

Natural Capital Committee

Marine and the 25 Year Environment Plan

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Summary

This paper sets a brief introduction to the considerable extent of the UK sphere of marine interest and its marine natural capital, and the very wide range of ecosystem services and benefits that derive from the marine environment.¹ In the broad context of the 25 Year Environment Plan (25 YEP), the Natural Capital Committee (NCC) considers and makes recommendations on how the government can protect and grow marine natural capital for public benefit and the enabling mechanisms to do so. It considers areas in which the UK can increase its international leadership to improve marine natural capital and its benefits. Finally, it considers those areas in which we need to build more underlying understanding of marine natural capital.

The terms of reference for the NCC relate to the environment in England, yet it would be difficult to ignore the wider UK marine environment given that its continuity enables the flow of marine natural capital around the UK. Although the NCC refers to and considers the whole of the UK in this paper, its recommendations are limited to the English marine environment and the area of jurisdiction of the UK marine environment that is not covered by the devolved administrations.

Key recommendations

- A more holistic approach is required for the protection and growth of marine natural capital. This approach should consider what further actions could be taken, in addition to marine protected areas, so that all of the UK's marine environment and its natural capital could be improved to deliver increased economic and social benefits and public services.
- Deeper consideration of management of the marine environment and its natural capital is needed, including within the Draft Environment Bill.² The Fisheries Bill³ currently pertains to limiting impacts on the environment of fishing activities but the extent of extractive activity for fisheries should be set by a natural capital approach, most appropriately within the Environment Bill.
- Natural capital thinking should be applied when implementing marine regulation and decision making under the Marine and Coastal Access Act,⁴ such as in developing planning policies and making licencing decisions.
- Incentives that reward good environmental stewardship should be provided for landowners to reduce their impact upon the coastal and marine economy and environment through the Agriculture Bill. These should be mirrored by incentives in the Environment Bill for good

¹ The broad marine habitat that covers all UK areas that are either permanently immersed in seawater or are inundated with saline water at some stage in the tidal cycle. This includes estuaries, beaches, coasts and all subtidal habitats out to the 200 mile limit of the UK's marine area.

² Defra, *Draft Environment (Principles and Governance) Bill* (2018): <https://www.gov.uk/government/publications/draft-environment-principles-and-governance-bill-2018>

³ Defra, *Fisheries Bill* (2017-19) <https://services.parliament.uk/bills/2017-19/fisheries.html>

⁴ <https://www.legislation.gov.uk/ukpga/2009/23/contents>

environmental stewardship among marine users such as fishermen, aquaculture businesses, marine renewable developers, oil and gas companies and port and harbour authorities.

- Net gain principles should also be applied to marine activities and implemented through existing regulation under the Marine and Coastal Access Act (via spatial planning and licencing activities) and via the Environment Bill.
- The physical and psychological health and wellbeing benefits (as well as social and economic benefits) for those living in or visiting the coast should be recognised, and public engagement should be encouraged including by improving public access.
- Further incorporation of current scientific understanding on the marine environment into all aspects of policy relating to the marine environment (such as climate change, energy and food production, public health, flooding, local communities, transport) would lead to the following benefits: increases in climate regulation and waste regulation services; potentially increased food production arising from increases in the biomass and productivity of fisheries, and take-up of opportunities for aquaculture; improvements in natural flood defence; as well as increases in the wildlife that people enjoy watching.
- It is not possible to quantify precisely the extent to which services might increase and further benefits be gained. More effort is required to understand what success would look like as the marine environment improves, as well as the trade-offs that arise among our uses of the different ecosystem services that flow from the marine environment currently and in the future.

Introduction

The UK marine environment

The UK sphere of marine interest covers national waters, Overseas Territories, Commonwealth and - through Official Development Assistance (ODA) - the wider international arena. The marine environment provides a very wide range of natural capital assets, services and benefits for multiple uses and users. These are much broader and deeper than what the marine chapter of the 25 YEP currently suggests.

The broad marine habitat covers all UK areas that are either permanently immersed in seawater or are inundated with saline water at some stage in the tidal cycle. This includes estuaries, beaches, coasts and all subtidal habitats out to the 200 mile limit of the UK's marine area (Figure 1). As described in the Marine assessment within the National Ecosystem Assessment⁵ the seas of the UK extend to some 867,400 km², which is more than three and a half times the land area. Mainland Britain has over 17,820 km of coastline and the widest range of marine habitats of any European country with an Atlantic border.⁶ These habitats support a high diversity of animals and

⁵ Austen et al, UK National Ecosystem Assessment (2011) <http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>

⁶ Hiscock K, Joint Nature Conservation Committee, *Marine Nature conservation Review* (1996).

plants, and are ranked as one of the highest in Europe⁷ with approximately 8,500 marine species.⁸ This number only refers to multi-cellular species, and one drop (one millilitre) of seawater can contain 10 million viruses, 1 million bacteria and about 1,000 small protozoans and algae.⁹ Estimates of marine biodiversity for the UK will continue to be revised upward as the diversity of the microbial component is elucidated. At phyletic¹⁰ levels marine diversity is higher than diversity on land or in freshwater. Although there are 14 exclusively marine phyla but only one exclusively terrestrial phylum, recorded multi-cellular species diversity is lower in the marine environment than it is on land and in freshwater.

Marine ecosystem services and their assessment

Because the marine environment and most of its biodiversity is largely unseen by the public compared to terrestrial biodiversity, only a few species (e.g. seabirds, seals, dolphins, porpoises and whales) are known and treasured by the public.

The systems approach taken by many marine scientists provides strong support for a natural capital approach. In many ways it is easier to take a natural capital approach to the marine environment than for the terrestrial and freshwater habitats, and to consider the flows of marine ecosystems services and the benefits they provide. These include provisioning services such as food, biotechnology, genetic and medicinal resources; regulating services such as climate regulation, coastal and flood defence, waste treatment and assimilation; and cultural services such as leisure, recreation, tourism and cultural heritage (see Figure 1).

The value of benefits from marine ecosystem services in the UK, and the natural capital that underpins them, are not yet well quantified. However, the Government's Office for Science Foresight Future of the Sea report¹¹ provides the following values for some of them: aquaculture, fisheries and processing - £1.1 billion Gross Value Added (GVA); marine tourism and recreation - £4-5 billion GVA; climate regulation/CO₂ sequestration (in the coastal shelf) - £7 billion GVA; coastal protection - £3.1-33.2 billion GVA (provided by intertidal habitats of sand dunes and salt marshes, these are lower and upper estimates that arise from capital savings in sea defence). In the UK the combined marine and maritime sectors are estimated to be worth around £47 billion GVA (~2.7 per cent of total UK GVA) and employ more than 500,000 people.

⁷ Defra, *Charting Progress - an Integrated Assessment of the State of UK Seas* (2005): <https://webarchive.nationalarchives.gov.uk/20141203170840/http://chartingprogress.defra.gov.uk/resources>

⁸ Hiscock & Smirthwaite, Marine Biological Association, *Marine Life Topic Note* (2006).

⁹ Heip et al., *Marine Biodiversity & Ecosystem Functioning*, Printbase (2009).

¹⁰ Higher level taxonomic classification of organisms.

¹¹ Government Office for Science, *Future of the sea* (2018): <https://www.gov.uk/government/publications/future-of-the-sea--2>

These sectors are growing so that all marine waters are subject to increasing and diversifying uses with corresponding pressures on marine natural capital e.g. shipping, renewable energy (offshore wind, wave and tidal power), aquaculture (rapidly increasing for both shellfish and fish), oil and gas and associated pipelines, subsea cables, aggregate extraction, tourism, leisure and recreation, and wild capture fisheries (fish and shellfish). Many of the uses are dependent on healthy natural capital, or impact on natural capital including that used by other sectors, or both. Marine natural capital changes when these uses change.

Although fisheries are the most obvious marine sector to many people, and arguably the most heavily supported by government policy and regulation, at a national scale they have a comparatively small economic, social, health and wellbeing impact on UK people compared to leisure, recreation and tourism. Some of the recreational sectors, such as sea angling and wildlife watching, which may or may not be supported by commercial sectors, are directly or indirectly in competition for the same natural capital resources. In many cases the public benefits from natural capital can be at direct odds with private use of common natural resources. The example of potential conflicts in use of marine natural capital is indicative of the multiple trade-offs among the different marine and maritime sectors and public services and their use of natural capital. These trade-offs need to be considered now and during increasing development of the use of marine space to ensure that the aspiration of the 25 YEP can be met: to improve the environment, protecting and growing its natural capital.

The UK's marine environment provides important but rarely considered regulating ecosystem services including coastal protection, climate regulation, and waste management (e.g. detoxification and sequestration) and assimilation. Coastal protection from effects of extreme weather (including floods, storms and waves) and erosion can be enhanced through managed realignment to restore coastal wetlands, and potentially improved through recovery of salt marsh, seagrass beds and shellfish reefs. Marine ecosystems are important for climate regulation, sequestering and storing more than half (55%) of the world's carbon.¹² Yet, the importance of carbon cycling in the UK's temperate marine ecosystems, offshore and inshore pelagic ecosystems, estuaries, sedimentary seabed etc. is largely ignored in natural capital accounting. UK estuaries and seas act as repositories and assimilators of waste received from land via licensed discharges, urban and catchment runoff, dredge spoil dumping, and accidental pollution, with plastics and litter being a highly visible indicator. There is a danger that this capacity is being exceeded, which is likely to result in future loss of revenue due to unconsidered externalities. In the UK for example, coastal habitats alone (e.g. saltmarshes and sand dunes) are estimated to

¹² Nellemann et al., United Nations Environment Programme, *Blue Carbon. A Rapid Response Assessment* (2009).

contribute £1bn in CO₂ sequestration, but that may fall to £0.25 billion by 2060 if habitat loss continues.¹³

Natural capital benefits of the marine and coastal environment may include health with coastal populations reporting better health than non-coastal populations (after accounting for local age and socio-economic population profiles).¹⁴ Gaps in self-reported health between relatively rich and poor coastal communities are smaller than the gaps between similar communities inland.¹⁵ These relationships are currently poorly explained and are subject to ongoing research.

By considering the marine environment using a natural capital approach - the benefits that attain to the seas, coasts and estuaries, the natural capital that underpins these services, and the impacts of current and future use of the marine environment under a time of global climate change - it is apparent more can be done to meet the aspirations of the 25 YEP to improve the marine environment and grow natural capital. The 25 YEP provides a policy framework to make a decisive change in the way the UK government considers and manages the marine environment and its natural capital, in particular for managing the many different economic sectors that utilise, interact with and impact upon marine natural capital.

NCC advice on improving the marine environment

The NCC proposes a list of diverse actions to government for the seas for which it has responsibility. These are set out as *Recommendations*, with explanatory text, which would start the process of change that could achieve improvement of the marine environment and its natural capital. These are required collectively as there is no single action that can achieve overall improvement. Each of the recommendations would to some degree mark a decisive step change in the way the UK considers and manages the marine environment and its natural capital. The natural capital approach will identify economic sectors and public services (such as leisure and recreation, and regulating services) where a change in policy, regulation, or management approach is likely to bring increased economic, social and health benefits over the current status quo.

The Terms of Reference for the NCC relate to the environment in England, yet it would be difficult to ignore the wider UK marine environment given that its continuity enables the flow of marine natural capital around the UK. Although we refer to and consider the whole of the UK in this

¹³ Beaumont et al., *The value of carbon sequestration and storage in coastal habitats. Estuarine, Coastal and Shelf Science* (2014).

¹⁴ Wheeler et al., *Does Living by the Coast improve Health and Wellbeing? Health & Place* (2012).

¹⁵ Wheeler et al., *Beyond Greenspace: An Ecological Study of Population General Health and Indicators of Natural Environment Type and Quality, International Journal of Health Geographics* (2015).

paper, our recommendations are limited to the English marine environment and the area of jurisdiction of UK marine environment that is not covered by the devolved administrations.¹⁶

Some of the recommendations made here were first introduced in the Natural Capital Committee's State of Natural Capital Annual Report 2019, its sixth report to the Economic Affairs Committee of the Cabinet, and are cross referenced in the forthcoming Natural Capital Committee Advice to Government on Net Environmental Gain.

Recommendations

These Recommendations are made with respect to the marine environment and the following broad goals in the 25 YEP:

- Clean air;
- Clean and plentiful water;
- Thriving plants and wildlife;
- Reducing the risks of harm from environmental hazards;
- Using resources from nature more sustainably and efficiently;
- Enhancing beauty, heritage and engagement with the natural environment;
- Mitigating and adapting to climate change;
- Minimising waste;
- Managing exposure to chemicals;
- Enhancing biosecurity.

Reconsidering protection and growth of natural capital

Approximately 24% of UK waters are covered by a mix of designations of marine protection via the EU Habitats and Birds Directives and more recently Marine Conservation Zones (in England) and Marine Protected Areas (Scotland). The 25 YEP aims to move towards a 'whole site' approach for marine protected areas, yet it is not clear how closely this aligns to the natural capital approach. Recovery and improvement of the marine environment solely within these sites is deemed to be sufficient to improve our marine environment. Activities that affect the marine environment are managed through marine planning and licencing, with each application for a new activity being considered largely on the basis of environmental impact assessment (which does not include natural capital approach thinking); damage is avoided or mitigated largely on a case by case basis. A more holistic view is recommended that considers what further actions could be taken, in addition to marine protected areas, so that all of our marine environment and its natural capital

¹⁶ The UK government has responsibility for England's marine environment from the shore out to the limit of the exclusive economic zone (EEZ, up to 200 miles offshore or to the median line bordering another country's EEZ), and for UK seas adjacent to territorial waters of the devolved administrations, from 12 miles offshore to the EEZ limit. Devolved administrations have responsibility for their own waters up to 12 miles offshore.

could be improved - i.e. throughout our seas rather than only in specific protected areas - and at the same time economic and social benefits increased and public services improved.

Recommendation 1.

As a part of the review process for the network of marine protected areas (currently designated to protect target features): evaluate their effectiveness in terms of improving natural capital, flows of ecosystem services and benefits, and where necessary re-orientate their protection towards natural capital assets and flows of ecosystem services more generally including their recovery and resilience.

Recommendation 2.

Consider extending and expanding the UK's marine protected areas (MPAs) and banning fishing and other disruptive activities in order to allow greater recovery of fish stocks and other natural capital.

A review and reorientation of marine protected areas could be factored into the Environment Bill and be undertaken by JNCC, EA and NE. Most of the marine protected areas of the UK have only recently been designated. The process has largely followed that applied terrestrially and is based purely on specific conservation features (nationally important marine wildlife, habitats, geology and geomorphology). Given that marine environments lend themselves more easily to a natural capital-ecosystems service approach (see introduction), this could be more appropriate than the historical species-led approach that was developed for terrestrial systems.

For example, recovery of fish stocks is not an objective of the UK's marine protected areas. Fish stocks are managed separately from other marine natural capital through management of fisheries effort. Protected areas for fish stocks would not necessarily be only for the benefit of fisheries, as fish would overspill from protected areas to adjacent areas, but also for the benefit of other wildlife such as seabirds and sea mammals (e.g. dolphins, porpoises, whales, seals) and the species of fish that are so important for marine leisure, recreation and tourism.

It is not yet known how effective current marine protection designations and fisheries management are for improving carbon management and other ecosystem services including mitigation and alleviation of extreme weather events. Increase in marine protection combined with fisheries management could mean that the UK fishes below maximum sustainable yield, but this is a trade-off that should be considered alongside other important ecosystem services.

Controlling fisheries for the benefit of wider natural capital through marine protected areas is one route to restoring marine natural capital in offshore and nearshore marine environments. Actions to evaluate the effectiveness of marine protection in terms of natural capital and ecosystem services, and re-orientate and expand marine protection, could have widespread and positive impact on marine natural capital assets.

Recommendation 3.

Implement fisheries management as a component part of wider natural capital, including actions to minimise the effects of different types of fishing activities on other natural capital assets. This could be incorporated into the Environment Bill so that fisheries are not managed in isolation from other marine natural capital via the Fisheries Bill but ensure instead that the two bills work closely together.

Targets for the amount of fish that can be extracted via fisheries (fish quotas) are currently determined independently of other natural capital needs via the EU Common Fisheries Policy, and so far it appears likely that this will continue to be the case in the current Fisheries Bill. Yet, the UK has an opportunity to take an internationally leading stance and commit to a broader natural capital approach that sets fish quotas as part of the wider context of environmental management of marine natural capital rather than as a separate entity (as they have been historically). The 25 YEP and the forthcoming Environment and Fisheries bills provide the opportunity to have a more integrated and coordinated approach to management of *all* marine natural capital (in the same way that terrestrial environmental management seeks to align with agricultural management.)

Those prosecuting fisheries have access to a common good without property rights, which has so far been managed in a way that considers the exploitation of fish stocks to be non-rival to other uses of marine natural capital. However, a change in approach is required because there is an increase in rival activities for ecosystem benefits that also rely on flows of fish stocks. For example sea angling is directly dependant on fish stocks and wildlife watching is indirectly dependant (since the wildlife consume fish and therefore compete with fisheries).

A step change in consideration of fisheries targets and in management of fishing activities would signal that the government believes that natural capital approaches are the most appropriate way of managing natural resources, and understands that fisheries are just one of the many benefits that marine natural capital provides. As well as potential increase in economic and social benefits via the valuable marine recreation and tourism sector, it would enable more equitable management and use of the public goods of marine natural capital. It would be welcomed by other marine users and environmentalists. However, it could be unpopular with those fishers who do not view themselves as co-stewards of the marine natural capital and guardians of its sustainability for all.

Recommendation 4.

To recover and improve marine natural capital in the seabed, encourage fishing behaviour that reduces disturbance to the seabed; prohibit trawling and dredging inside and near all UK protected areas; and eliminate dredge spoil dumping at sea, increasing efforts towards beneficial use.

Much of the UK seabed is sediment. It has a 3-dimensional biological and chemical structure that is created and maintained by marine invertebrates and by the microbial communities their activity facilitates, as well as the hydrodynamic forces of tidal currents and waves. Offshore sedimentary

seabed can be viewed as the engine room of the marine environment, lubricated and fuelled by the overlying water. Seabed sediment is similar to soil in as much as it is the natural capital that works with the overlying water ecosystem to maintain balances of seawater nutrients that are vital for maintaining all marine life, and for climate regulation through ocean carbon storage and sequestration. Ploughing with fishing gear destroys the 3-dimensional structure of sediment, fauna and chemistry. According to the Joint Nature Conservation Committee (JNCC) 74% of the seabed experiences pressure from trawling year on year, and the remaining 26% has a high degree of annual variability in the extent of this pressure.¹⁷ Any fertilisation effects of trawling (some fishermen argue it is similar to ploughing farmland fields) are short-lived.

For offshore areas it is not possible to actively manage to restore natural capital, except through reduction in pressures to allow the marine ecosystems to naturally improve their biodiversity and functioning. Trawl and dredge fishing is an active and widespread damaging pressure. Reduction of this pressure, with enforcement, would (literally) enable bottom up improvement of natural capital leaving the marine environment in a better state for future generations. It is likely that reduced seabed disturbance would lead to an increase in climate regulation/CO₂ sequestration (already valued at £7 billion GVA in the coastal shelf).¹⁸

Similarly, dredge spoil dumping damages the seabed through smothering and sometimes through contamination if it comes from historically contaminated harbours and ports. It can also negatively affect pelagic (water column) wildlife and ecological processes by creating localised, increased loading of suspended particulates. Dredge spoil could instead be used to rebuild and enhance coastal wetlands, or where feasible and appropriate to replace farmland soil loss. It has been argued that disposal at sea is the most economically viable option – but this does not take into account the long-term damage to natural capital. The Environment Bill should spell out that dredge spoil should be put to beneficial use and not dumped ‘elsewhere’ and out of sight. Promoting intertidal/subtidal habitats such as salt marsh, and also seagrass, maerl beds, offshore and nearshore living reefs (built by e.g. mussels, oysters and serpulid worms) would provide additional natural protection from extreme weather impacts of waves and flooding, and would enhance marine and coastal wildlife. Dredge spoil dumping is often locally quite contentious among marine users and coastal populations. Seeking beneficial use could be a popular outcome and innovative solutions would be something citizens could potentially engage with.

¹⁷ JNCC, *JNCC Report No: 515* (2018): http://jncc.defra.gov.uk/pdf/Report_515_WEB.pdf

¹⁸ Government Office for Science, *Future of the sea* (2018): <https://www.gov.uk/government/publications/future-of-the-sea--2>

Enabling mechanisms

Recommendation 5.

Make use of the experience being gained and lessons learned in the Marine and other pioneers to further develop local priorities and solutions that work with national strategies.

The Marine Pioneer programme has been developing and testing methods to deliver the government's 25 YEP, and the Natural Capital Committee's approach is being applied to the marine environment in North Devon. The Marine Pioneer is trialling the application of the natural capital approach to managing impacts on the marine environment, integrating planning and delivery for improving and restoring the marine environment, exploring sustainable funding options and sharing best practice. The other pioneers provide important lessons (that should feed into the Marine Pioneer) concerning governance, investment strategies and co-delivery by numerous organisations. A pilot local marine 25 YEP delivery plan (equivalent to terrestrial 'natural capital plans' for the 14 local areas) is being developed to work alongside the terrestrial plans.

Recommendation 6.

Defra and the Marine Management Organisation and other Defra agencies should formally incorporate natural capital thinking into all of their decision making using existing legislation under the Marine and Coastal Access Act (2009) (MCAA) and the forthcoming Environment Bill.

In support of implementation of the 25 YEP the Marine Management Organisation (MMO) should initially encourage and then request information on natural capital and ecosystem services to support its regulatory functions, for example when considering licence applications. The MMO, Environment Agency and Inshore Fisheries and Conservation agencies could increase their use of regulatory levers within existing and new marine protected areas to protect and enhance natural capital and flows of wider ecosystem services. There is growing support for this kind of natural capital leadership from both commercial users and NGOs.¹⁹ As the government's marine regulator, the MMO also has a role to support and link the government's Clean Growth Strategy²⁰ and Industrial Strategy²¹ with the 25 YEP policy aim to improve and restore the environment, and the 25 YEP aspiration to involve everyone in terms of responsibility to achieve this.

Applying natural capital approaches would be a highly significant, innovative and internationally-leading approach to marine management, decision making and regulation, affecting all aspects of

¹⁹ See E.g. Marine Conservation Society, RSPB, The Wildlife Trusts and WWF, *Joint Statement on Marine Conservation by Sea Bed User and Developer Group, issued at Coastal Futures 2019 conference*: <http://coastal-futures.net/wp-content/uploads/2019/01/Short-Presentations-Day-1-Barham-Batey-Appleby-Elliott-McKinley-Bradshaw-Pryor-Watts.pdf>

²⁰ BEIS, *Clean Growth Strategy* (2018) <https://www.gov.uk/government/publications/clean-growth-strategy>

²¹ BEIS, *Industrial Strategy* (2019): <https://www.gov.uk/government/topical-events/the-uks-industrial-strategy>

the UK's use of the seas. It will not be easy to implement and may require support from Natural England, the JNCC and the Environment Agency to provide additional guidance to all affected marine users. Few marine and maritime businesses and organisations are geared up to be able to undertake marine natural capital assessments, and indeed it is unlikely that the full level of detailed natural capital assessment and accounting is required to support all decisions. Nonetheless, through staged introduction UK marine businesses and environmental consultants could become international leaders in applying the natural capital approach to the marine environment that the Natural Capital Committee is advocating for, providing some competitive advantage if adopted worldwide as anticipated. This is likely to require additional resources, especially in the Marine Management Organisation and Inshore Fisheries and Conservation agencies, which are perceived to be operating with very limited resources for the remit which they cover. There are potentially resources available to support this through green-blue sustainable finance initiatives.

Recommendation 7.

Work towards an innovative sea management system, equivalent to and working with the land management system for land owners. This includes use of public money or other incentives to empower and enable users of the sea to become the stewards of the marine environment and its biodiversity as public goods for all users.

Recommendation 8.

Apply net gain principles to marine activities through existing regulation under the Marine and Coastal Access Act (via spatial planning and licencing activities) and via the Environment Bill.

Through the Agriculture Bill the government is proposing that land owners such as farmers receive land management incentives that reward good environmental stewardship.²² Future farming support should be subject to economic analysis that also incorporates the impact upon the coastal and marine economy (e.g. current and potential shellfisheries) and environment. Similar incentives to those for farmers should be provided to marine users such as fishermen, aquaculture businesses, marine renewable developers, oil and gas companies and port and harbour authorities. This would be a radical change in approach for many marine and maritime businesses, with potential for innovative actions towards widespread positive outcomes.

Opportunities for better environmental stewardship, or for marine environmental net gains, include:

- Use of less destructive fishing gears, and fisher collaboration to develop, agree and implement fishing behaviour that is more sustainable, with associated marketing of sustainable products to the consumer;
- Voluntary monitoring of the marine environment to inform policy and science;

²² Defra, *Agriculture Bill* (2017-19): <https://services.parliament.uk/bills/2017-19/agriculture.html>

- Co-location of sectors such as aquaculture and/or sea angling with offshore renewables, to increase ecosystem service flows and benefits;
- Better design of sea walls and other hard structures with features to benefit marine wildlife, for example incorporation of textured surfaces, crevices, overhangs and gradients that mimic natural foreshore features;
- Aquaculture of bivalve molluscs to improve water quality (removes excess nutrients, makes water clearer). Culture in reefs or banks (rather than in cages or on ropes) could also improve coastal protection. With significant water quality improvement bivalves may also become fit for human consumption in the longer term;
- Co-location of protected areas with improved facilitation of public access for non-disruptive leisure and recreation activity (e.g. snorkelling, kayaking, wildlife watching);
- Planning at the coast (enhancement of the 'blue' belt) – to enable and improve public access to blue space and marine natural capital (i.e. for leisure and for sustainable marine businesses and industry);
- Support for national marine park implementation (see Recommendation 10 below).

As far as we are aware there has been little or no activity to implement net gain in the marine environment.

Recommendation 9.

Local marine 25 YEP delivery plans should be developed that work with, and integrate with the 25 YEP land-based natural capital plans being developed for the 14 delivery areas. Catchment and land management approaches and any associated payments should take full account of their impact on estuaries, coastal waters and the sea and the need to protect and enhance these.

The 14 terrestrial delivery areas have their own area integrated plans, and it was proposed in the 25 YEP that these would be developed into natural capital plans that are aligned with the 25 YEP but are particularly relevant to the local area. Similar plans should be developed for marine areas (and the Marine Pioneer in North Devon has received funding to develop such a plan). However, these should integrate with terrestrial plans. This could help to improve quality of sea water downstream of catchments, which would enhance natural capital assets and processes, improve UK potential for aquaculture, and could enable an increase in the number of designated bathing waters and improve their all-year quality. Such action is needed to further reduce run-off from land to sea (often via water catchments and estuaries) of microbial contaminants from livestock, soil, and nitrates (fertiliser), i.e. better land management is required. Downstream improvement in freshwater quality has already been seen from Upstream Thinking programmes that reduce nutrient runoff from farmland, and anecdotally this may be improving estuarine biodiversity (although systematic evidence gathering is required here).

Natural solutions could also be implemented in estuaries and coasts, possibly under net gain or environmental stewardship, for example managed realignment and other measures to restore salt marsh habitats, and creation of mussel and oyster reefs that provide water filtration and

simultaneously restore natural capital. This could have significant local impacts for improving associated estuarine and coastal natural capital and helping local businesses that are dependent on clean water as a marine natural capital asset, such as aquaculture, tourism, recreation and leisure.

Recommendation 10.

Enhance public engagement with the natural marine environment through promotion of the massive recreational and leisure value of blue spaces with their physical and psychological health and wellbeing benefits (as well as social and economic benefits) for those living on or visiting the coast, including improving public access.

This aligns with the policy focus ‘Connecting people with the environment to improve health and wellbeing’ in the 25 YEP, which unfortunately does not provide illustrative examples or planned actions for engaging with the marine natural environment, even though many urban populations are situated at the coast. Impacts include potential for much greater public engagement with the marine natural environment, cost savings for health services, and economic benefits for those engaged in use of marine natural capital (tourism, leisure, recreation, local seafood producers etc.). The high value of the recreation and tourism sector demonstrates a public appetite for such engagement amongst those who can afford it. There are no marine equivalents of our national parks that act to increase opportunities for public engagement with the environment, enhance understanding and ownership, and also bring social, economic and health and wellbeing benefits. The 25 YEP policies present an innovative opportunity for government to support implementation of national marine parks (such as the one currently being proposed in Plymouth). In many cases more could also be done through schools programmes, through working with NHS mental health providers, through facilitation via environmental stewardship²³ or net gain actions,²⁴ through sustainable finance, or in some cases through government initiatives to support small businesses to enable wider public access to:

- Coast paths, for walking and contemplation;
- Beaches, for swimming, beachcombing, rock-pooling and other family activities;
- Watersports activities;
- Wildlife watching – charismatic mammals, birds, including through snorkelling;
- Seaside destination heritage.

Recommendation 11.

Harness the excellent science base in the UK to anticipate and plan policy for likely changes in natural capital under climate change, and to operationalise warning systems

²³ See: <https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management>

²⁴ See: <https://consult.defra.gov.uk/land-use/net-gain/>

(through satellite remote sensing and spatial modelling) that can enhance seafood and bathing water safety from natural hazards such as harmful algal blooms and pathogens.

The UK has excellent dynamic spatial models of marine ecosystems, their biogeochemistry and biology linked to hydrodynamic models. These can be forced by climate change models giving scenarios of changes in natural capital and ecosystem services. When used with satellite and airborne remote sensing these models have been used to provide early warning alerts for hazards to human health and seafood from harmful algal blooms and pathogens (e.g. in west coast of Scotland salmon farms). More widespread application of this UK science would allow adaptation and mitigation in our use and management of marine natural capital; e.g. for leisure (short-term forecasting of bathing water safety, long-term planning for future pathogen hazards), or for planning future management of fisheries and aquaculture resource, or natural flood defence capability provided by salt marsh and reefs under climate change. Scientific understanding of the marine environment should inform multiple aspects of policy including relating to climate change, energy and food production, public health, flooding, local communities, transport etc.

Recommendation 12.

Implement marine natural capital assessment and accounting²⁵ to achieve updated understanding and evidence of the extent of assets, services and benefits from the sea, coastal waters and estuaries so that we can monitor to ensure that improvements have been achieved that can be related to the actions relating to the 25 YEP.

This will also help to identify evidence gaps concerning natural capital stocks, ecosystem service flows and the values of specifically marine goods and benefits that need to be filled, and monitoring programmes that may need to be adapted or changed to enable this.

International leadership to improve marine natural capital and its benefits

Recommendation 13.

Take international leadership on tackling marine pollution with cross departmental coordination and action.

The UK Government has shown international leadership on oceans at the Commonwealth Heads of Government Meeting 2018 (Commonwealth Blue Charter)²⁶ and in implementing the plastic microbead ban, yet there are more opportunities to do so. UK leadership is needed across different government departments in international efforts to address, for example: reduction in ship emissions and waste; discarded fishing gear, plastic based ropes and netting; and containers lost at sea. The UK can work through the International Maritime Organisation (IMO) to maintain

²⁵ See:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/608852/ncc-natural-capital-workbook.pdf

²⁶ The Commonwealth, *Commonwealth Blue Charter* (2013): <https://bluecharter.thecommonwealth.org/>

pressure to avoid collisions at sea that can cause harmful pollution. The UK can provide leadership on plastic dumping at the coast (outside of UK waters) and engage more with international efforts to address other aspects of marine littering through circular economy approaches and attitudes to plastic in association with the Clean Growth and Industrial strategies.

The UK Government has still not ratified the IMO Ballast Water Management convention to remove risk of transferring invasive species and pathogens via ships ballast water.²⁷

Recommendation 14.

Take international leadership on improving marine natural capital in Official Development Assistance (ODA) countries with cross departmental coordination and action.

In Official Development Assistance recipient countries the marine environment is hugely important for livelihoods, health and wellbeing. More than 44 % of the world's population live within 150 kilometres of the coast and this percentage is growing rapidly. Seafood is a mainstay of protein supply in ODA countries: 60% of people depend on fish for more than 30% of their animal protein supply; 400 million people get more than 50% of their protein from fish; and 95% of the world's 38 million fishers live in ODA countries. Yet most ODA country fisheries are overfished; marine natural capital such as fish populations, coral reefs and mangroves is highly degraded. Areas that could be used for tourism revenue or for aquaculture, or could be of environmental benefit for the health and wellbeing of local communities, are often polluted and degraded by plastics, sewage and chemical contaminants. The UK Government has an opportunity to increase its current efforts to transfer best practice from its own experience, and take more action and leadership on facilitating inter- and transdisciplinary research and aid to improve management and equitable local and national governance of marine natural capital resources in ODA countries. This is important to enable more sustainable use of resources for food and raw materials, to improve health and wellbeing outcomes and to increase livelihood opportunities.

Building underlying understanding and establishing metrics

Application of the natural capital approach to the marine environment presents particular challenges, but these are not insurmountable and should not detract from the importance of continuing to seek mechanisms by which to apply the approach in practice. In general, data for the UK marine environment are inconsistent, and there are significant gaps in understanding how habitats and species support the delivery of ecosystem services.

Recommendation 15.

²⁷ IMO, *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (2004): [http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-\(BWM\).aspx](http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx)

A greater level of effort and resource is required to develop and then implement approaches by which the supply of marine ecosystem services and benefits can be adequately assessed and managed. This will require associated improvement in research-based understanding of the role of assets, ecological functions and processes.

The natural capital approach has been developed primarily from land cover mapping approaches in the terrestrial environment as illustrated by its use of defined, discrete, spatially-bound habitats as service providing 'units'. This methodology is appropriate for seabed (benthic) components of coastal and marine systems but less so for the overlying water (see further on for more discussion of this). However, knowledge of the location and extent of seabed habitats across most of the marine area is derived from model outputs and therefore highly uncertain (confidence is largely ranked low to medium in predictive habitat classification maps). In consequence, a system of natural capital assessment based on the quality and quantity of marine habitats will be unworkable in practice at the national level. Unlike land, it is not possible to measure the seafloor directly from satellites to a high resolution except in very shallow coastal waters and intertidally. We rely instead on sonar attached to marine vessels. A large investment would be required to map and monitor these habitats with adequate confidence and regularity.

There is greater potential for the quantity and quality of marine benthic habitats to be understood and monitored at smaller spatial scales, such as for an individual protected area, where the resource requirements are less and ongoing condition assessment may be a statutory requirement. Currently, due to lack of resource, the monitoring of offshore marine protected areas is highly infrequent (once every 5-15 years). It should be possible to learn useful lessons concerning monitoring from the ongoing work of the Marine Pioneers, within which natural capital approaches are being tested.

The European Nature Information System (EUNIS) habitat classification is a pan-European system that covers all types of natural and artificial habitats, both aquatic and terrestrial. The JNCC has actively contributed to the development of the marine sections of the EUNIS classification, since development began in 1996, with both the structure and detail of the marine classification strongly influenced by JNCC-led work in this area. A recent Defra report described the marine and coastal habitat classifications used within natural capital frameworks in the UK policy context as 'not yet fit for purpose' stating that 'it is essential that the habitats chosen as service providing 'units', and thus constituting the foundation of natural capital assessment, are selected appropriately.'²⁸ They recommended that the EUNIS system would be appropriate and the Natural Capital Committee concur, particularly as it is already used by government in marine protected area designations. Seabed (benthic) habitat classifications would thus be disaggregated to ensure vegetated habitats and biogenic reefs are adequately assessed along with different types of sediment and hard rock.

²⁸ Hooper et al., Defra, *Application of the natural capital approach to the marine environment to aid decision-making* (2019): [file:///C:/Users/x947269/Downloads/14440_FinalreportPhase1%20\(1\).pdf](file:///C:/Users/x947269/Downloads/14440_FinalreportPhase1%20(1).pdf)

Recommendation 16.

The European Nature Information System (EUNIS) should be used as a consistent classification of marine habitats, with a logical basis, that can be used for defining service providing 'units' in natural capital assessment.

It is also important to know the different depths at which the seabed habitats occur. Natural capital asset assessments must also include pelagic (water overlying the seabed) habitats. Salinity and stratification distinctions are also required to recognise key functional aspects of the natural capital assets. Assessment of pelagic habitats must also encompass the dynamic nature of the system, for example the spatial and temporal mobility of plankton, fish and marine mammals. Adequate classification and assessment of the pelagic system, and the interconnected nature of spatially disparate components of the wider marine environment, is a major omission in natural capital frameworks and a real challenge for them to address.

A further recommendation is that it is sensible to distinguish coastal habitats, which are influenced to at least some degree by the ocean but are not permanently submerged, from fully marine (subtidal) habitats.²⁹ This acknowledges how coastal habitats are part of both terrestrial and marine ecosystems and also, pragmatically, how coastal habitats are already mapped and monitored within the same national-scale programmes as terrestrial habitats. Presuming that coastal habitats will continue to be monitored as part of terrestrial programmes, it is important that the full extent (to the low tide mark) is recorded and that condition assessment takes account of their function as an integral part of the marine environment (the role of saltmarshes in providing a refuge for juvenile fish, for example).

Recommendation 17.

For the purposes of marine natural capital frameworks, the broad category of 'coastal' should extend to the low water mark i.e. consistently including all supralittoral (splash zone) and littoral (intertidal) habitats. Other coastal habitats should be included within terrestrial assessment programmes (rather than marine), in recognition of the national monitoring systems that already span land and coastal habitats. However, extent and condition monitoring must be modified to ensure that it encompasses the full intertidal extent and marine functional aspects.

Seabed (benthic) habitat classifications should be disaggregated to ensure vegetated habitats and biogenic reefs are adequately assessed along with different types of sediment and hard rock, and the different depths at which these occur.

Marine natural capital assessment must also include pelagic (water overlying the seabed) habitats. Knowledge of salinity and stratification characteristics of this habitat is also required as these affect key functions of biota in the water and in the seabed that the water covers. Assessment of

²⁹ Hooper et al., Defra, *Application of the natural capital approach to the marine environment to aid decision-making* (2019): [file:///C:/Users/x947269/Downloads/14440_FinalreportPhase1%20\(1\).pdf](file:///C:/Users/x947269/Downloads/14440_FinalreportPhase1%20(1).pdf)

pelagic habitats must also encompass the dynamic nature of the system, for example the spatial and temporal mobility of plankton, fish and marine mammals. The use of defined, discrete, spatially-bound habitats as service providing 'units' within the natural capital approach does not recognise certain key aspects of marine systems. In particular, large numbers of species (from plankton to whales) move horizontally and vertically through the water column on different spatial and temporal scales and may use different habitats (benthic and pelagic) for different phases of their lifecycle. Furthermore, not all marine environmental change manifests in relation to changes in spatial extent. Phytoplankton, for example, have a seasonal succession of blooms, which used to be matched to the seasonal succession of higher species that could consume them including larval fish of commercial importance and small fish important for seabirds. Climate change is affecting the timing of blooms, which is reducing the productivity and survival of some fish and bird species in UK waters.

Recommendation 18.

The application of the natural capital approach to marine pelagic ecosystems needs further consideration to ensure that its assessment can allow for the interconnected nature of spatially disparate components of the wider marine environment.

While the lack of data from *in situ* investigation of the marine environment does remain a problem, there are alternatives that will allow certain data gaps to be overcome to some extent. The use of proxies based on known pressures, their impacts, and habitat sensitivity is one pragmatic approach to overcoming the lack of habitat quality information, especially in light of significant, publicly available resources on habitat sensitivity. Remote sensing also has the potential to provide cost-effective data, particularly for certain pelagic information and for mapping coastal habitats. Expert judgement is useful and necessary, but there could be benefits to standardising how it is reported (such as the method employed by the Intergovernmental Panel on Climate Change (IPCC) to describe confidence in the evidence and the likelihood of an outcome). Citizen science can also generate data as well as engaging the public. Better communication between those collecting and using data is essential to increase awareness of available data and to facilitate its incorporation into central databases and tools.

In reality, because of the uncharted habitats of the sea, and the lack of any continuous timeline of marine natural capital data (especially in comparison to terrestrial habitats), it is difficult to know what an improved marine environment will look like or to quantify the extent to which services might increase. Current scientific understanding tells us that there would be increases in climate regulation and waste regulation and assimilation services; potentially increases in food production arising from increases in the biomass and productivity of fisheries (although it is difficult to define which species), and take-up of opportunities for aquaculture; reductions in coastal flood risk; as well as increases in the wildlife that people enjoy watching.

The UK would need a better understanding and consideration (in regulation, management and policy) of the trade-offs that arise among the uses of the different ecosystem services that flow from the marine environment. For example, trade-offs and synergies between food production

from fisheries, food production from aquaculture, and improvements in health and wellbeing and reduced healthcare costs arising from increased public engagement and access to the sea for leisure, recreation and wildlife watching. These examples entail competition for marine and coastal space, access, and biological resource (fish as food for human consumption versus for consumption by wildlife).

Recommendation 19.

Research and data collection should be directed towards understanding and quantifying the outcomes for marine ecosystem services and benefits as the marine environment improves, including the trade-offs that will arise among the uses of the different ecosystem services that flow from the marine environment currently, and in the future.

Figure 1: Marine ecosystem services

PROVISIONING	REGULATING	HABITAT	CULTURAL
1a: Food provision - Wild capture sea food	3: Air purification	10: Migratory and nursery habitat	12: Leisure, recreation and tourism
1b: Food provision - Farmed sea food	4: Climate regulation	11: Gene pool protection	13: Aesthetic experience
2a: Biotic raw material - Genetic resources	5: Disturbance prevention and moderation		14: Inspiration for culture, art and design
2b: Biotic raw material - Medicinal resources	6: Regulation of water flows		15: Cultural heritage
2c: Biotic raw material - Ornamental resources	7: Waste treatment and assimilation		16: Cultural diversity
	8: Coastal erosion prevention		17: Spiritual experience
	9: Biological Control (checks & balances)		18: Information for cognitive development

Hattam et al. Marine ecosystem services: linking indicators to their classification. Ecol. Indicators (2015)