly protect sub-tidal habitats, many people may not get significant tangible benefits through direct or indirect use of protected features. The benefits they derive from rMCZs may therefore be primarily those of non-use value.

L.81 There is reliable evidence that the population of the UK has significant combined use (such as recreational) and non-use values associated with conserving the marine environment. McVittie and Moran (2008) found that households in the UK were willing to pay a total of between £487m/yr and £1,171m/yr for a UK network of MCZs. It is suggested in McVittie and Moran (2008) that a high proportion of this value will be non-use value. These figures were used in the Marine and Coastal Access Act IA to represent the non-use value of UK-wide marine conservation through MCZs (Defra, 2010). However, it should be noted that the non-use value cannot be isolated from the use value in the estimate of willingness to pay, and as such the estimates include use value. These estimates cannot be directly transferred to the suite of rMCZs being considered in this IA, as the estimates were based on a hypothetical network covering all UK territorial and offshore waters, which differs from that under assessment here. However, they give an indication of the potential scale of non-use benefits that could accrue from the suite of rMCZs.

L.82 There is other evidence that the UK population values the marine environment that is provided by recent surveys. In surveys, 80% of the adult population in England stated that a healthy marine environment was important (ICM Research, 2012; TNS, 2009); 68% of the UK population were in favour of governments designating parts of the ocean as protected areas (Potts and others, 2011); and 32% of the UK population were concerned about ocean health in general (Potts and others, 2011). Again, these opinions may include both use and non-use sentiments. Recent research by the European Centre for Environment and Health found that being beside the coast was significantly more likely to create a feeling of well-being than being in other natural areas (BBC, 2012).

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[17] A study on the value of Natura 2000 sites in Scotland found that 99% of the overall value of such sites was non-use (Jacobs, 2004, cited in Defra, 2007).

L.83 The 'Your Seas Your Voice' campaign, which the MCS ran through its website, identified the reasons why people would like specific areas of the marine environment to be conserved by protected areas[18] (Ranger and others, 2012). Reasons provided by participants reflected a range of potential non-use sentiment, including: the need for conservation, including conservation for future generations; aesthetic values; personal significance; emotional attachment; the wide range of plants and animals; perceived national or international importance of the sites; heritage; and a social responsibility to look after the sites.

L.84 Research by Pike and others (2010), based on interviews with 24 marine and coastal protected area (MCPA) practitioners, sought to identify what the practitioners understood by social value of their MCPAs, and what activities encouraged or discouraged social value. Pike and others (2010) conclude that MPAs in the UK (which did not include MCZs at the time of the study) generate non-use social value and they identified that the natural environment was the primary reason why the public visited MPAs. The MCPA practitioners thought that a feeling of spirituality by visitors was closely associated with MPAs and in particular MPAs are associated with feelings of peace and tranquillity, natural beauty, inspiration for creativity and the provision of areas for reflection and solitude. The practitioners thought that the degree of social value is proportionate to the degree of promotion and communication of the MPAs, including reasons for protection. They also considered that social value was proportionate to how the site was managed in terms of numbers of people accessing the MPA and the implementation of projects involving the local community. Again, these opinions may include both use and non-use sentiments.

L.85 In summary, the designation of MCZs may benefit the full range of non-use values: existence, altruistic and bequest, as well as non-anthropocentric intrinsic value. Ultimately, the non-use value of MCZ designation and management, as demonstrated by McVittie and Moran (2008), may be significant and could run to hundreds of millions of pounds.

3.5 Environmental resilience

L.86 Environmental resilience is defined as 'the extent to which ecosystems can absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping to alternate states' (Hughes and others, 2005). The degree of environmental resilience of marine ecosystems is highly linked to marine biodiversity (Beaumont and others, 2006).

L.87 Marine ecosystems with high biodiversity are likely to have greater resilience to natural or human pressures compared to ecosystems with lower biodiversity (Hughes and others, 2005; Tilman, Reich and Knops, 2006, in Beaumont and others, 2006). Biodiversity, that represents a range of species and habitats (that each respond differently to natural or human pressures), is needed in order to increase environmental resilience. On the whole, species have evolved to fill different ecosystem niches and, as such, respond differently to different pressures. Small-scale surveys of biodiversity suggest that marine ecosystems with high biodiversity, such as kelp forests, have greater resilience (Steneck and others, 2002; Steneck, Vavrinec and Leland, 2004,

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[18] Participants were able to vote for specific areas identified by the MCS or to nominate and vote for new areas in addition to those already identified by the MCS.

both in Beaumont and others, 206). More recent studies suggest that the same phenomenon can be observed at larger scales (Beaumont and others, 2006).

L.88 The simplification of food chains has been found to detrimentally affect environmental resilience. For example, the removal of predators, such as pelagic fish, can lead to an increased abundance of their prey, in this case plankton, which can result in plankton blooms (Hughes and others, 2005). This can also increase susceptibility to invasion by non-native species, which can also affect environmental resilience (Beaumont and others, 2006). Hsieh and others (2008) demonstrate that unexploited fish species are able to respond more readily to environmental change than exploited fish stocks and voice concern over the exploited fish stocks resilience to climate variability.

L.89 There is also evidence to suggest that bottom-towed fishing gear can impact on benthic biodiversity (Kaiser and Spencer, 1996; Dernie, Kaiser and Warwick, 2003; Collie, Hall and Kaiser, 2000) and the effects of this can permeate through the whole marine ecosystem and affect environmental resilience. Gear was found to cause varying levels of disturbance that: alters sea-bed complexity; removes, damages or kills biota; and reduces benthic production, thereby leading to substantial changes in benthic community structure and habitat (COST-IMPACT Impacts Database (2004), based on: Baretta, Ebenhöh and Ruardij, 1995; Blackford, Allen and Gilbert, 2004; Burchard, Bolding and Villareal, 1999).

MCZ features associated with environmental resilience

L.90 As explained above, the degree of environmental resilience to natural and human pressures is linked not only to the level of biodiversity but also to the range of species and how they respond differently to pressures. The contribution of individual species to environmental resilience has not been comprehensively assessed. The MCZ habitats and species discussed below are not identified because of their unique or special contribution to environmental resilience, but because reasonable evidence is available that indicates their relationship with environmental resilience (citations are taken from Fletcher and others, 2012):

- In ecological terms, intertidal rock communities have a robust capacity to recover naturally from anthropogenic impacts (Hill, Burrows and Hawkins, 1998);
- Although no information could be found on the resilience of UK infralittoral ecosystems, Pinnegar and Polunin (2004) indicate that all aspects of the infralittoral rocky zone could recover to within 1% of baseline levels within 20 years after a disturbance;
- Biogenic habitats, such as coral reefs, mussel beds and seagrasses, require several years to recover following perturbation (Hall-Spencer and Moore, 2000; Peterson, Summerson and Fegley, 1987).Sedimentary habitats (such as sub-tidal coarse sediment, sub-tidal sand, sub-tidal mud and sub-tidal mixed sediments) can recover rapidly from disturbance through natural physical processes (e.g. wave action and currents) and biological processes (e.g. bioturbation (Collie, Hall and Kaiser, 2000; Norkko and others, 2002; Bishop and others, 2006)). Clean sand communities are thought to recover more rapidly following disturbance

than communities in muddy sand habitats, which have slower physical and biological recovery rates (Dernie, Kaiser and Warwick, 2003);

- It is likely that the climate regulation processes associated with mud habitats in deep water, with native oysters and deep-sea sponge aggregations contribute to climatic environmental resilience ('expert opinion' provided in Fletcher and others, 2012);

MCZs and environmental resilience

L.91 It is not possible to quantify the potential benefits that MCZs will deliver as a result of changes to environmental resilience, due to a lack of scientific knowledge about the relationships between biodiversity and resilience, and the inherent complexity of such relationships.

L.92 Ensuring that the marine environment can withstand the impacts of future natural and human pressures is critical to ensuring that the marine environment can continue to provide the same level of final ecosystem service benefits in the future. If allowed to continue, the decline in UK marine biodiversity will result in unpredictable changes in the provision of future goods and services. This change could result in severe impacts on society and the economy (Beaumont and others, 2006).

L.93 MCZs seek to protect a range of species and habitats in an ecologically coherent network. As such, MCZs will help to conserve environmental resilience for the future (McCook, Ayling and Cappo, 2010). This will help to ensure that natural and human pressures are absorbed by the marine environment, protecting against degradation, irreversible damage and potential reductions in all ecosystem services delivered by the marine environment.

3.6 Natural hazard protection

L.94 Marine species and habitats play a critical role in defending coastal regions against tidal, storm and flood damage, dampening environmental disturbances (Beaumont and others, 2006). In particular, species that bind and stabilise sediments and/or create natural sea defences can dampen environmental disturbances. Many types of marine species, such as seagrasses (Fonseca and Cahalan, 1992, cited in Beaumont and others, 2006) and saline reedbeds[19], can help to reduce wave energy in coastal areas. Intertidal rock communities also help to protect the rock underneath from erosion, partly by trapping sediment and by reducing the wave energy that reaches the shore (Anthony, 2008, cited in Fletcher and others, 2012). Similarly, intertidal biogenic reefs dampen wave energy and thereby help to limit erosion rates (Riding, 2002, cited in Fletcher and others, 2012). Intertidal blue mussel beds[20] are known to help stabilise sediment and therefore to limit erosion rates (Holt and others, 1998, cited in Fletcher and others, 2012).

L.95 The importance of natural hazard protection has become heightened as the risk of flooding , both in terms of intensity and frequency, has increased in recent years, and is likely to continue to increase (Defra, 2012) due to climate change (Beaumont and others, 2006; Austen and others, 2011).

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[19] Referred to as 'halophytic reeds' in Coops and others, 1996.

[20] Referred to as 'mytilus reefs' in Holt and others, 1998.

L.96 In the UK, saltmarshes make a significant contribution to natural coastal defences, as the habitat covers in the region of 45,500ha (Paramor and Hughes, 2004; in Beaumont and others, 2006). Saltmarshes are areas of vegetation that colonise intertidal sediments and are inundated by seawater at least once a lunar month (Hughes, 2004; in Beaumont and others, 2006) and attenuate and dissipate wave and tidal energy. This has been shown in a number of UK studies; for example: it has been found that saltmarshes reduce wave energy by 82.5% (Möller and others, 1999; in Beaumont and others, 2006) and by between 79% and 99% (Cooper, 2005; in Beaumont and others, 2006). The reduction in wave energy associated with saltmarshes diminishes the potential for erosion. Coupled with this, saltmarshes act like giant sponges that absorb vast amounts of water when inundated and then slowly release it afterwards, preventing flooding.

L.97 A decline in the condition or area of saltmarsh (or any associated species) could have significant consequences for natural hazard protection in the UK (Hughes, 2004; in Beaumont and others, 2006). Paramor and Hughes (2004) find that saltmarsh is more prone to erosion if changes occur to the intertidal biota. The loss of intertidal seagrasses on the seaward edge of marshes may also be linked to increased wave action and increased tidal current speeds in estuaries.

L.98 Saltmarsh is found mostly in the low-lying estuaries of eastern England. The saltmarshes of south-east England have been eroding rapidly for about the last 50 years, at a continuing rate of about 40ha per year, with significant consequences for conservation and coastal flood defence (Hughes, 2004; in Beaumont and others, 2006). Much of the land in eastern England is low-lying and adjacent to property and infrastructure, which makes it more vulnerable to the impacts of rising sea levels and flooding. Much of the low-lying land is protected from flooding by sea walls, which in turn are protected by saltmarshes (Dixon and Weight, 1996; in Beaumont and others, 2006).

MCZs and natural hazard protection

L.99 In the context of the increasing frequency and intensity of storms, as well as the threat of higher sea levels due to climate change (Defra, 2012), MCZs could play a vital role in providing increased protection for the biota of coastal MCZ features that help to defend against coastal erosion. As various authors suggest (Anthony, 2008; Riding, 2002; Holt and others, 1998; Hughes, 2004; in Fletcher and others, 2012), the degree of coastal defence is related to biodiversity and the condition features.

L.100 rMCZs, if designated, will help to ensure that human pressures do not degrade, irreversibly damage or alter the natural hazard protection currently provided by rMCZ species and habitats. The value of such services provided by MCZ features is likely to be higher in coastal areas adjacent to property, land or infrastructure where the features would be subject to degradation in the absence of the designation i.e. where the protection is afforded to at risk assets of high value.

L.101 Various authors have sought to value the natural hazard protection provided by intertidal habitats and species. Based on a meta-analysis of 30 contingent valuation studies of wetlands in temperate climate zones in developed economies, Brouwer and others (1997) (in Beaumont and others, 2006) found that households are willing to pay (WTP) £88.25[21] per household per year for the storm and flood protection services provided by wetlands (based on five observations). However, this includes services provided by freshwater as well as saltwater wetlands. Brouwer and others (1997) distinguish the value of marine saltwater wetlands to be £21.67[22] per household per year (based on two observations). However, this is a general WTP and is not specifically related to the storm and flood protection services of marine wetlands.

L.102 King and Lester (1995) (in Beaumont and others, 2006) estimate that the loss of saltmarshes from Essex would cost in the region of £600m, based on the increased maintenance of the sea walls that would be required. This highlights that by reducing average wave energy, saltmarshes enable the cost flood defence measures to be reduced (Morris and others, 2004; in Beaumont and others, 2006).

L.103 King and Lester (1995) (in Beaumont and others, 2006) found that as the width of a saltmarsh increased, the height of sea wall required, and associated capital and maintenance costs, decreased: an 30 metre wide saltmarsh required a 5 metre seawall, whilst an 80 metre wide saltmarsh required a 3 metre high seawall. King and Lester (1995) (in Beaumont and others, 2006) estimated that an 80 metre width of saltmarsh could result in cost savings, in sea defence terms, of between £0.38m/ha and £0.71m/ha in terms of capital costs, and £0.007m/ha in terms of annual maintenance costs (taken from Beaumont, 2006, which adjusted to 2004 prices).

L.104 Approximately 4,041ha[23] of saltmarsh, seagrass beds, intertidal rock, biogenic reefs and mytilus beds are proposed for protection by the MCZ network. The data provided in King and Lester (1995) is not sufficient to calculate potential seawall cost saving associated with all these features, and not all of the features are likely to be in areas that have assets that require protecting. However, it can be seen that if the per hectare costs are applied to just a fraction of the area of the listed MCZ features, then the potential values would run into may millions. The designation of the MCZs may ensure that the condition of the features is maintained, preventing any potential reduction in the value of the natural hazard protection provided. Where recovery of feature condition results in its expansion then, based on the conclusions of King and Lester (1995), the value of the service provided (through reduced coastal protection costs) could increase.

3.7 Regulation of pollution

L.105 This service includes the detoxification and purification of water. Marine living organisms store, dilute, bury and transform many wastes through assimilation and chemical decomposition and recomposition, either directly or indirectly. The role of biodiversity in bioremediation is complex. Organisms in the marine environment contribute to a huge number of processes that can affect anthropogenic waste, ranging from burial, dilution and detoxification to re-suspension and transformation to more toxic compounds, as well as biomagnification to make toxic compounds available within the human food chain. Added to this complexity is the huge number of potential

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[21] Based on findings of willingness to pay (WTP) of 92.6 Special Drawing Rights (SDR) per household per year, using SDR equivalent of 1.54 USD (20 April 2012) and conversion rate of 1 USD = 0.62 GBP (23 April 2012). See Brouwer and others (1997) for methodology.

[22] As per previous footnote.

[23] With duplication removed.

and actual contaminants in the marine environment (Beaumont and others, 2006). Saltmarshes and seagrass beds are thought to be particularly good at regulating pollution, and sub-tidal sediment habitats can act as pollution sinks, aided by the fauna resident within them (Fletcher and others, 2012).

L.106 Existing literature on the value of pollution regulation is focused on waste-water treatment. Breaux, Farber and Day (1995) estimate that the potential savings of using the water purification and detoxification services of coastal wetlands rather than conventional waste-water treatment to be £1,097 to £1,237 per acre.[24] A study conducted by OFWAT that is cited in Beaumont and others (2006) estimated cost savings of discharging raw sewage into the marine environment rather than treating it to a tertiary level to be £1bn/year.[25] However, no studies were identified for this review that quantify the relationship between the regulation of pollution and changes in habitat quality or biodiversity.

L.107 Beaumont and others (2006) conclude that a decline in biodiversity will reduce the environment's capacity to process waste, resulting in a decline in marine health and water quality. To the extent that rMCZs will contribute to the conservation and recovery of marine biodiversity, they will protect the regulating capacity of the marine environment. With regard to waste water, the contribution of MCZs to the value of this service is likely to be concentrated in those areas where waste water discharges occur, typically coastal and estuarine rMCZs.

3.8 Gas and climate regulation

L.108 Living marine organisms contribute to the maintenance of the chemical composition of the atmosphere and the ocean. The marine environment plays a significant role in climate control through the regulation of carbon fluxes, in part due to its capacity to sequester carbon dioxide (CO_2). Its capacity to sequester CO_2 (i.e. to act as a carbon sink) is affected by changes in marine food webs and trophic dynamics, and the biodiversity of the pelagic and benthic marine systems (Beaumont and others, 2006).

L.109 Based on existing literature, Beaumont and others (2006) conclude that changes in biodiversity influence the biogeochemical cycling of carbon and nutrients, and therefore feedback on the atmosphere and the climate (Legendre and Rivkin, 2005; cited in Beaumont and others, 2006). Given that decreasing biodiversity has been linked to decreasing productivity (Tilman and others, 2006, cited in Beaumont and others, 2006), it is reasonable to assume that it is linked to decreasing carbon sequestration. Ultimately, a decrease in biodiversity could therefore have potential implications for climate change Beaumont and others (2006).

L.110 Beaumont and others (2006) estimate the value of UK marine carbon sequestration to be between £420m and £8.47bn, based on estimates of marine primary production and the social value of sequestered carbon. They acknowledge that many other processes also act to balance and maintain the chemical composition of the atmosphere and oceans, and as such the value is likely to be an underestimate.

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[24] Present value discounted at 9% over 30 years.

[25] Based on average raw sewage discharge over 2003 and 2004 of 36,094.28kg BOD 5/day (biochemical oxygen demand - a measure of organic pollution of water); and a cost of treating this sewage to a tertiary level of £2.9m/day.

L.111 Beaumont and others (2006) provide a case study of the effect of demersal trawling on gas and climate regulation, using net primary production as a proxy. Their modelling found that pelagic primary production was largely buffered from biogeochemical impacts of demersal trawling by the physical environment and the ability of phytoplankton to vary their internal cell nutrient contents. Beaumont and others (2006) concluded that, following a demersal trawling event, the rate of gas and climate regulation may increase by between 0.952% and 14.88%.

L.112 Studies on the potential impact of marine aggregate dredging on gas and climate regulation adopt a different approach, considering the effects of the activity on benthic biomass (rather than pelagic primary production) (Austen and others, 2009; Cooper and others, 2010).[26] Here, changes in benthic biomass are taken as an indicator of the capacity of sea-bed substrates to sequester carbon.[27]

L.113 Austen and others (2009) conclude that aggregate extraction tends to depress carbon sequestration in benthic biomass but they note that, based on their case studies, this is not always the case.[28] Data presented in Cooper and others (2010) indicate that aggregate extraction depresses carbon sequestration in benthic biomass. Similar conclusions may be drawn for other similar activities, including navigational maintenance and capital dredging.

L.114 Based on an assumption that demersal trawling causes reduced diversity, reduced biomass and reduced productivity of benthic communities, particularly in areas of relatively high trawling disturbance (Jennings and others, 2001; Hiddink, Jennings and Kaiser, 2006), using benthic biomass to calculate carbon sequestration (as done for aggregate extraction above in Austen and others [2009] and Cooper and others [2010]) is likely to indicate that demersal trawling may negatively impact on the delivery of climate regulation services by the marine environment (in contrast to the conclusions drawn by Beaumont and others, 2006).

L.115 Where rMCZs result impose management on activities that reduce levels of benthic biomass, such as demersal trawling and aggregate extraction[29], this may result in a recover of benthic biomass in the rMCZs. As a result there may be a net increase (compared with the baseline) in the rate of carbon sequestration. Recovery rates of biomass as a result of rMCZ management, and therefore increases in carbon sequestration, will depend on the habitat type and previous level of benthic disturbance (Hiddink, Jennings and Kaiser, 2006).

L.116 Some rMCZ features, including those listed below, are identified as having particularly important roles in the sequestration of carbon (Fletcher and others, 2012). Where activities such as demersal trawling and aggregate extraction currently occuring over these features are reduced as a result of rMCZ designation, potential carbon sequestration benefits may be greatest.

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[26] Both studies convert biomass into an equivalent biomass of carbon and then to carbon dioxide equivalent (CO^2e) and then apply a shadow price of carbon to estimate the difference in value of the ecosystem service between reference and dredged sites.

[27] It therefore excludes respiration and excretion, which return CO_2 to the atmosphere; and excludes pelagic production of plankton and large organisms such as fish.

[28] A net positive impact may occur, dependent on the trajectory of biomass recovery after dredging.

[29] It should be noted that, whilst demersal trawling activity may be managed in a high proportion of rMCZs, analysis in this IA indicates that there is unlikely to be a significant level of aggregate extraction activity affected (see Annex I for site-specific details of the management of these activities.

- **Intertidal mud:** Carbon burial rates within intertidal mud are influenced by sediment accumulation and production, and by the rate of biomass decomposition. Therefore greater levels of sediment area allow for increased carbon burial (in comparison with freshwater wetlands/peatland areas, where sedimentation rates are slower).
- **Coastal saltmarshes and saline reedbeds:** Wetlands represent the largest component of the global terrestrial organic carbon inventory. Saltmarshes provide carbon storage at approximately 10 times the rate observed in temperate forests and 50 times the rate observed in tropical forests per unit area.
- **Deep-sea bed:** The deep sea bed contributes to maintenance of the chemical composition of the atmosphere and the oceans, for example via the 'biological pump', which transports carbon absorbed during photosynthesis into the deep seas.

L.117 There are a number of existing estimates of the value of a carbon storage, typically £ per tonne of carbon, based on the damage cost method and the social cost of carbon (see Luisetti and others, 2011). However, given the significant site-specific data requirements (which are generally not available) of establishing quantitative estimates of the likely changes in benthic biomass and resulting changes in the quantity of carbon stored as a result of rMCZ, such calculations have not been undertaken.

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Appendix 1 Lists and Acts that indicate the need for conservation of MCZ features

Table A1: Broad-scale habitats

Broad-Scale Habitat Types	**EUNIS Level 3 Habitat Code**	**Conservation Need**
High-energy intertidal rock	A1.1	Precautionary & representative
Moderate-energy intertidal rock	A1.2	
Low-energy intertidal rock	A1.3	
Intertidal coarse sediment	A2.1	
Intertidal sand and muddy sand	A2.2	
Intertidal mud	A2.3	
Intertidal mixed sediments	A2.4	
Coastal saltmarshes and saline reedbeds	A2.5	
Intertidal sediments dominated by aquatic angiosperms	A2.6	
Intertidal biogenic reefs	A2.7	
High-energy infralittoral rock	A3.1	
Moderate-energy infralittoral rock	A3.2	
Low-energy infralittoral rock	A3.3	
High-energy circalittoral rock	A4.1	
Moderate-energy circalittoral rock	A4.2	
Low-energy circalittoral rock	A4.3	
Sub-tidal coarse sediment	A5.1	
Sub-tidal sand	A5.2	
Sub-tidal mud	A5.3	
Sub-tidal mixed sediments	A5.4	
Sub-tidal macrophyte-dominated sediment	A5.5	
Sub-tidal biogenic reefs	A5.6	
Deep-sea bed	A6	

Source: ENG

Table A2: Habitat FOCI

Habitats of Conservation Importance (Habitat FOCI)	**OSPAR list of threatened and/or declining species and habitats**	**UK list of priority species and habitats (UK BAP)**
Blue Mussel beds (including intertidal beds on mixed and sandy sediments)	•	•
Cold-water coral reefs	•	•
Coral gardens	•	
Deep-sea sponge aggregations	•	•
Estuarine rocky habitats		•
File shell beds		•
Fragile sponge and anthozoan communities on sub-tidal rocky habitats		•
Intertidal underboulder communities		•
Littoral chalk communities	•	•
Maerl beds	•	•
Horse mussel (*Modiolus modiolus*) beds	•	•

Mud habitats in deep water		•
Sea-pen and burrowing megafauna communities	•	
Native oyster (*Ostrea edulis*) beds	•	
Peat and clay exposures		•
Honeycomb worm (*Sabellaria alveolata*) reefs		•
Ross worm (Sabellaria spinulosa) reefs	•	•
Seagrass beds	•	•
Sheltered muddy gravels		•
Sub-tidal chalk		•
Sub-tidal sands and gravels		•
Tide-swept channels		•

Source: ENG

Table A3: Low or limited mobility species FOCI

Scientific Name	**Common Name**	**Taxon. Group**	**OSPAR list of threatened and/or declining species and habitats**	**UK list of priority species and habitats (UK BAP)**	**Wildlife and countryside Act 1981 (Schedule 5)**
Padina pavonica	Peacock's tail	Brown alga		•	
Cruoria cruoriaeformis	Burgundy maerl paint weed	Red alga		•	
Grateloupia montagnei	Grateloup's little-lobed weed	Red alga		•	
Lithothamnion corallioides	Coral maerl	Red alga		•	
Phymatolithon calcareum	Common maerl	Red alga		•	
Alkmaria romijni	Tantacled lagoon-worm	Annelid (worm)			•
Armandia cirrhosa	Lagoon sandworm	Annelid (worm)		•	•
Gobius cobitis	Giant goby	Bony fish			•
Gobius couchi	Counch's goby	Bony fish			•
Hippocampus guttulatus	Long-snouted seahorse	Bony fish	•	•	•
Hippocampus hippocampus	Short-snouted seahorse	Bony fish	•	•	•
Victorella pavida	Trembling sea mat	Bryozoan (seamat)		•	•
Amphianthus dohrnii	Sea-fan anemone	Cnidarian		•	•
Eunicella verrucosa	Pink sea-fan	Cnidarian		•	•
Halicylstus auricula	Stalked jellyfish	Cnidarian		•	
Leptopsammia pruvoti	Sunset cup coral	Cnidarian		•	
Lucernariopsis campanulata	Stalked jellyfish	Cnidarian		•	
Lucernariopsis cruxmelitensis	Stalked jellyfish	Cnidarian		•	
Nematostella vectensis	Starlet sea anemone	Cnidarian		•	•
Gammarus insensibilis	Lagoon sand shrimp	Crustacean		•	•
Gitanopsis bispinosa	Amphipod shrimp	Crustacean		•	
Pollicipes pollicipes	Gooseneck barnacle	Crustacean		•	

Scientific Name	**Common Name**	**Taxon. Group**	**OSPAR list of threatened and/or declining species and habitats**	**UK list of priority species and habitats (UK BAP)**	**Wildlife and countryside Act 1981 (Schedule 5)**
Palinurus elephas	Spiny lobster	Crustacean		•	
Arctica islandica	Ocean quahog	Mollusc	•		
Atrina pectinata	Fan mussel	Mollusc		•	•
Caecum armoricum	Defolin's lagoon snail	Mollusc			•
Ostrea edulis	Native oyster	Mollusc	•	•	
Pauludinella littorina	Sea snail	Mollusc			•
Tenellia adspersa	Lagoon sea slug	Mollusc		•	•

Source: ENG

Table A4: Highly mobile species FOCI

Scientific Name	**Common Name**	**Taxon. Group**	**OSPAR list of threatened and/or declining species and habitats**	**UK list of priority species and habitats (UK BAP)**	**Wildlife and countryside Act 1981 (Schedule 5)**
Osmerus eperlanus	Smelt	Bony fish		•	
Anguilla anguilla	European eel	Bony fish	•	•	
Raja undulate	Undulate ray	Bony fish		•	

Source: ENG

Table A5: Coastal areas of importance identified by the Geological Conservation Review (CGR)

Name	**Type**
Axmouth-Lyme Regis	Mass Movement
Black Ven	Mass Movement
Budleigh Salterton	Coastal Geomorphology
Dawlish Warren	Coastal Geomorphology
Hallsands	Coastal Geomorphology
Isles of Scilly	Coastal Geomorphology
Slapton Ley	Coastal Geomorphology
Westward Ho!	Coastal Geomorphology
Whitsand Bay	Coastal Geomorphology

Source: ENG

Table A6: Geological and geomorphological features and their conservation importance index

Name	**Type**	**Conservation Importance Index (%)**
Haig Fras rock complex	Geological process features	79
Celtic Sea relict sand banks	Marine process features	66

Portland Deep	Marine process features	50

Source: ENG

Appendix 2 Anticipated benefits of marine protected area policy

Version 0.6

Version control

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Version	**Date**	**Author**	**Reason/Comments**
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Draft: Anticipated benefits of marine protected area policy

Scope of this paper

- To describe the history and background to the development of Marine Protected Area policy in England;
- To describe the predicted benefits of MPAs that led to current Government policy;
- To provide evidence of the benefits of MPAs as they were known at the time of development of the Marine and Coastal Access Act.

Background

The seas around the UK are extremely rich and diverse and contain amongst the widest range of habitats in Europe. They are also important to the economy, for example for transport, energy extraction, recreation and fishing. The pressures on the marine environment from the range of human activities have grown and there is evidence that marine habitats and species are being damaged (Defra 2005a), (UKMMAS 2010).

Protected areas have been a component of effective conservation strategies worldwide for decades, though their use in the marine environment has, until relatively recently, been limited with the vast majority of protected areas established on land.

In the UK, legislative provision for terrestrial nature reserves was made as far back as 1949 (HM Government 1949) and for Sites of Special Scientific Interest (SSSIs) and Marine Nature Reserves in 1981 (HM Government 1981). Although the term Marine Protected Areas (MPAs) was not widely used prior to the mid-1980s, in the UK there were a small number of statutory Marine Nature Reserves (MNRs) which today are recognised as MPAs (Strangford Lough MNR, established in 1985, Lundy Marine Nature Reserve, designated in 1986 and Skomer MNR, designated in 1990) alongside a handful of voluntary MNRs that had no statutory basis.

From the mid-1980s onwards there was an increasing recognition both nationally and internationally that the establishment of MPAs was required as an important component of the conservation of our seas and for the integrated management of coastal and marine areas. In England, developing Government policy led to creation of the Marine and Coastal Access Act, 2009 (MCAA) (HM Government 2009a) with its provisions for the establishment of a UK MPA network, including Marine Conservation Zones (MCZs). A history of the development of MPA policy in the UK is included at Annex 1.

Marine Protected Areas benefits

Predicted benefits

From the outset, MPAs were anticipated to have a wide range of benefits encompassing all 3 strands of sustainable development (environmental, economic and social) (IUCN 1988). These benefits mirror the well-established track record of protected areas on land. It has also been recognised that highly protected marine areas are a key component of any MPA network. In particular, from the outset, MPAs were anticipated to:

- Enable the protection and management of representative examples of marine ecosystems to ensure their long-term viability and the maintenance of genetic diversity;
- Enable the protection of rare, threatened and/or endangered species and populations and the conservation of the habitats critical to the survival of such species;
- Provide benefits to commercial species as a result of biodiversity conservation measures;
- Facilitate the interpretation of the marine environment for conservation, education and tourism;
- Allow a range of management measures (including highly protected areas) so that human activities consistent with the conservation objectives of sites could continue;
- To provide a focus for research and increasing understanding of the functioning of the marine environment and the effects of human activities upon it.

By the mid 2000s, MPAs were an established part of marine conservation programmes around the world. A number of reviews were carried out to try and quantify the potential benefits of MPAs.

The 2003 report from the Commonwealth of Australia (Commonwealth of Australia 2003) set out the role of MPAs and their benefits, including their broader benefits and discussed some of the principles which have been incorporated into the Ecological Network Guidance (Natural England and the Joint Nature Conservation Committee 2010) including viability, connectivity and protection as well as including a number of case studies demonstrating the benefits of MPAs from around the world.

Convention on Biological Diversity (CBD) technical reports 13 and 14 (CBD 2004a), (CBD 2004b) described the need for MPAs in the context of the Convention of Biological Diversity which sees the establishment of protected areas as an essential element in the management of biological diversity. For maritime states, MPAs are essential to establishing a protected area network covering all ecosystems. The reports also reviewed the evidence supporting the benefits of MPAs, including the benefits of Highly Protected Marine and Coastal Protected Areas. Benefits included:

- *Protecting ecosystem structure, functioning and beauty, allowing recovery from past damage, and serving as stepping stones for migratory/dispersive species;*
- *Protecting the genetic variability of exploited species;*
- *Increasing our understanding of marine biodiversity and systems, including by providing a baseline benchmark for identifying human-induced changes....;*
- *Providing opportunities for the public to enjoy natural or relatively natural marine environments.*

The reports concluded that the dynamic and connected nature of the marine environment, with few physical limits, highly mobile reproductive stages and strong interactions across long distances, supported a network approach and the management of activities both inside and outside MPAs. The reports further proposed that the MPA network should be comprised of two elements, highly protected MPAs and sustainable use MPAs sitting within a framework of sustainable management of the wider marine environment (including spatial planning) each of which contribute to the three primary CBD objectives of biodiversity conservation, sustainability and equity, and set out a series of principles for the design of the network.

The reports set out the anticipated costs and benefits of MPAs, which could be short or long term, including:

- economic impacts on traditional livelihoods;
- ecological benefits;
- knowledge to support resource management.

OSPAR has published a number of reports including 3 setting out guidance on the identification of MPAs (OSPAR 2003a), the ecological coherence of MPAs (OSPAR 2006) and MPA management (OSPAR 2003b). These reports set out the aim of the OSPAR network to:

- protect, conserve and restore species, habitats and ecological processes which are adversely affected as a result of human activities;
- prevent degradation of and damage to species, habitats and ecological processes, following the precautionary principle;
- protect and conserve areas that best represent the range of species, habitats and ecological processes in the OSPAR maritime area.

The guidelines adopt the CBD principles for network design, modified for the OSPAR maritime area, and taking account of the requirements of the Habitats and Birds Directives as well as providing more detailed advice and principles to underpin the identification and management of MPAs.

Evidence of benefits

A Defra study (Defra 2006) looked more specifically at the goods and services provided by the marine environment and provided evidence to support intervention to ensure that the marine environment could continue to provide these services. Six categories of ecological goods and services were considered and, for each category, the ecosystem components contributing to its delivery were identified and the extent of any changes were assessed to see whether the change documented might compromise delivery of the ecological service. A summary of the analysis is shown in Table 1.

Table 1 Summary of the analysis of the evidence that biological systems that deliver ecological services have been compromised and the risk to the continued delivery of the service

Ecological services	**Quality of evidence of a deterioration in ecosystem providers**	**Risk to delivery of ecological service**
Gas and climate regulation	Good	Low-moderate
Nutrient cycling	Some	Low
Waste treatment	Good	Low (Moderate for nutrient containing wastes
Habitat functions	Good	High
Food and material provision	Good	High
Biodiversity in support of societal values	Good	High

Despite limitations in data availability and quality, the report concluded that there was good evidence of adverse change in many marine ecosystem components (plankton, benthos, fish, birds, marine mammals etc) and that both the biodiversity and ecological functions of the marine environment are being adversely affected as a result of human activities. The report also concluded that the highest risk to ecosystem service functioning was likely to result from changes in microscopic organisms, plankton and benthic species and the habitats on which they depend, whilst loss of higher trophic levels would impact some of the economic benefits gained from the sea. These conclusions suggest that action to conserve these components of the marine ecosystem is required to ensure the continuance of the range of services provided by the marine environment.

A report produced for English Nature in 2006 (English Nature 2006) reviewed the evidence for the effectiveness of MPAs as a mechanism for the conservation of biodiversity, focussing on evidence mainly from temperate regions. The report contains numerous examples of the positive benefits of MPAs though acknowledged the often poor information base, including the absence of baseline data, differences in management regimes and levels of protection. Nonetheless it was possible to draw some conclusions which are summarised in Table 2.

Table 2 Evidence for the beneficial effects of MPAs (highly protected and multiple use)

Area where effects seen	**HPMRs**	**Multiple use MPAs**	**MPA networks**
Conservation of biodiversity	Good	Some	Data not available
Habitat protection	Good	Good	Data not available
Commercial species	Good	Some	Data not available

Protection or enhancement of ecosystem services	Some	Some	Data not available
Insurance against environmental or management uncertainty	Not available	Not available	Data not available

Marine ecosystems are complex and the impacts of MPAs and the timescale for those effects can be difficult to predict and sometimes unexpected due to effects on local food webs which can result in the increase in some species at the expense of others. In general, it was found that there is a considerable body of evidence on the beneficial effects of MPAs on marine biodiversity in temperate ecosystems, with most of the documented evidence in relation to habitats, species and ecosystem services. Much of the quantified evidence was in relation to highly protected areas. The study also found evidence of both negative (e.g. the results of displaced activities) and positive effects of MPAs on marine biodiversity outside their boundaries, which demonstrates that MPAs are unlikely to be successful unless they are set within a wider marine management framework.

The 2011 report by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO 2011) reviewed the effects of marine reserves (highly protected areas) using case studies from Europe. As well as providing advice on the design of marine reserves the report concluded that marine reserves are an effective way to protect habitats and biodiversity in the ocean leading to increases in the abundance, diversity, biomass and size of fish, invertebrates and seaweeds. Whilst the benefits occur across different habitats, and may spill over to areas outside the boundaries of specific MPAs, some species and habitats take many years to respond, meaning that MPAs should not be viewed as a quick-fix solution, nor can they be used in isolation from other marine management tools.

Summary

Protected Areas have long been recognised both globally and nationally as a key mechanism, working alongside broader environmental measures, to ensure the conservation of habitats and species and the continuing functioning of ecosystems. A range of international agreements, with supporting targets, including for the establishment of protected area networks, have been put in place to which the UK Government is a signatory. Efforts over the past two decades have been to extend the well-developed system of protected areas on land to the marine environment and this aspiration has been encompassed in many of the international agreement with specific targets set for the establishment of MPAs. In the UK legislation has recently been put in place to address the failings of previous domestic legislation in protecting marine habitats and species and to enable Government to meet its international commitments.

From the outset, MPAs were anticipated to have a wide range of benefits encompassing all 3 strands of sustainable development (environmental, economic and social). These benefits mirror the well-established track record of protected areas on land. It has also been recognised that highly protected marine areas are a key component of any MPA network. In particular, from the outset, MPAs were anticipated to:

- Enable the protection and management of representative examples of marine ecosystems to ensure their long-term viability and the maintenance of genetic diversity;
- Enable the protection of rare, threatened and/or endangered species and populations and the conservation of the habitats critical to the survival of such species;
- Provide benefits to commercial species as a result of biodiversity conservation measures;
- Facilitate the interpretation of the marine environment for conservation, education and tourism;
- Allow a range of management measures (including highly protected areas) so that human activities consistent with the conservation objectives of sites could continue;
- To provide a focus for research and increasing understanding of the functioning of the marine environment and the effects of human activities upon it.

As the number of MPAs increases worldwide, with MPAs now established covering all the major ecosystems and climatic regions, there is a substantial and growing evidence base demonstrating their benefits. Actual benefits demonstrate the value of MPAs in each of the key areas above with benefits including the conservation of biodiversity, habitat protection, benefits to commercial species and the protection and enhancement of ecosystem services. What remains clear is that MPAs as a tool cannot be successful used in isolation with MPAs needing to be implemented alongside other mechanisms that address the functioning and management of the entire marine ecosystem.

In the UK, the MCAA (alongside existing and proposed legislation covering Scotland and Northern Ireland) provides the framework for the establishment of the England (and Wales) contribution to a UK MPA network through the designation of MCZs alongside SSSIs, European Marine Sites and Ramsar Sites.

Existing MPAs in England, where effective management is in place, already demonstrate some of the benefits set out above and there every reason to consider that these benefits will be shared by MCZs once they are in place and being effectively managed.

History of Marine Protected Area policy in the UK

In 1988, the World Conservation Union (IUCN) General Assembly (IUCN 1988) recommended that *as an integral component of marine conservation and management, each national government should seek cooperative action between the public and all levels of government for development of a national system of marine protected areas (MPAs)*[30]*.* Included amongst the objectives for MPAs were to*:*

- protect and manage substantial examples of marine and estuarine systems to ensure their long-term viability and to maintain genetic diversity;

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[30] Marine Protected Areas are defined as: *any area of intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by legislation to protect part or all of the enclosed environment*.

- protect depleted, threatened, rare or endangered species and populations and, in particular, to preserve habitats considered critical for the survival of such species.

By 1999 there was growing recognition in the UK that existing policy and practice, including the creation of Marine Nature Reserves under the Wildlife and Countryside Act 1981, had been unsuccessful and that the systems for marine environmental protection lagged far behind those on land. In response to these concerns the UK Government initiated a review of marine nature conservation (RMNC), the first for 25 years, to evaluate existing measures for marine nature conservation, to identify best practice for effective marine conservation and to develop proposals for improving nature conservation of the marine environment.

The review released an interim report in 2001 (RMNC Working Group 2001) with a series of recommendations which were accepted by Government, which in 2002 published the Marine Stewardship Report (Defra 2002). The Marine Stewardship Report not only began to address the recommendations from the RMNC interim report, but also set out Government's commitment to delivering the goals of the 2002 World Summit on Sustainable Development and of the 1992 OSPAR Convention. The report set out a new UK Government vision for the marine environment of *clean, healthy, safe, productive and biologically diverse oceans and seas* and signalled Government's intention to put an ecosystem approach at the heart of their strategy and to pursue policies that *promote sustainable development, integrated management, stakeholder involvement, robust science and the precautionary* principle. Amongst the targets set out in the report was one of identifying and designating MPAs as part of a network of well-managed sites by 2010.

In 2001, John Randall MP introduced a Private Members Bill (HM Government 2002) to legislate for marine nature conservation. The Bill, which proposed to legislate for nature conservation only, was based on the existing approach for Sites of Special Scientific Interest on land and almost made it to the statute books, running out of time in the House of Lords in early 2002. Although that Bill did not reflect the need to take an ecosystem approach and contained no measures for the sustainable management of the wider marine environment, which were the emerging findings of the RMNC, the near success of that Bill increased the pressure on Government to take action.

In 2004, the House of Commons Environment, Food and Rural Affairs Committee published the results of their inquiry into the marine environment (EFRA 2004) and made several recommendations amongst which were that:

- Government should explore the desirability of a Marine Act if changes to the existing regime cannot be achieved within the framework of existing legislation;
- Government should report on the effectiveness of conservation measures for marine species that are not protected under the EU Habitats and Birds Directives.

The final RMNC report (Defra 2004) recognised the need to shift the emphasis from the protection of individual habitats and species to an ecosystem approach[31] to achieve the integration of marine conservation with social and economic goals and to ensure that any approach takes account of all

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[31] Ecosystem approach is the integrated management of human activities based on knowledge of ecosystem dynamics to achieve sustainable use of natural resources and the maintenance of ecosystem integrity.

components of the ecosystem and the functional processes supporting them. The report made 12 recommendations including that:

- Government should adopt and apply a marine nature conservation framework of Wider Sea, Regional Seas, Marine Landscapes, Important Marine Areas, and Priority Features in UK waters and discuss with other countries in the North-east Atlantic biogeographic region the potential for extending it to their waters;
- Government establish conservation objectives at each level of the marine conservation framework;
- An ecologically coherent and representative network of MPAs should be identified and established, and appropriate and proportionate measures applied to ensure their conservation needs are met;
- Government should introduce the necessary measures, including policy and legislation as appropriate, to underpin the application of the marine nature conservation framework throughout the waters under UK jurisdiction;
- Government should develop procedures to assess the impact of human activities at each level of the marine nature conservation framework and to assist in the determination of the appropriate level of response.

At the same time, evidence was growing about the decline in biodiversity of the UK's seas. A number of key reports and reviews (OSPAR 2000), (Laffoley 2000), (Covey 2002), (Defra 2005a) highlighted the increasing pressure on the marine environment from human actions that had led to adverse changes in the structure and functioning of the marine environment and a significant reduction in the overall health and quality of the UK's seas.

In addition to the growing body of evidence in the UK, the value of MPAs as a key part of conservation strategies in the marine environment had been internationally recognised and a number of international commitments and obligations had been established to which the UK Government was a signatory but for which it had no legislative mechanisms to implement (Box 1).

Box 1: International commitments for establishing networks of Marine Protected Areas

- The Convention on Biological Diversity (UN 1992) has led to a programme of work to assist the implementation of Decision II/10 (the Jakarta Mandate on Marine and Coastal Biological Diversity) at the national, regional and global levels. It identified key operational objectives and priority activities within the five key programme elements: integrated marine and coastal area management, marine and coastal living resources, marine and coastal protected areas, mariculture and alien species and genotypes. Its current objective is to conserve 10 per cent of coastal and marine areas through effectively managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures by 2020. (CBD 2010).
- The World Summit on Sustainable Development (UN 2002) resulted in more than 180 states agreeing a range of targets *to better protect and manage the world's seas*, including application of the ecosystem approach by 2010 and the establishment of representative networks of marine protected areas (MPAs) by 2012.
- The OSPAR Convention (OSPAR 1992) sets out obligations on signatories for the prevention and elimination of pollution (Annexes I-III), for assessing the quality of the marine environment (Annex IV) and for the protection and conservation of ecosystems and biodiversity (Annex V), and includes an objective of establishing well-managed and ecologically coherent networks of Marine Protected Areas throughout the OSPAR maritime area of the North-east Atlantic. The current target is for the network to be ecologically coherent and representative by 2012 and to be well-managed by 2016 (OSPAR 2010).
- The Water Framework Directive (EU 2000) seeks to deliver more integrated, ecologically driven management of inland surface waters, ground water, transitional (estuary) and coastal waters (to 1 nautical mile offshore). The overall objective is for waters to achieve "good ecological status" by 2015.
- The EU Marine Strategy Framework Directive (EU 2008) sets out a range of objectives and measures for the achievement of good environmental status of Europe's seas by 2020, based on application of an ecosystem approach, to deliver measures including the development of marine strategies for the sustainable management of marine areas and a coherent and representative network of MPAs by 2016.
- The Natura 2000 network is comprised of Special Protection Areas designated under the 1979 Birds Directive (EU 2009) and Special Areas of Conservation designated under the 1992 EU Habitats Directive (EU 1992). The Natura 2000 network is an EU wide network of protected areas with the aim of ensuring the long-term survival of Europe's most valuable and threatened habitats and species.

Government's response to the RMNC (Defra 2005b), recognised the importance of the UK's seas to the economy and to communities but acknowledged the growth in pressure on the marine environment from human activities. It set out a series of actions including a commitment to introduce a Marine Bill containing *measures to improve the conservation of marine biodiversity, including marine protected areas for nationally important species and habitats...."*.

In 2004 Government started work on a marine bill which entered the statute books in November 2009 as the Marine and Coastal Access Act (MCAA) (HM Government 2009a). The MCAA legislates in a number of areas including, the establishment of a new system of marine planning, a new marine licensing system to streamline previous arrangements and measures to improve the management of inshore fisheries. Part 5 of the MCAA (HM Government 2009a) provides the legislative framework for the designation of MCZs in England, Wales and UK offshore waters[32]. The Act establishes a duty to *designate MCZs so as to contribute to a UK network of marine sites, MCZs complementing the Natura 2000 network of European sites, Sites of Special Scientific Interest and wetlands protected under the Ramsar Convention* (HM Government 2009b) (**Error! Reference source not found.**).

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[32] In offshore waters adjacent to Scotland MCZs will be referred to as Marine Protected Areas.

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