

Applying a natural capital approach to the Yorkshire coast – a feasibility report

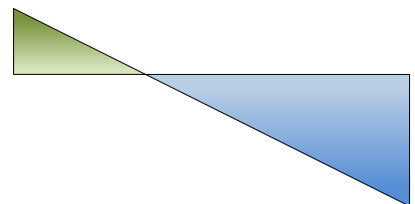


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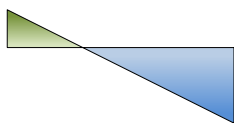
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Executive summary

Over the last two years, the Yorkshire Marine Nature Partnership (YMNP) has been working with partners to develop their knowledge and understanding of the natural capital approach. The YMNP, in collaboration with the region's Local Nature Partnerships, local authorities and regional ecological data centre, has recently supported application of the Environment Agency's Natural Capital and Register Account Tool to help better understand how the tool might be applied to Yorkshire's terrestrial and coastal environments. Additional funding enabled the YMNP to build on this work through a feasibility study, exploring how marine and coastal ecosystem services should be incorporated into the natural capital approach. The three principal aims of this study were to:

- Identify core evidence and/or resource gaps (relevant) to the implementation of a marine natural capital approach on the Yorkshire coast;
- Work with key stakeholders to understand how a natural capital approach to marine environments could be applied to local and regional decision-making, and improve coordination across the marine, coastal and terrestrial ecosystems; and
- Identify any potential challenges to the application of a natural capital approach, including 'artificial' boundaries (political, geographic and social) which may present barriers to progress in the coastal environment.

A natural capital approach to policy and decision-making considers the value of the natural environment for people and the economy. This report explores how marine and coastal ecosystem services might be incorporated into the natural capital approach with respect to the Yorkshire coast; the main outputs and findings are summarised below:

1. A narrative review examines what can be learnt for the Yorkshire coast setting from the application of the natural capital approach in other areas of the UK. The review introduces the core concepts that underpin the natural capital approach together with approaches to economic and non-economic valuation, and place-based applications. It outlines several tools that support the application of the natural capital approach. Examples of the application of the natural capital approach to coastal and marine places across the UK are reviewed for lessons that can be learnt. The review is not comprehensive in its coverage of government and Defra family reports, the wider literature on natural capital, or place-based evidence reported in support of the named case study applications, and is not intended to be exhaustive in its coverage of the full range of place-based activity that has recently been, or is currently being, undertaken in the UK.
2. Ten key practitioners, identified as potentially being able to provide valuable views and comment on the application of the natural capital approach to marine settings, were interviewed online by the authors. Each interview lasted about an hour, and covered discussions about both perceived challenges or blockages to the adoption of the natural capital approach, and the effective embedding of the approach to organisational policies and processes — whether at the generic national level or (where the participants' knowledge/experience permitted) for the more specific case of the Yorkshire coast. Interview notes and transcripts were subsequently reviewed, and around 100 principal comments (providing insights and learning points) were identified and extracted. From observation, and through expert judgement, six broad categories of comment were identified from those principal comments derived from the interviews, viz: underlying project philosophy, and how projects are structured and managed; opportunities; challenges and threats; data availability and handling; engagement; and networking. Further clustering was apparent within each of these broad categories. This hierarchical structure was used as a framework to present and summarise the principal comments provided by the key practitioners.
3. An online questionnaire was produced to collect information from a range of stakeholders. While the link to the online survey was emailed to 37 stakeholders, just eight completed questionnaires were received for analysis. These questionnaire responses provided key comments, insights and learning points on core evidence and/or resource gaps; on how the application of the natural capital approach to marine environments could be applied to local and regional decision-making (with improved

coordination across the marine, coastal and terrestrial ecosystems); and on potential challenges to the application of the natural capital approach - including 'artificial' boundaries (political, geographic and social) which may present barriers to progress in the coastal environment. The feedback provided advice on: data availability; progressing the application of a natural capital approach to the Yorkshire coast; opportunities for embedding a natural capital approach into regional decision-making or policy development; areas of potential coordination/cooperation; and suggested 'next steps'.

4. From the engagement with stakeholders, evidence elsewhere, national guidance, and the authors' own expert opinions, it is argued that the (methodological) challenges that have been identified to the application of the natural capital approach to the Yorkshire coast are likely to be able to be addressed by YMNP in the short- to medium-term. The report includes nine recommendations for 'next steps' actions required to implement the natural capital approach effectively to the Yorkshire coast, taking account of regional and national progress on this topic. These recommendations are:
 - Undertake a participatory system mapping of the Yorkshire Coast nexus, including natural capital assets, ecosystem services, and beneficiaries including values;
 - Undertake a scoping study to identify the location, quantity and condition of natural capital assets that make up the Yorkshire Coast based on known evidence;
 - Establish collaborative research networks with ecological and socio-economic researchers/research groups in the region;
 - Ensure that any new natural capital project has a well-integrated and representative structure;
 - Ensure that, for any new natural capital work, there is a clear project vision;
 - Create a single repository for information;
 - Further develop and maintain a programme of stakeholder activities to promote engagement and to elicit the value of the Yorkshire coast to communities;
 - Employ the 'community voice method' to elicit qualitative, social and cultural assessments of the value of the Yorkshire coast and to promote wider engagement;
 - Recognise the extent to which natural capital is already embedded in decision-making.
5. It is concluded that substantial progress in the application of the natural capital approach to the Yorkshire coast should be able to be made against the recommendations over the next few years. However, if this ambitious programme of work is to be achieved and used to support Yorkshire's marine and coastal environment, significant investment in the YMNP will be required, with particular focus on data collection and sharing, knowledge exchange, and in the working relationships between partner organisations.
6. Annexes to the report include: a brief introduction to tools available to support the application of the natural capital approach; brief accounts of place-based applications of the natural capital approach in the UK; records of interviews with key practitioners; and copies of stakeholder questionnaire responses.

The YMNP recognises the importance of aligning their work with progress elsewhere, including terrestrial, to maintain connectivity and consistency for 'cross-ecosystem' partners. The tools and methods employed in the application of a natural capital approach to the terrestrial environment provide helpful lessons for employing natural capital approach in coastal and marine environments. However, too great reliance on linking it with terrestrial accounting may be counter-productive at this time, and more rapid progress might well be made through a more focussed drive to use the lessons from existing marine and coastal work to help inform the application of the approach to the Yorkshire coast. As noted above, such a drive would inevitably be dependent on the availability of adequate funding.

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Thanks are due to the ‘key practitioners’ for agreeing to participate in this work, for providing so much valuable material through the course of their online interviews, and for subsequently providing review and feedback on derived interview transcripts; thanks also to those stakeholders who responded to the request to complete the online survey questionnaire.

Project funding by the Championing Coastal Coordination fund, as part of the Yorkshire Marine Nature Partnership’s ‘Connecting the Dots’ project supported by the North York Moors National Park Trust, is gratefully acknowledged.

Acronyms used

The following (Box 1) presents a summary of the range of acronyms and abbreviations that are used throughout this report.

Box 1 Acronyms and abbreviations used

AONB	Area of Outstanding Natural Beauty
BEIS	Department for Business, Energy & Industrial Strategy
BID	Business Improvement District
CaBA	Catchment Based Approach
CAVCA	Coast and Vale Community Action
CSMNCP	Cumbrian Solway Marine Natural Capital Project
ENCA	Enabling a Natural Capital Approach
ESRC	Economic and Social Research Council
EUNIS	European Nature Information System
IFCA	Inshore Fisheries Conservation Authority
JNCC	Joint Nature Conservation Committee
LGR	Local Government Reorganisation
LNRS	Local Nature Recovery Strategy
MCS	Marine Conservation Society
MCZ	Marine Conservation Zone
MEDIN	Marine Environmental Data and Information Network (S3.2.4)
MMO	Marine Management Organisation
NCA	Natural capital approach
NCRAT	Natural Capital Register and Accounts Tool
NEIFCA	North Eastern Inshore Fisheries Conservation Authority
NERC	Natural Environment Research Council
NEYEDC	North and East Yorkshire Ecological Data Centre
NGO	Non-Governmental Organisation
NYMNPA	North York Moors National Park Authority
SAC	Special Area of Conservation
SCAMPP	Solway Coast and Marine Pilot Project
SEAES	English Solway
SEASS	Scottish Solway
SFP	Solway Firth Partnership
SMILE	Solway Marine Information Learning and Environment
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
YMNP	Yorkshire Marine Nature Partnership
YNY LEP	York & North Yorkshire Local Enterprise Partnership

1 Introduction

1.1 Project background

Wolds Environmental Consulting has been engaged by the Yorkshire Marine Nature Partnership (YMNP) to explore how marine and coastal ecosystem services might be incorporated into the natural capital approach with respect to the Yorkshire coast.

The delivery of this project has addressed five key objectives as identified by YMNP in their original ITT:

- i. Identify core evidence and/or resource gaps (relevant) to the implementation of a marine natural capital approach on the Yorkshire coast;
- ii. Work with key stakeholders to understand how a natural capital approach to marine environments could be applied to local and regional decision-making, and improve coordination across the marine, coastal and terrestrial ecosystems;
- iii. Identify any potential challenges to the application of a natural capital approach, including ‘artificial’ boundaries (political, geographic and social) which may present barriers to progress in the coastal environment;
- iv. Provide expert support during the production of three short videos (separately contracted) designed to share information and knowledge with stakeholders about the marine environment and the natural capital approach;
- v. Deliver a feasibility report to explain how a natural capital approach could be applied on the Yorkshire coast, which is complementary to progress being made elsewhere in the region and nationally. This report should include recommendations for ‘next steps’ and priority actions.

Accordingly, this report:

- explains how a natural capital approach could be applied on the Yorkshire coast in a manner that is complementary to progress being made elsewhere in the region and nationally (Objective v);
- identifies core evidence supportive of, and/or resource gaps prejudicial to, the implementation of a marine natural capital approach on the Yorkshire coast (Objective i);
- uses insights from key stakeholders to inform an outline of how a natural capital approach to marine environments could be applied to local and regional decision-making (Objective ii), and to identify the principal challenges associated with this, including the issue of ‘artificial’ boundaries (political, geographic and social) which may present barriers to progress in the coastal environment, and to improve coordination across all environments (Objective iii); and
- includes recommendations for ‘next steps’ and for priority actions required to implement this approach effectively, taking into account regional and national progress on this topic (Objective v).

In addition, the project provided support during the production of three short videos (separately contracted) intended to share information and knowledge with stakeholders about the marine environment and the natural capital approach (Objective iv).

For the purposes of this report, the Yorkshire coast is considered to encompass the coastal strip (including estuaries, the intertidal, and the subtidal out to the 12 nautical mile limit) from Staithes in the north to Spurn Point in the south.

1.2 Approaches

1.2.1 Outline of review work

A narrative review was undertaken to examine what can be learnt for the Yorkshire coast setting from the application of the natural capital approach in other areas of the UK. The review introduces the core concepts that underpin the natural capital approach together with approaches to economic and non-economic valuation. It also outlines several tools that support the application of a natural capital approach. Examples of the application of natural capital approach to places across the UK are reviewed for lessons that can be learnt.

The review is illustrative and is not intended to be comprehensive in its coverage of government and Defra family reports, the wider literature on natural capital, or place-based evidence reported in support of the named case study applications, and is not exhaustive in its coverage of the full range of place-based activity that has recently been, or is currently being, undertaken in the UK.

1.2.2 Insights from key practitioners

Following informal discussion with the YMNP Project Lead, a number of key practitioners were identified as being potentially able to provide valuable views and comment on the application of a natural capital approach to marine settings. These individuals (see Table 1.1) were each invited to take part in an online discussion with the authors, via the MS Teams video-conferencing platform. Ahead of each meeting interviewees were asked to provide their consent for the meeting and for the meeting dialogue to be recorded and transcribed to better support the drafting of this report. Requests for interviews were also made to staff at defra and at JNCC but, within the relatively short timeframe of this study, suitable representatives were not able to contribute.

Table 1.1 Key practitioners interviewed

Interviewee	Organisation	Date of meeting
Simon Pickles	North & East Yorkshire Ecological Data Centre	8 February 2022
Tara Hooper	Natural England	10 February 2022
Georgina Reid & Beth Churn	SCAMPP & CSMNCP (Solway Firth Partnership / Cumbria Wildlife Trust)	11 February 2022
Aisling Lannin	Marine Management Organisation	14 February 2022
Tim Smith	NE Inshore Fisheries & Conservation Authority	24 February 2022
Briony Fox	North York Moors National Park Authority	25 February 2022
Alice Lord	Natural England	2 March 2022
Claire Argent	Natural England	3 March 2022
Antony Firth	Historic England	3 March 2022

SCAMPP (Solway Coast and Marine Pilot Project)

CSMNCP (Cumbrian Solway Marine Natural Capital Project)

Where appropriate, interviewees were able to provide comments specific to their respective employer organisations. However, all views and comments provided were those of the individuals concerned and were not assumed to necessarily reflect their employers' views or official positions.

Each interview lasted for around an hour. Interviewees were asked to talk about their perceptions of challenges or blockages to the adoption of a natural capital approach. This included the effective embedding of the approach to organisational policies and processes (whether at the generic (national) level or, where their knowledge/experience permitted, for the more specific case of the Yorkshire coast).

Interview transcripts were subsequently reviewed, and key comments, insights and learning points identified. A structured summary of these is presented below (see Section 3).

1.2.3 Stakeholder survey

An online questionnaire was produced, using the Jisc 'Online Surveys' platform, to collect information from stakeholders that could then be used:

- to help identify core evidence and/or resource gaps;
- to understand how a natural capital approach to marine environments could be applied to local and regional decision-making (with improved coordination across the marine, coastal and terrestrial ecosystems); and
- to identify potential challenges to the application of a natural capital approach -including 'artificial' boundaries (political, geographic and social) which may present barriers to progress in the coastal environment.

A link to the online survey was emailed to 37 stakeholders, from a variety of organisations, by the Project Leader. Recipients were identified by the Project Leader and were further informed by the ongoing interviews with key practitioners (see above).

The online survey went live on 18 February 2022 and, following email reminders and a short extension, was finally closed on 18 March 2022.

2 Application of a natural capital approach regarding the marine environment

2.1 Natural capital and the natural capital approach: an introductory overview

A natural capital approach to policy and decision-making considers the value of the natural environment for people and the economy. According to the Natural Capital Committee's Natural Capital Terminology (Natural Capital Committee, 2019, p.3), the focus is on:

“that part of nature which directly or indirectly underpins value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions ... In combination with other types of capital, natural capital forms part of our wealth; that is, our ability to produce actual or potential goods and services into the future to support our well-being.”

The UK National Ecosystem Assessment (UK NEA, 2011) was one of the first national-scale assessments of the contribution of nature to human well-being. The UK National Ecosystem Assessment Follow-on Project included the development of an ecosystem service framework for coastal and marine environments with UK applications (Turner et al., 2014; Turner et al., 2015). The Dasgupta Review (Dasgupta, 2021) emphasises the importance of the natural capital approach for economic activity and human wellbeing, recognising biodiversity as an asset which should be protected and actively restored.

The natural capital approach is now found within the policy framework. The Natural Environment White Paper (HM Government, 2011) “pledged to put the value of England’s natural capital at the heart of our economic thinking”. Similarly, the 25 Year Environment Plan published in 2018 (HM Government, 2018) “reaffirmed the government’s position that the environment underpins well-being and prosperity and provides quantifiable economic benefits” (Hooper et al., 2019). Furthermore, Defra’s *Enabling a Natural Capital Approach* (ENCA) guide (2020) consolidated natural capital thinking and evidence¹. Coastal and marine policy and management, such as the UK Government’s (2019) Marine Strategy², reflect the importance of natural capital and the ecosystem services that such capital provides for the economy and human health and well-being.

2.1.1 Key elements of the natural capital approach

Operationalising the natural capital approach centres on four concepts (Natural Capital Committee, 2017) - natural capital, assets, ecosystem services (and abiotic services), and benefits - and the logic chain that links them. Further, to assess the contribution of benefits to society implies a focus on economic and non-economic concepts of value and the role of valuation techniques that are used to elicit such values. These concepts are reviewed briefly below.

Natural capital:

According to HM Treasury's *Green Book: Appraisal and Evaluation in Central Government* (HM Treasury, 2020), natural capital

“includes certain stocks of the elements of nature that have value to society, such as forests, fisheries, rivers, biodiversity, land and minerals. Natural capital includes both the living and non-living aspects of ecosystems.”

Assets:

The ENCA guidance (Defra, 2020) considers the natural capital approach, at its simplest, to be thinking of nature as an asset, or set of assets, which benefit people. The ability of the natural environment to provide benefits will depend upon the assets’ quality, quantity and location which, in turn, are affected by

¹ <https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca>

<https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance>

² <https://www.gov.uk/government/publications/marine-strategy-part-one-uk-updated-assessment-and-good-environmental-status>

background pressures, management measures and drivers of demand. In this regard, natural assets should be considered as a:

“distinctive component or grouping of biotic and abiotic components and other elements which function together or interact within a spatial area, including ecosystems, ecological communities, species, soils, freshwater, land, atmosphere, minerals, sub-soil assets and oceans” (BS 8632 cited in Makowska et al., 2021)

Ecosystem services (and abiotic flows):

Assets, the stocks of natural capital, provide flows of environmental or ecosystem services over time. Hence, ecosystem services are:

“Functions and products from nature that can be turned into benefits with varying degrees of human input”

To realise the human benefits from the flow of ecosystem services typically requires the use of human inputs in the form of complementary capital (Turner et al., 2014), comprising built capital (e.g. fishing vessels, port infrastructure), human capital (e.g. the time, knowledge and skills of fishers) and social capital (e.g. relationships within and between fisher communities, and their relationships with other communities).

A distinction should be drawn between abiotic flows and ecosystem services. Abiotic flows of natural capital comprise flows which are not dependent upon functioning ecosystems e.g.: minerals; oil and gas; solar, wind and tidal power. In contrast, ecosystem services are defined as being biotic, that is, dependent upon functioning ecosystems, as is implied by the UK Natural Ecosystem Assessment Follow-on framework (Turner et al., 2014) depicted in Figure 2.1 below.

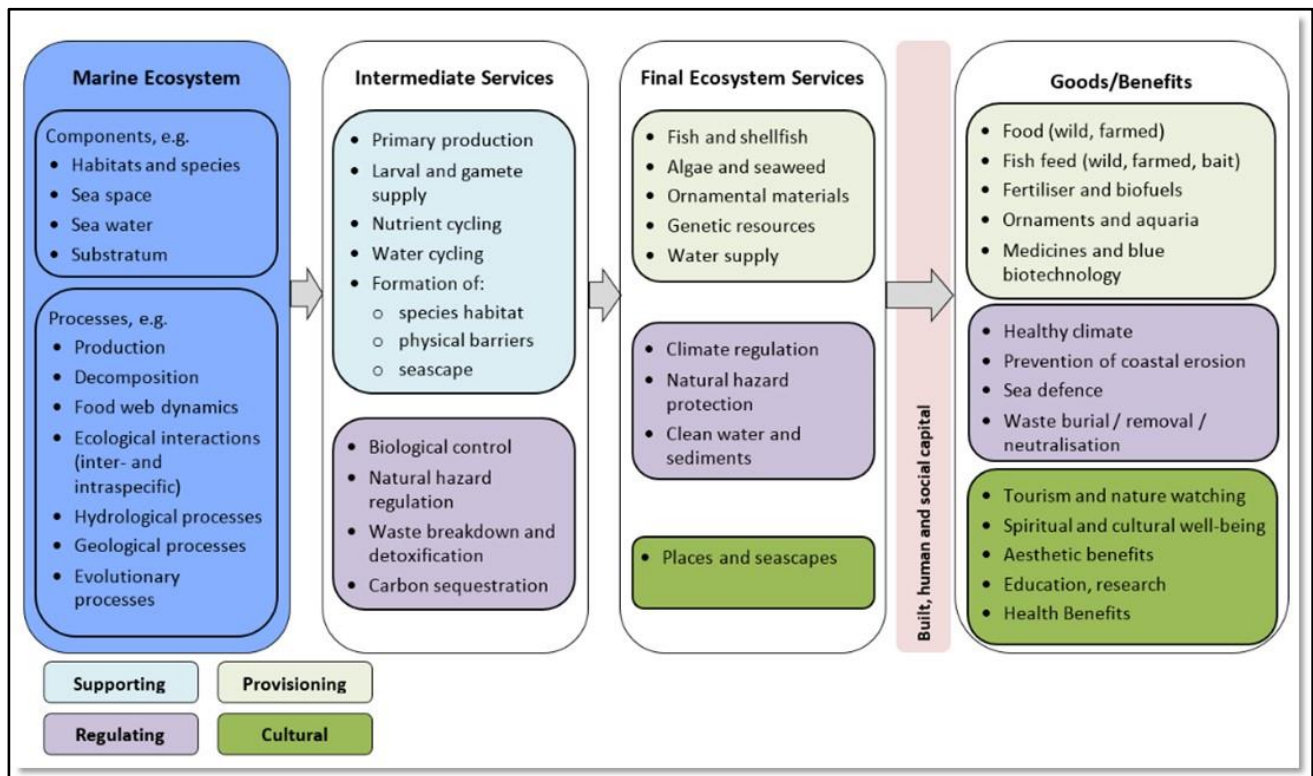


Figure 2.1 The NEAFO ecosystem service framework

(Source: Turner et al., 2014)

Figure 2.1 identifies (biotic) ecosystem services to comprise:

- ‘provisioning services’ which are tangible outputs that can be obtained from ecosystems that meet human needs e.g. fish, standing vegetation and genetic materials;
- ‘regulating services’ which are ecological processes that regulate and reduce pollution and other adverse effects e.g. climate regulation and natural hazard regulation;
- ‘cultural services’ associated with environmental settings (landscape and seascape) that enable cultural interaction and activity e.g. settings for education, leisure and recreation; and
- ‘supporting services’ which do not produce outputs for final consumption or production, but are essential for the functioning of provisioning, regulating and cultural services, which do provide outputs.

Benefits:

Benefits are associated with changes in human health and well-being that result from the use or consumption of benefits (including goods) derived from ecosystem services and abiotic flows, or from the knowledge that something exists. As Figure 2.1 shows, the UK NEA Follow-on framework (Turner et al., 2014) categorise these benefits as:

- ‘provisioning goods/benefits’ e.g. fertilisers and bio-fuels, food for human consumption and food for non-human consumption;
- ‘regulating benefits’ e.g. healthy climate, flood control and erosion control; and
- ‘cultural benefits’ e.g. aesthetic benefits, spiritual and cultural well-being, human health benefits, leisure and recreation, and education and research.

The logic chain framework described above is summarised in a schematic in Figure 2.2. However, when considering this depiction of the relationships, it should be recognised that it simplifies the reality in important ways, as:

- individual benefits will depend upon an array of ecosystem services rather than being attributable to a single one, as interdependencies and backward linkages are characteristics of complex coastal and marine systems;
- ecosystem services associated with one broad habitat type can be affected by changes in other habitats;
- the interconnected nature of spatially separate components of the wider environment, highly mobile species and the role of the water column are particularly important considerations in coastal and marine habitats.

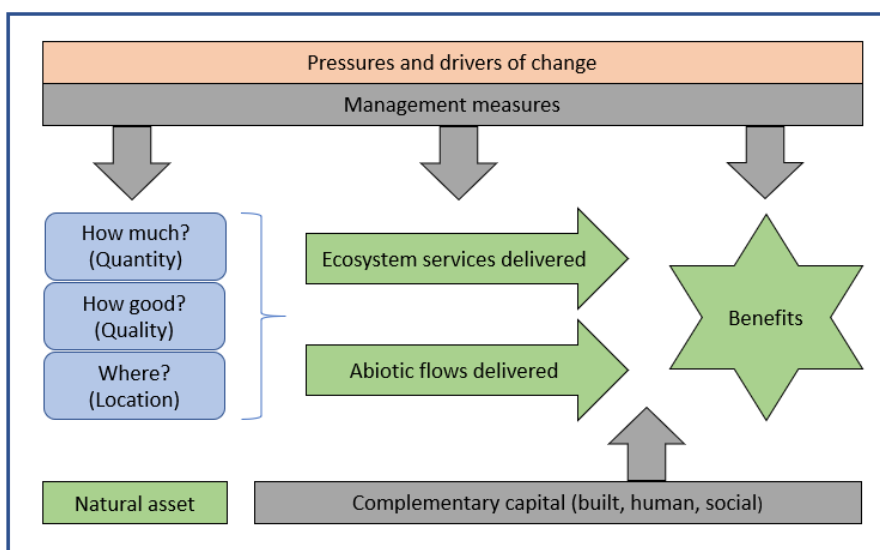


Figure 2.2 A natural capital application framework

(Adapted from *Enabling a Natural Capital Approach* guidance, Defra, updated 4th August 2021)

Economic valuation of benefits:

The economic valuation of the benefits of environmental enhancement or loss is central to the natural capital approach being one way to understand how much a benefit is worth to people or society. For that reason ENCA guidance provides a wide-ranging introduction to economic valuation (ENCA, 2021, Section 2), with more extensive guidance available from HM Treasury's 'The Green Book' (HM Treasury, 2020) alongside more specialist, technical literature. Economic value can be expressed and measured through market prices for goods and benefits, especially provisioning goods. However, many environmental benefits are not typically traded in markets so non-market approaches to valuation may be necessary to uncover their value.

Valuation methods can be broadly categorised into 'revealed preference' (e.g. market behaviour, travel cost approach, hedonic pricing), 'stated preference' (e.g. contingent valuation, choice experiments), direct 'well-being' and cost-based approaches. Generic values do exist for certain environmental benefits, such as carbon sequestration where, for example, the Department for Business, Energy & Industrial Strategy publish annual 'traded and non-traded carbon values' (BEIS, 2021), but many benefits will often vary with local and spatial factors, and over time. 'Value transfer', that is applying pre-existing economic valuation evidence to a new context, can be cost-effective but its use should be moderated by consideration for temporal, local and spatial factors.

There are technical and inherent limitations to using economic valuation to value marine and coastal benefits. Briefly:

- Valuation methodologies have specific technical limitations.
- Economic valuation may be partial in coverage where multiple effects are expected.
- Some benefits (e.g. regulating and cultural benefits) vary from place to place and over time.
- Valuation evidence is subject to uncertainty, for example, because the scientific effects associated with the benefits are uncertain and/or based on modelling.
- In complex ecosystems, where ecological processes and their interdependencies are not fully understood, the benefits are uncertain.

For these and other reasons, methodological limitations and uncertainties should be recognised.

Non-economic valuation of benefits:

ENCA guidance (Defra, 2020) recognises that:

“valuing’ nature is not solely the domain of economic valuation and that nature is a broader concept than natural capital. The focus on costs and benefits rather than ethics and meaning is a limitation of valuation” (p.14).

This broader understanding of value and valuing nature is a particularly important aspect of the natural capital approach. Hence, it is argued that qualitative social and cultural assessments of environmental change can complement economic valuation, and ENCA guidance suggests:

- a 'Balance Sheet Approach' as one way of collating, analysing and presenting diverse data and evidence for decision making purposes (see: Turner et al., 2014, Section 1.4.6);
- multi-criteria decision analysis to aid decision-making; and
- group-based deliberative methods, using techniques identified below, which encourage and inform discussion and debate among relevant participants.

Such considerations are considered especially important for place-based natural capital approaches (see below).

In addition, shared values provided by natural capital – values we hold in common as communities, cultures and societies – are not easily reducible to conventional economic values (see: Irvine, 2016). The UK NEA Follow-On report, 'Shared, Plural and Cultural Values: A Handbook for Decision Makers' (Kenter et al., 2014) provides practical information and examples of when and how shared values other than economic values can be considered. ENCA guidance provides examples of deliberative, analytical, interpretive and psychometric techniques, and suggest these to be particularly important for the assessment of cultural services provided by natural assets. Suggested techniques include:

- in-depth discussion groups and citizens' juries;
- participatory mapping and modelling;
- group-based monetary valuation;
- storytelling and media analysis;
- historical analysis;
- subjective wellbeing indicators.

2.1.2 Place-based natural capital approaches

The Natural England report 'Natural Capital Evidence Handbook: to support place-based planning and decision-making' (Rice et al., 2021) sets out a six-phase system for taking a natural capital approach. It provides best practice based on Natural England's learning on what is most important to include in a natural capital approach. Since this system is highly relevant to the application of the natural capital approach to the Yorkshire Coast setting, the six-phases are summarised below:

1. **Define partnership and vision:** Being clear of the motivation to support meaningful collaboration with partners and stakeholders throughout the process.
2. **Establish a shared evidence base:** Collate evidence about the place and allow all stakeholders to gain an understanding of the current state of natural capital. It constitutes a data intensive and interdisciplinary task involving use of tools (see below) and is structured as a natural capital account. It includes measuring and analysing the natural capital assets within scope, their quantity, quality and location, identifying the ecosystem services and social benefits and who it is that benefits.
3. **Forecast and understand drivers of change:** Explore, in an integrated way, how natural capital and ecosystem services are affected (extent, location, quality) by long-term drivers of change, and how these affects can be managed (challenges and opportunities). This will inform the selection of pressure indicators or a risk register.
4. **Decide and plan for multiple benefits:** Identify priorities and how potential barriers may be overcome. Assisted by opportunity mapping, appraisal, modelling, tools, scenario development and deliberative discussions.
5. **Make it happen:** An action plan will help embed the changes needed, for example, in relevant local strategies and plans.
6. **Check and improve - evaluation and monitoring:** Provide feedback lessons and evidence for future decision making and funding (for principles and methods, see HM Treasury, The Magenta Book (2020)).

2.1.3 Tools to support the natural capital approach

There are many research and analytical initiatives, models, tools and methods to support the natural capital approach, some of which are directly relevant to its application in a Yorkshire coast setting. ENCA guidance (Defra, 2021) argues that tools for assessing and exploring natural capital comprise a range of methods that can provide tailored information and analysis, which it categorises as:

- mapping natural capital stocks (habitat and land use surveys, mapping ecological networks for wildlife or assessing the condition of ecosystems);
- quantifying ecosystem service flows (simple scoring tools, process-based and rule-based spatial modelling, calculation of biodiversity or environmental net gain, monetary and non-monetary valuation);
- opportunity mapping (analysing ecosystem service supply and demand to look for gaps, opportunities to improve networks for wildlife and people, cost-effectiveness analysis).

'ENCA featured tools for assessing natural capital and environmental valuation' (Defra, 2021) provides guidance on 11 such tools that support the natural capital approach. It includes brief reviews of what each tool does, its purpose, how it works, its limitations and provides examples of applications. The guidance is generic and not specific to a given habitat type or natural capital asset, and only four of the case studies it provides are coastal/marine.

A JNCC commissioned report (Makowska et al., 2022) has collated a range of existing knowledge on how natural capital approaches have been applied specifically to marine and coastal environments to gain insights

from this experience for future management and policy work in the UK. The focus on coastal and marine reflects the view that the application of the natural capital approach on land is being developed successfully but applying it to the marine environment remains challenging. Part of the review of relevant ‘studies, frameworks and tools’ included in the report, involved a strengths, weaknesses, opportunities and threats (SWOT) analysis and the findings of a Quick Scoping Review for the 35 ‘products’ included. There is overlap in the products reviewed with those tools featured in the ENCA Tool guidance. Through the SWOT and in consultation with the research project’s steering group, the report was able to identify the priority research gap across the ‘products’, as:

“the limited consideration of beneficiaries and the distribution of benefits to different beneficiary groups across the products. It was acknowledged that understanding who benefits from marine ecosystems services is essential for achieving buy-in to the marine natural capital approach as well as being key to making the approach coherent to stakeholders that want to implement it. Having robust evidence of the beneficiary groups could underpin decision-making in areas such as marine management, blue financing, and cost-benefit analyses.”

While the tools are applicable across different habitats or natural capital assets, they have relevance to the Yorkshire coast setting. Hence, a summary and links to 13 tools is provided in Annex A along with a summary and links to several reports describing specific methods and frameworks. The material presented in Annex A includes the following tools and approaches:

- Natural England’s Natural Capital Atlases
- Environment Agency’s Natural Capital Register and Account Tool
- Ecosystems Knowledge Network (EKN)Tool Assessor
- Defra Biodiversity Metric
- Environmental Benefits from Nature Tool
- Managing Ecosystem Services Evidence Review (MESER) Tool
- Local Environment and Economic Development (LEED) toolkit
- Environmental Valuation Reference Inventory (EVRI)
- Natural Environment Valuation Online (NEVO)
- Outdoor Recreation Valuation Tool (ORVal)
- Woodland Valuation Tool
- Ecosystem Services Valuation Database (ESVD)
- Integrated Valuation of Ecosystem Services and Trade-offs (INVEST)

and reports describing participatory mapping of natural capital and benefits, natural capital approach to Sustainability Appraisal, and a methodology for applying the natural capital approach to marine planning.

2.2 What is happening across the country?

There are a number of place-based applications of the natural capital approach that can inform the use of the approach in the Yorkshire coast setting. While cases are outlined in more detail in Annex B, some key points that emerge are noted below.

- The **Solway Firth Partnership** has demonstrated the importance of establishing shared aims and maintaining ongoing dialogue/engagement with stakeholders at an early stage. This included establishing an understanding of the state of the natural capital assets (location, quantity and condition, including a socio-economic assessment) based on available data/evidence (e.g. the Solway Firth Review created as the main output of the ‘Solway Marine Information Learning and Environment’ (SMILE) project and the associated socio-economic analysis of the Scottish Solway (SEASS) and English Solway (SEAES)), and creating an open access data/evidence repository. (<https://www.solwayfirthpartnership.co.uk/>)
- The **Oceans of Value Project** (Orkney Islands; Scottish Wildlife Trust) promotes the use of a desk-based natural capital assessment. This project has benefitted from a relatively well-researched setting, along with stakeholder engagement using the Community Voice Method which is designed to capture the

different values placed on the marine environment by members of Orkney's community. At the time of writing the Community Voice Method was not complete and so this element of the project should be revisited in the future. (<https://scottishwildlifetrust.org.uk/tag/oceans-of-value/>)

- **Tees Valley Nature Partnership** (with Tees Valley Combined Authority and Natural England) has developed a natural capital account for the Tees Valley as a starting point upon which to build up a comprehensive natural capital evidence base to support decision-making (see, Harle and Marsh, 2021). The approach is exploratory, employing Natural England's Natural Capital Atlas indicators, supplemented with publicly available data and methods transferable to other areas, to identify (using 5km² hexagonal grid) the quantity, quality and location of natural assets, including coastal assets and marine assets, encompassing habitats out to 12 nautical miles. The account illustrates, through maps and tables, the state of the natural capital in the Tees Valley and highlights how it provides benefits to people by assessing a number of ecosystem services flowing from: coastal assets, specifically, erosion control, flood protection, biodiversity, climate regulation and cultural services; and marine assets, specifically, fish and other marine products from wild sources, water quality, biodiversity, climate regulation and cultural services. (<http://publications.naturalengland.org.uk/publication/5271371803525120>)
- Natural capital assets have been identified for **Anglian Water combined services area** (CSA) (Lovett et al., 2018), with further analysis of pressures on assets and asset distribution at the local authority level to identify areas that require further resource planning in the future. This work also produces a risk register for the CSA based on the national risk register produced by Mace et al., (2015). It aims to show how a natural capital asset statement and risk register can be developed for a region but also local authorities using open data to facilitate transferability of the approach across the UK at different spatial scales.
- Hooper (2021) reviews two regional IFCA cases and argues that these demonstrate applications of the natural capital approach throughout a decision process, including the overarching framework, the language adopted and tools used to assimilate the supporting evidence, and was robust enough to support the development of legally enforceable management measures.
 - **Isles of Scilly IFCA (Fishing gear permit byelaw)** demonstrate that the natural capital approach can be used to support specific management strategies for fisheries. To organise the evidence base, a natural capital asset and risk register (Ashley et al., 2020) was commissioned, which used the same general approach as that developed for the North Devon Marine Pioneer (Rees et al., 2019). Hooper suggests this case study shows how the concepts of the natural capital approach have been embraced, "particularly ecosystem services and to a lesser extent economic perspectives and valuation" (Hooper, 2021, p.7).
 - **Sussex IFCA (Nearshore trawling byelaw)**, used natural capital concepts and methods to inform the revision process associated with the byelaw. This included the type, extent and condition of natural capital assets, risks, and associated ecosystem services and values. Methods included the adoption of principles from the asset register developed by Rees et al., (2019), a matrix of ecosystem service provision by the main habitat types (to EUNIS Level 3), multicriteria analysis to attribute "environmental value" to the different habitats, which was also used as a proxy indicator of potential risks to the flow of services and benefits, and commissioning a valuation of the ecosystem service benefits that could arise from the recovery of kelp beds off the coast of West Sussex.
- Discussions with North Eastern IFCA (Tim Smith, pers.comm.) suggest that an audit of past and current byelaw reviews undertaken by the North Eastern IFCA could provide evidence of how widely used natural capital concepts and methods are in their recent decision-making.

The following two case studies are the coastal/marine projects established by Defra to examine place-based natural capital applications and inform the implementation and iteration of the Government's 25 Year Environment Plan. In the Yorkshire coast context, they provide important insights for the use of particular tools.

- **Suffolk Marine Pioneer**³ explored the natural capital approach in the context of an area of estuarine salt marsh in Suffolk. The Pioneer took a stakeholder participatory approach, including the use of participatory mapping of features, benefits and values. In so doing, it allowed for a wider perspective of value to be evaluated and inform decision making and helped to mitigate community concern that external influences would override local interest, and it empowered constructive dialogue around natural assets and benefits provided to inform the implementation of plans.
- **North Devon Marine Pioneer**⁴ were especially innovative in producing a place-specific asset register and risk register, as well as identifying ecosystem service provision linked with the assets. The project developed (see Ashley et al., 2018) and applied (see Rees, et al., 2019) a framework to assess marine natural capital, including mapping habitat extent of the accounting boundary, establishing links between natural capital assets and ecosystem service/benefit provision and identifying indicators to measure ecosystem service flows. The risk register built on Mace et al., (2015) to consider not only the asset-benefit relationship but also the severity of risks to the provision of ecosystem services. The North Devon marine pioneer area is relatively well-researched so there was a strong evidence base to draw from to support the asset register and risk register.

Other relevant approaches and projects have included:

- The **Community Voice Method**⁵ has been used by the Marine Conservation Society (MCS) since 2009 when it established the 'Our Community Voice' programme, a "versatile, film-based approach to engage communities in a variety of issues in the UK and the UK Overseas Territories". It brings together people "to share what they value and their vision for the future", enabling "inclusive conversations about how challenges can be met that have resulted in positive change for people and the places they love and depend on". Examples of their work include:
 - **'Wild Coast Sussex'**, a collaborative, 3-year, project led by Sussex Wildlife Trust, with MCS, Sussex IFCA and Brighton Sealife. It "aims to inspire people living along the coast in Sussex to cherish their local sea and act in more ocean-friendly ways". MCS is leading on the work with 16-25 year-olds, filming young people, seeking their perspectives, and grounding the conversation in value. These values are built into "the project plan, including a series of beach events for young people".
 - the **'Living Coast'** project, delivered for Natural England with MCS collaborating with the University of Greenwich and Community Voice Consulting. It was designed to help elicit "more about how people, including those from underserved or minority communities, in Portsmouth and along the Durham Coast connect with the coast and sea. The project included a particular focus on what barriers there may be to connection and benefit with regard to use of the England Coast Path".
 - **'Common Ground'**, delivered in partnership with the Eastern IFCA and with support from Community Voice Consulting. It actively emphasizes "the values that connect people to their local coast and sea, and guide thinking on how management reflects, supports or impact on local values. The film was shown at workshops in Suffolk, Norfolk and Lincolnshire which brought together a wide range of people, views and values". Guided deliberation was used to "explore the shared values that connect people to their coastal and marine resources, key issues in the district and potential actions that could help address them". This fed into the local authority's strategic planning.

³ <https://www.suffolkcoastandheaths.org/managing/projects/marine-pioneer/>

⁴ <https://sweep.ac.uk/portfolios/north-devon-marine-pioneer/>

⁵ <https://www.mcsuk.org/ocean-emergency/people-and-the-sea/community-voice-method/#our-community-voice-projects>

There are a number of Research Council-funded research projects which will inform the natural capital approach. Taking two examples from the NERC/ESRC-funded 'Sustainable Management of UK Marine Resources' programme⁶ where projects commenced in 2021:

- **'Integrating Diverse Values into Management'** (Lead: Prof S. Fletcher, Portsmouth Univ.) which is investigating the many dimensions of value including economic values, social and cultural values, aesthetic values, and natural values, and how they might be accounted for in decision-making frameworks. Test sites for the research comprise Portsmouth, Severn Estuary/Chepstow and the Shetland Islands. This project also includes the Community Voice Method (see above).
- **'Restoration of Seagrass for Ocean Wealth UK'** project (Lead: Dr C. Evans, National Oceanography Centre) aims to inform management and restoration of seagrass for sustainable social, environmental and economic net gains for the UK. It will use existing data on the benefits that seagrasses provide to people and planet and their conservation management and target ecological, remote satellite and socio-economic data to fill gaps in our understanding. The coverage is national.

⁶ <https://www.smmr.org.uk/funded-projects/>

3 Key practitioners' views on the application of a natural capital approach

3.1 Approach taken

The central discussions from each of the nine online interviews with key practitioners (Table 1.1) were not recorded *verbatim* but were instead drafted through reference to notes taken during the interviews, and from on-line interview transcripts (with additional reference to interview recordings where appropriate - e.g. for clarification, or confirmatory purposes). As part of this drafting process, all interview material was represented in the third person. Each of key practitioners interviewed has reviewed the derived material from their particular interview, offering corrections and clarifications where appropriate, and each has consented to the reporting of these outputs as part of this report. The full versions of these (derived) records of the discussions from each of the nine interviews are presented as Annex C.

As noted earlier, all comments provided are taken as representing the views of the individuals concerned and are not assumed to necessarily reflect their employers' views or official positions.

Subsequently, each of these derived transcripts was reviewed by the authors and further summarised to identify the principal comments, insights and learning points relevant to the project. This subset (of 102 principal comments) was extracted for further consideration. From observation, and through expert judgement, six broad categories of comment were identified, broadly covering the range of topics/subjects that was seen. These six categories related to:

- Underlying philosophy, and how projects are structured and managed;
- Opportunities;
- Challenges and threats;
- Data availability and handling;
- Engagement; and
- Networking.

The 102 principal comments were each assigned to one of these six categories according to their particular focus or relevance. They are all reproduced below, together a summarising narrative, as Section 3.2.

Note that, to preserve a reference back to the original interview, each principal comment is tagged with the initials of the original interview subject(s):

- Claire Argent - [CA]
- Antony Firth - [AF]
- Briony Fox - [BF]
- Tara Hooper - [TH]
- Aisling Lannin - [ALa]
- Alice Lord - [ALo]
- Simon Pickles - [SP]
- Georgina Reid & Beth Churn - [GR/BC]
- Tim Smith - [TS]

3.2 Principal points arising from interviews with key practitioners

Within each of the following subsections the principal comments from the key practitioners are presented below, structured by broad category. The range of comments within each category has been re-ordered to cluster similar points together. Again, this clustering was undertaken on the basis of expert opinion, and was intended to help indicate the ‘weight of feeling’ for particular subjects.

3.2.1 Consideration of the underlying philosophy of projects applying the natural capital approach, and associated project structure/management

A number of interviewees remarked on the complexity of the natural capital approach and the clear need to foster multi-disciplinary collaboration in order to use the approach effectively:

- The natural capital approach requires a multidisciplinary approach involving not only consideration of social, economic, and ecological aspects, but also drawing on network- and systems-thinking. In addition it needs collaborative input from across different perspectives, including the (statutory) government perspective, the theoretical and academic perspective, and the practical (implementation) perspective, and should involve not only representation from the people who are living it and who are involved in it, but also people who have an outside or independent perspective. As well as the multi-layered quality that this approach produces, projects should also aim to be multi-scale, with a range of different statutory organisations providing connections across the local, regional, national and international scales. [ALa]
- YMNP needs sound supporting data, and needs data custodians, ecologists, and economists looking after it so that the flow of information is trusted and as accurate as it can be, and is also illustrative (and not abstract). Part of successful delivery is political, part is philosophical, and part is psychological, and the whole needs to be multidisciplinary in its approach. [ALa]
- In hindsight it would have been better to have worked at a more strategic level, identifying what the [Landscape Pioneer] project’s priorities were and then gathering more focused evidence about those specific priorities. [ALo]
- On the one hand the natural capital approach can be used simply as a generic driver to promote and extend the collection of general data about the extent and condition of our natural capital assets. It can also be employed as a vehicle for doing things a bit differently, and for trying to use the concepts of value to drive the way that decisions are made. Consequently, going forward under the programme, there are effectively two workstreams: one relating to ecological evidence gathering, and a smaller (but nonetheless significant) strand around application innovation (how you would use that ecological data within a decision-making framework). [TH]
- What is a potentially very complex approach needs to be made as easy to understand as possible; there is a wide and diverse group of people from across a range of partner organisations and stakeholder groups that need to be engaged in this process at a number of different levels. This challenge is replicated within organisations, where issues around understanding the process, and how the natural capital approach is taken forward, are likely to be seen; there is obviously a big role for communications within all of that. [CA]

Further comments from interviewees highlighted how a shared vision for marine restoration and coordinated progress at a general scale, might help support the implementation of a natural capital approach as well as fostering an appreciation of how the natural capital approach fits more generally into marine planning:

- It's about changing behaviour and culture, and connecting things up; people don't always work toward being connected - because they've got their own things they're trying to achieve – so we need a simple shared vision: we need to reorient toward restoration and come up with something collaborative where individual partners can get on with their own little bits, but where there is also somebody who can join up all the pieces and evaluate whether the sum of those parts is achieving the whole of the objectives. [ALa]
- Although not directly relevant to the Yorkshire coast, approaches taken by the Orkneys Oceans of Value project (looking at a natural capital assessment of Orkney’s waters) provide an assessment of how the ecosystem-based approach and natural capital are enshrined in marine planning from a national perspective and may be of value. [GR/BC]

The impacts of data gaps and the requirement for a comprehensive asset register were raised by many interviewees. Whilst it was acknowledged that good data would be important to implement the natural capital approach, it was recognised that other elements, including communication and cultural shifts, would also be core parts of developing natural capital as a management system:

- The early stages of the Marine Pioneer project (Devon) focused on gathering data, but subsequent system mapping suggested that large bodies of data were not, in fact, going to directly help in changing behaviours to better support environmental outcomes. System mapping has been used to produce explanations of what actually effects change, and that turns out to be much more around the softer skills of behaviour change, communication, participation, engagement, empathy - and that's where the bulk of YMNP's efforts should go. [ALa]
- Although, the evidence-base was important (for example in helping to identify those assets that were in poor condition — and why that was, and which services were declining or not well-provided), the Landscape Pioneer was looking for strategic solutions rather than investment opportunities *per se*, and used the root cause analysis exercise to identify what the problems were before considering what the strategic solutions might be. [ALo]
- It's not really possible to unpick archaeology or historic sites from the environment; they produce cultural benefits, but they're not separate to the place that they sit within. A project needs to acknowledge and consider such assets together with the wider (natural) environmental assets that are identified. [ALo]
- The natural capital approach seems to work at quite a high level of generalisation (with all examples of a given habitat being considered in the same way). However, culture and heritage are never homogenised; they are always specific to place. [AF]
- The Solway Firth Partnership (SFP) is looking at marine natural capital on the Solway Firth through its Solway Coast and Marine Pilot Project (SCAMPP). On the Scottish side, the SFP is applying innovative methods to help restore, expand, or reintroduce marine natural capital habitats. It is focussed on three features: saltmarsh, native oysters (*Ostrea edulis*) and seagrass (*Zostera marina* and *Zostera noltii*) – not just because those three habitats are already present, but also because they are important ecologically (in terms of the role saltmarsh and seagrass in carbon storage) and culturally (the local Solway native oyster bed supports the last remaining sustainable wild oyster fishery in Scotland). This focus on just three principal habitats not yet tested through wider engagement with the public, but has broad informal support amongst stakeholders. [GR/BC]
- The first thing that people talk about when the issue of applying the natural capital approach is raised is invariably based around the potential problems that will be caused by big data gaps but, realistically, it's important to go back to thinking about what the benefits are, what the assets are that relate to those benefits, and then working through data that you need to bring about an understanding of the condition or distribution of those assets. [SP]
- In considering biodiversity net gain in the marine environment, there is also scope to extend discussions to examine where gains to ecosystem services could be realised – i.e. 'environmental net gain' (for example alternative options for restoration or recovery that are proposed in order to promote biodiversity net gain might support different levels of ecosystem services such as flood resilience or recreation). [TH]
- In the case of NEIFCA and its application of byelaws, the key role of natural capital is in providing additional (discriminatory) information to support the assessment of alternative options. By looking at the ecosystem services and the benefits that come from different elements of the ecosystem, and from different types of natural capital, it is possible to develop a feeling for which are more important in terms of the local stakeholders, and which are more important in terms of the local economy, and this understanding can then start to help shape how a particular byelaw might be promoted, or how the priority ordering of byelaw reviews might be adjusted. [TS]
- It is clear that, to support the application of the natural capital approach, an asset register is needed, together with the data on those assets. At the other end of the process you need a benefit register along with an understanding of the full range of benefits that will impact your decision-making — what is the best understanding of the delivery of this benefit; what is the best model or tool for monetising that; and what is the data that is needed to feed into that particular model? [SP]

3.2.2 Opportunities

A number of comments highlighted how the natural capital approach could be used to improve engagement and communications with the general public and industry, to build a sense of ownership and shared awareness:

- The natural capital approach can be used as a way of supporting, or providing a better framework for, marine planning. Although ecologists and academics want to talk about fisheries in terms of carbon budgets, and impacts on the natural assets this isn't easily understood by the participants in the fisheries sector. If you talk instead about sustainable catches for the future then you've got the right framework to actually deliver for fisheries — the fisheries sector can be engaged by identifying the common objective of sustainability into the future generations. [ALa]
- Cultural heritage can be important as a means of accessing value arising from the natural environment ... which parallels the concept of 'complimentary capital' (human social and manufactured capital) within the current environmental capital framework.
- Heritage can be tremendously evocative and, by providing a platform for engaging with the public, can act as a valuable entry point into discussions regarding site management — it presents a good way to draw people into questions and debate that perhaps might relate more to the natural environment. [AF]

Interviewees also noted that improved engagement and communications can help to both increase investment and funding for the marine environment, and identify where investment might be better placed to optimise potential (environmental) returns:

- It became apparent that by taking a perspective that considered changes to governance, incentives or changes to people's capacity, in contrast to considering the on-the-ground changes to land-use or land management that were being sought, provided a good way of framing different solutions. [ALo]
- By better understanding how, through the nature and the character of a place, people gain value from the from the marine environment, it may be possible to better identify where additional investment could enable more people to gain value from the natural environment in that place. [AF]
- Private investment is really difficult to source (there's a lot more risk involved for the individuals concerned; people want returns on their investments) — if you've got some public funding going in it may help to absorb some of the risk (and so make it more attractive to private investment). [ALo]

Whilst acknowledging that good data provides the foundations for an application of the natural capital approach, the associated requirement for a secure and openly accessible data repository was also noted. Whilst there are opportunities to explore this within existing organisations and structures, the requirements for data gathering and necessary maintenance should not be underestimated (see also Section 3.2.4):

- With regard to the feasibility of applying the natural capital approach to the Yorkshire coast, it is acknowledged that there is currently no regional repository of suitable data to support the process, and that data required to support the application of a natural capital approach would need to be collated specifically for the purpose. Having generated such data, NEYEDC has the capacity to hold it, and is accredited and recognised by Defra in this respect — under such a scenario NEYEDC would aspire to be the primary repository for the data that goes into creating an asset register. [SP]
- Whilst NEYEDC would be happy to help source data and facilitate its mapping, and have a desire support the embedding of the natural capital approach into the way that things are done routinely, it is unlikely this would be a blanket development and (at least initially) the focus would need to be on specific areas. By operating at that sort of spatial scale (notionally around 100km²) the local communities can easily be brought on board and understand what their relationship with, and dependence on, the local natural capital is — along with an appreciation of the inter-dependencies between different groups of stakeholders. [SP]

Due to the recent and upcoming changes in national environmental legislation, there are likely to be many opportunities to embed the natural capital approach, and wider marine management considerations, into emerging regional strategies and plans. Interviewees noted this need to integrate marine environmental challenges and opportunities into organisational policy, and into strategic and operational workstreams:

- NYMNPA has just released a revised management plan which makes reference to a specific objective that refers to supporting the improvement of the marine and coastal habitat (a high-level objective that will be translated to more local detail through the local nature recovery strategies). [BF]
- There's a lot of work being led out of the MMO about how to effectively map assets and ecosystem services (and the risks to them), feeding into their marine planning and spatial prioritisation work. [TH]
- The requirement for embedding biodiversity net gain is actually a significant driver for more work to be done on the natural capital approach: critical aspects of the natural capital approach actually underpin the discussions that need to go into an assessment of biodiversity net gain. [TH]
- There have been discussions in Scotland around the three-mile inshore ban on trawling where part of the supporting argument being promoted is that a ban would allow the recovery of the inshore habitats and an associated increase in the levels of ecosystem services that those areas provide. On the question of whether a similar ban would benefit the Yorkshire coast, NEIFCA has noted that the two areas have very different fisheries and that promoting the closure of the inshore fishery on the basis of enhancing natural capital would be unlikely to get stakeholder buy-in. Amongst other things it's an issue of scale; to say that the intention is to protect a small inshore habitat on the specific basis of carbon sequestration, when the area involved is almost negligible compared to the wider North Sea, would not be a strong argument. [TS]

3.2.3 Challenges and threats

It was noted by some key participants that the need to source appropriate data (to support an application of the natural capital approach as part of a particular project) is key and, once identified, it is also important to ensure that such can be held in a way that makes it freely available, and that its subsequent use is open and transparent:

- It's been said that one of the biggest barriers to applying the natural capital approach is the availability of information. It's not only important to identify what sort of information you need, and who's best to provide it, but the information has to be made publicly available and open-access, so it can be easily downloaded, analysed and used. [ALa]
- Although the recent review paper by Tara Hooper suggested that byelaw reviews by both the Isles of Scilly and the Sussex IFCA applied a natural capital approach, both areas appear to be relatively 'data rich' in comparison to the current situation on the Yorkshire coast where NEIFCA does not have the data that would be required to support such an approach. [TS]

Several comments were made by interviewees regarding the underlying methodologies and problem structuring that is used to underpin a project, including aspects of the logic chain models (the theoretical relationships linking assets, ecological services and goods, and beneficiaries) that provide a framework for applying the natural capital approach:

- The benefits or public goods produced after an area is improved (for example where an arable area is converted to grassland) are often not delivered to clearly defined individuals, or to one specific location, but are widely dispersed making it more difficult to identify where the beneficiary funding should be drawn from (because you don't really know who's benefiting; you can't identify, for example, one company or one individual). Put another way, it can be hard to identify the specific beneficiaries who might gain from the interventions that are put in place; the interventions lead to public goods, so effectively everyone, across all organisations, benefit. That same problem may present a challenge when applying the natural capital approach to the Yorkshire coast. [ALo]
- There is explicit recognition that we are often talking about public goods, which aren't going to be captured by individual or specific stakeholders, and therefore you need a wider recognition of the need for some public funding. [ALo]
- Natural capital isn't great at capturing heritage, despite the fact that heritage can be considered fairly fundamental to the concept of capital value. The natural capital approach applies an area-based methodology, with the value per unit area for a given habitat multiplied up by the area of habitat that is present. In comparison, cultural heritage tends to be very limited in area, but very intense in value, and that's not something that's captured well by the generalised area-based natural capital approach. [AF]
- None of the value that we gain from the natural environment arises without some kind of human input, and that's effectively a cultural input, although it may have a historical dimension too. It's important that the natural capital approach finds some way of accommodating the fact that none of these (natural capital) values are wholly natural. [AF]
- Once the benefits that are coming from a particular asset are identified, and an attempt is made to optimise or increase the flow of those benefits in some way, there is the potential risk that the level of benefits that are currently accrued from a different set of assets may decrease. Such 'unintended consequences' may, in other instances, impact on the asset originally targeted for improvement; for example, when the environment is improved, it is likely that there will be a concomitant improvement in (for example) tourism and recreation, and hence an increase in the local value of the related benefits. However, the uplift of such changes would need to be seen in the light of the potential adverse impacts that tourism and recreation might have on the natural environment, for example through disturbance. So then it becomes a question of how to prioritise the relative importance of the different assets and the different services or benefits they provide. Although managing such antagonisms represents a challenge, the situation might also be seen in a more positive light as it brings such tensions to the surface and exposes them to more open, public debate. In this sense, as a way of promoting collaboration between different users and trying to find a solution that is seen as an improvement over the *status quo* for all parties, there are definitely some positives that can come from this complex situation. Also, Natural England has for a long time wanted to get people together to discuss these sort of issues - the YMNP's engagement in this area is really helpful. [CA]
- A tool that would be useful, but is not currently available, could be based around 'assets service matrices' (such as those presented by Potts et al., 2014). The matrix structures (identifying the linkages between assets and ecosystem services) may need to be modified to reflect more recent thinking, and be updateable and support a clear audit trail, but would provide the strong evidence base that is required for it to be used in decision-making (especially with respect to licensing where there are potential legal implications and there is a need to ensure that the evidence base is strong). [TH]
- The natural capital approach is an easy, tangible concept to grab onto, but the devil is in the detail, and there is still a lack of standardisation around the key concepts — along with issues of scale, inconsistencies regarding geospatial boundaries or differing degrees of granularity in the data, and uncertainty around the transfer of benefit values. [SP]

Some interviewees picked up on other perceived challenges that were based around the scope of projects, and the definitions that are used as part of the application of the natural capital approach and how these are understood across/between organisations, or shared with the public:

- The level of understanding amongst the general public, organisations, and agencies regarding the jargon or language being used, the incentives for change, and the different but related strands of work, is one of the big challenges. Generating a consensus of understanding and prioritising actions are both of key importance. [BF]
- One of the biggest challenges around the application of a natural capital approach to the coast lies around what ‘the coast’ actually means in terms of where it starts and ends. The coast obviously includes the intertidal, but (with consideration out to 12 nm) the move offshore into the subtidal marine environment presents very different ecosystems. Associated with this change is an increase in the range of activities that are found in the marine compared to the (intertidal and terrestrial) coast and a high level of spatial overlap between activity types (e.g. fishing, recreation, renewable energy generation, etc.). This difference presents an initial challenge – should the inshore (terrestrial and intertidal areas) be treated separately to the offshore (subtidal) areas, or should it be considered as a part of a larger whole? [CA]
- Another challenge is around defining the spatial scope for services such as renewable energy provision, with the need to account for the spatial separation between the site of energy generation (based on the natural assets that are being harnessed, whether they are wind- or tide-based) and the site used for (cable) landfall. [CA]
- Going forward with nature conservation the Government, particularly for the marine environment, wants to adopt a natural capital approach. However, how such an approach might actually be applied isn't really apparent in the high-level policy documents, which is possibly one reason for Defra to have established their natural capital and ecosystem assessment program (although this programme started in the terrestrial environment, it's now completing its first year on the marine side and will be running for another three years). Basically the purpose of that programme is to try to answer some of these questions around what the natural capital approach is, and what it looks like. [TH]

It is important to consider the human dimension in any project, and several comments were made by interviewees that focused on potential challenges around human aspects of applying and communicating the natural capital approach. For example, in terms of providing opportunities for public engagement, or in promoting the approach and enabling an improved (public) understanding of how natural capital relates to the public at large:

- The involvement and engagement of people with their environment through time is almost the definition of archaeology and is fundamental. Every time the two are split apart, opportunities are missed – whether that's opportunities to engage, or to change behaviours, or to understand what's actually going on. Anything that enables the natural capital approach to cope with the human dimension is a good thing. [AF]
- How do you take those people who have an interest – the fishermen, and the marine archaeologists for example – along the process to promote a natural capital assessment that is bringing in those other factors that sit alongside the strict academic calculations? [BF]
- It is important to recognise that the connectivity across the terrestrial-coastal-marine continuum is fairly fundamental, and one has to try to establish as much consistency as possible to make the stakeholders' lives easier, and to reflect the equivalence in treatment that different stakeholder groups expect. [CA]
- There are two aspects to managing natural capital: the academic aspect (saying this is the natural capital of the place, and this is what can be done to enhance it); and the human aspect (which is about emotion, history, and perception). The practical issue is how to move from the academic to the desired outcome, whilst accounting for that human aspect. [BF]

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The interplay of organisations' statutory duties, operational activities, and public outreach is important in embedding the natural capital approach into their work. To do this successfully requires the provision of adequate and appropriate resources (in terms of staff, and their training/expertise). Also, the importance of organisations' external communications (in terms of their stakeholder management), and the links between both statutory organisations and NGOs (in terms of common objectives or 'joined-up thinking') were flagged by interviewees as being central to effective project delivery:

- Natural England area teams aren't particularly engaged in the natural capital approach at this time. The national teams have an initial strategic overview and, when they understand the process and what the approach is, that's when it is passed to the area teams (who are better placed to work more closely with partners on the ground) for operational delivery. [CA]
- One of the other significant challenges with applying a natural capital approach centres around its size and the scope of stakeholders that will be involved. Achieving and supporting the level of join-up and agreement required between different parties will be challenging, not least because of the range of views that different stakeholders may have. [CA]
- NEIFCA's current involvement with natural capital tends to be incidental and occurs more as a consequence of their operational management of species and habitats. For example NEIFCA has byelaws in place to protect eelgrass which will in turn have a positive benefit as regards promoting carbon sequestration. The supporting documentation for the revision of the site boundary mentions this benefit, but the primary purpose of the byelaw is to protect the species from damaging activities. That's not a management decision that has been taken in respect of natural capital, but instead is a decision that is based on the IFCA's legislative duty to protect the site. [TS]
- In terms of taking the natural capital approach forwards and embedding it more into NEIFCA's work public education, this is probably more about an organisational, top-down process. The biggest barrier to its adoption is likely to be simply having a clear, top-down instruction to just pick up this approach and use it. [TS]
- With the increasing restrictions on pay and on resources across every sector involved in the application of the natural capital approach to the Yorkshire coast, and given the wide range of people that have to be involved in making these approaches work, and the skill-sets that they require, there are perhaps legitimate concerns around whether they are appropriately funded, whether they have the right experience and knowledge, and if they have access to – and sound working relationships with – those people on the ground that are actually required to support and help deliver the process. [CA]
- The NEIFCA's main focus is on the management of wild capture fisheries; generally, stakeholders in those fisheries are under constant pressure from, and losing grounds to, other activities (other marine activities, and marine developments such as wind farms). Given the current levels of fishing effort, justifying the closure of an area outside of an MPA purely on the grounds of the protection of its habitat and its consequential value as a natural capital asset, would be a hard sell. It would need stakeholder buy-in to proceed; if they don't accept it, they would not follow the byelaws and there would be compliance and enforcement issues. [TS]

3.2.4 Data availability and handling

Data to support the implementation of the natural capital approach and its application to the coastal and marine environment is generally thought to be limited in terms of its availability. A number of potential data sources were identified by interviewees, along with ideas regarding the identification of those natural capital assets that are likely to be central to a project:

- A project is obviously going to want to map the geographic scope of its habitats and to understand their quality, but the Natural Capital Atlases (which map natural capital indicators at a 5km² scale) probably provide an adequate level of evidence to start with. If the scale is not appropriate then an alternative data source may be required (for example with stakeholders helping to identify information and developing that evidence-base themselves). [ALo]
- Inevitably, the evidence base is likely to be problematic (and thin) for the marine environment (at least initially) and any project will have to work with what's available; this is why qualitative evidence is so useful about understanding things such as habitat quality, as there is never going to be quantitative evidence for everything. [ALo]
- NYMNPA generally collects very little data on the coast; what data is gathered by the Authority is submitted to the North & East Yorkshire Ecological Data Centre. Where information is required to support operational work it is usually sourced from the Data Centre, or from other bodies such as the Yorkshire Wildlife Trust or the RSPB. [BF]
- The SFP's work on the Cumbrian coast (the Cumbrian Solway Marine Natural Capital Project; CSMNCP) doesn't have known (or historic) areas of key habitats so it has proved to be hard to identify specific features to focus on. It's not apparent if that's because key habitats have never been present on the Cumbrian coast, have been lost from the area, or are in fact present but have just not been identified in recent surveys. Consequently a lot of work is related to identifying, and then trying to find data for, key habitats and species. [GR/BC]
- A recent report (AECOM), intended to assess the feasibility of developing a natural capital data hub, concluded that whilst investment could be made in a bespoke data hub those data that are currently available are not fully fit for purpose. Whilst there are some data that are nationally recognised, and may fulfil a role at the strategic level, the quality of data currently available for natural capital assessment at the (regional) operational level is not always adequate/appropriate. [SP]
- Whilst NCRAT's framework provides a starting point for application to the Yorkshire coast (for example by approximating the coastal strip by considering only coastal parishes) it's not really fit-for-purpose for a coastal application as it fails to handle the interaction between marine and terrestrial environments in any meaningful way. [SP]
- Whilst the NEYEDC has data at a good resolution it doesn't hold data across all geographies. Typical data includes species data, habitat data, and site data (including elements of information about the habitat quality and management). Currently, except for very small areas (which in any case are unlikely to be amenable in scale coastal ecosystem service work), NEYEDC is unlikely to be able to provide YMNP with any data that could not be obtained elsewhere. [SP]
- Fish stock management is probably NEIFCA's primary areas of focus, and the fish stocks themselves are probably the main asset that NEIFCA are concerned with. Although carbon sequestration is also important, NEIFCA do not have sufficient resource to undertake specific studies to look at quantifying carbon sequestration. This is further complicated by the scale of the area that needs to be considered. [TS]
- There are no surveys that the NEIFCA can easily go out and deliver that will directly help natural capital accounting. [TS]

Some interviewees provided comments that were more focused on challenges associated with specific types or classes of data, and on possible approaches to identifying, collating, and processing data. This cluster of comments also include references to data resolution or scale:

- In terms of supporting information, it should be remembered that there are a lot of other forms of information in addition to (quantitative or qualitative) ‘scientific’ data, and it is important to have some flexibility regarding the idea of what information can be used to inform decisions and make progress. In time further information (of different types) can be accumulated to provide more detail but a lack of information should ever be seen as reason to be held back. This is why participatory decision-making, which is able to bring decisions forward despite a lack of formal information, is so important. [ALa]
- Natural capital information needs to be very detailed, which means that the best scale to have it at is the local scale. It would be great if we were at the stage where the data standards could be agreed for the local scale so that local data from different areas could be easily combined or amalgamated to derive regional- or national-level datasets, but we're not really in that position yet. By understanding what people value about their local environment it's possible to present them with options for the future, indicating the likely benefits of certain actions (or of inactivity). This approach supports a level of collective decision-making and builds community support that could not otherwise be achieved. [ALa]
- The Environment Agency's Natural Capital Register And Accounts tool (NCRAT) has some obvious shortcomings: it is very much water-focused; it recognises only a general suite of benefits and these are incomplete (for example, presenting hydropower as the sole component of the renewable energy benefit); and it uses river catchments as the basis for its area designations (so application at the local authority level would require boundaries to be adjusted, and coverage effectively excludes the intertidal portion of the coastal strip). [SP]
- The use of data is a key priority area for a marine natural capital project – especially in terms of the framework and data structure that is used within the supporting database. It is important to employ a framework that accounts specifically for those assets that the project is interested in, and for any assessments of their condition. [TH]
- All natural capital data in one place sounds like a good idea, but what counts as natural capital data? The range of information that is captured in the marine environment can be so diverse, and is collected for different reasons; it's hard to see how a data repository solely for natural capital would work and wouldn't just become a duplication of wider marine data storage that is going on. [TS]
- It is important to establish an evidence base: for the Landscape Pioneer this was accomplished by first setting-out what the project wanted to know, and filling in as much as possible using pre-existing data; then as a lot of environmental evidence is qualitative and in people's heads a series of large tables were drawn up, with placeholders for all of the information that the project wanted to collect. After completing them as far as possible using known data sources the project's partners and stakeholders were invited to add their own information by writing directly on the tables, recording their own evidence and the knowledge that they held in their heads. Then they went through a review phase where they went around in groups to peer-review, to discuss it and add further to it. This process built a strong evidence base which was strongly supported which had a high degree of buy-in from the stakeholders. In effect they owned the evidence base because it included their evidence. [ALo]
- The Landscape Pioneer tried to use a mapping approach, but it was concluded that opportunity mapping was only really suited to relatively small-scale use and, when you get to a larger scale, it becomes hard for people to provide robust information because their experience tends to be localised. [ALo]
- In its natural capital assessment of the habitats along the River Esk the NYMNPA approached natural capital in two stages: remote (desk-based) work, followed by stakeholder engagement work; it is possible that a similar approach could be applied to the marine environment. Initially, a computer-generated natural capital map of the Esk valley was produced, based on satellite imagery and other publicly available data, with any areas of uncertainty being clarified through local survey work. This GIS dataset was then used to model the distribution of natural capital enhancement opportunities (habitat connectivity opportunities, for example). The second stage then saw this 'opportunities map' being shared, through face-to-face discussions, with people on the ground, allowing it to be ground-truthed against 'real life' considerations. [BF]

In addition, there are other examples of how data might be sourced or generated for coastal projects that are making use of the natural capital approach. Several comments from interviewees expanded on this, and also provided further examples of other sources of data that may be of value when applying the natural capital approach to the Yorkshire coast:

- It's possible to break the environment down into defined coastal types. This has been done by NYMNPA, finessing the coastal landscape down into different types of coastline through an updated Landscape Character Assessment. [BF]
- To avoid potential duplication of effort, there then needs to be a conversation – by email or through an online meeting – to identify the current state of play as regards survey data amongst the wider group of relevant organisations. [CA]
- The wider issue of data-sharing between partners/stakeholders needs to be improved through the Nature Partnership, and could usefully draw on other sources, such as academia. [CA]
- Whilst it's recognised that the subset of three habitats being considered by the SCAMPP work represent high-value natural capital and give rise to high-value ecosystem services, the project doesn't currently make use of any particular framework for, or set of predefined relationships between, assets and goods/services that are delivered through them. [GR/BC]
- SMILE (Solway Marine Information, Learning and Environment) created a regional assessment for the Solway Firth and developed an online story map – a hub of information – through an update of the 1996 'State of the Solway Review', so providing a valuable source of, and repository for, information to support the SCAMPP. As well as the SMILE project, the region has a number of SACs, SPAs and SSSIs and a lot of information can come from those (designation) sources; the SCAMPP project team is aware of a lot of information, but it's often difficult and time-consuming to collate. [GR/BC]
- Whilst Natural England has suggested creating an inventory of all the natural capital assets rather than picking a few key ones (as, without supporting data, it's not currently clear what the priorities are), other suggestions from stakeholders have included prioritising the restoration of saltmarsh and sand dunes, and the improvement of water quality. It was also noted that restoring habitats that are able to mitigate for climate change, or which support biodiversity will generally tend to underpin other benefits and ecosystem services. [GR/BC]
- Sources of data for the CSMNCP work have been very scattered; a lot of statutory designations in the region means that there's lots of information from Natural England and Cumbria Wildlife Trust (especially from surveys to underpin MCZ designations for *Sabellaria* reefs), and from online mapping (Natural England Natural Capital Atlas; and part of the coastal species and habitats mapping done to support the Local Nature Recovery Strategy for Cumbria). [GR/BC]
- The NEYEDC position is effectively a combination of collecting data and analysing data, identifying what the gaps in the data are, and trying to energise the demand for the generation of new data. [SP]

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A number of interviewees commented on how data should be stored, highlighting the preference for a single open-access central data repository (a need that could potentially be met by the NEYEDC), with such a repository facilitating data-sharing and acting to promote transparency:

- Using the natural capital approach requires not only ecological information but also social and economic information which should be available on an open access platform that allows all of the people engaged to see, understand and analyse it. [ALa]
- As regards data storage, it would be much easier for everyone if all the data was held in one place, and that there was confidence that the data was complete and up-to-date. [BF]
- There needs to be somewhere to put data, and the prospect of developing a data repository is a real opportunity, but it must also be easily accessible in order to help users to identify where data already exists, where future surveys are planned and where they need to invest in the collation of new data. [CA]
- A new single data repository, into which everybody committed to uploading their data whenever they undertook a new piece of research, or when they carried out a new survey, would improve this situation considerably. In its absence though a simple shared Teams calendar – populated with survey dates and basic meta-data relating to each survey (organisation, survey location, objective, methods, etc.) that is accessible to all relevant parties (government organisations, NGOs, academia, etc.) – may at least provide a clear audit trail of what data are available and who the holders are. [CA]
- Data sharing — making it easier for councils, Wildlife Trusts, etc. to get hold of the publicly-funded information that is available — is important from a practicality standpoint. But, because understanding (for example) what habitat assets are present is fundamental to taking any of this forward, the gathering of (environmental) data becomes a significant undertaking for a project to have to address if it's something that's not already been done. In this context, the development of an appropriate data repository for the Yorkshire coast ought to be a priority to support taking this work forward. [TH]
- The data systems that are used should be flexible enough that people working locally are able to access data that already exist, whilst new data from commissioned surveys can easily uploaded to augment or update existing data. This may be especially important for habitat data, where existing inter- and sub-tidal EUNIS benthic habitat data may be modelled and so might be improved through a process of ground-truthing. [TH]
- NEIFCA generates significant amounts of information, especially stock assessment data, and this needs to be managed and stored. NEIFCA hold just their own data, uploading metadata to both MEDIN (Marine Environmental Data and Information Network) and Marine Recorder. Data that is stored in-house is shared with other agencies, proactively or on request. [TS]
- As regards those organisations that are collecting and using data, the current system of decentralised data storage is not exactly fit for purpose; everyone is saying the same thing: we don't know what everyone else is doing, and when we do know that they've got a survey that they've done in an area then there are issues in trying to get that data in the right format. [TS]
- Centralising natural capital data, however it's defined, isn't necessarily the best way forwards. It's probably more a case of having a natural capital 'tag' associated with the datasets that are held by different organisations in different places. Green data storage and handling in the UK needs to be addressed as a whole, but the best way forward, at least in the interim, is probably to have some kind of natural capital tag associated with it. [TS]
- The Landscape Pioneer recognised the importance and value of collecting the known evidence and then supplementing that by proof checking with stakeholders (and also giving them an opportunity to fill some of the gaps); the development of a data repository for this evidence was not seen as being important. [ALo]

3.2.5 Engagement

Comments from several interviewees recognised the importance of stakeholder engagement and public buy-in as factors contributing to the success of a project implementing the natural capital approach. They also included reference to the development of a shared vision, and participation in related community projects:

- Stakeholder mapping is one approach that would be recommended. Whilst it's (inevitably) more difficult to engage with stakeholders in the 'high influence/low interest' group it's important to find the hooks to get them on-board. [ALo]
- Given the lack of knowledge and data available regarding marine habitats, especially on the North Yorkshire coast, a two-stage (desk-based and public engagement) approach would present challenges, but working to secure stakeholder buy-in from the outset, and undertaking the journey to establish a shared vision of where the partners want to get to whilst taking people along with you is a sound and constructive way forwards. [BF]
- Being an independent charity is helpful because, over many years, SFP has built up a reputation and a dialogue with the public, for example: taking on community projects; administering the Robin Rigg Community Fund (funding from the Robin Rigg Wind Farm); coordinating a litter-picking project; delivering the SMILE project; delivering the Solway Coastwise project (which was about engaging people through the history of the coast through place names). All these projects have engaged with the public and formed a long-term dialogue and connection with them. [GR/BC]
- As well as taking a natural capital perspective, the Landscape Pioneer promoted the importance of stakeholder engagement, working in partnership, participation, etc., all of which support the shift to a natural capital approach. It's really important to make sure that the participation and engagement is well delivered; stakeholder buy-in tends to lead to wider public buy-in and acceptance. In turn it then becomes easier for the national agencies and national bodies to get buy-in and support for their proposals. [TH]
- What the YMNP is trying to achieve is really important - the more locally-based case studies that there are then the better the prospects are for developing the natural capital approach. Without local input the approach will just relate to national-scale marine plans and things of that nature, which isn't necessarily the best way to optimise the benefits. [TH]

More specific (external) project communication issues were discussed by some interviewees. In this context, the value of social media was highlighted, together with the role played by certain aspects of local cultural heritage in providing possible focal points for public engagement:

- Many of the structures in and around Yorkshire ports and harbours are historic, even if they have been augmented and have modern additions to help protect them. Given that heritage is something that communities buy-into, and which presents a way of engaging with people over their coastal and marine natural environments, it makes sense to place heritage considerations at the core whenever public engagement type activities are being planned. [AF]
- The SFP's YouTube channel hosts live webinars – e.g. the 'Coastal Conversations' series, developed by SFP and the Solway Coast AONB. An archive of previous sessions is also maintained on the channel. Attendance at live events is coordinated through Eventbrite, whilst proceedings are also streamed to a global audience via Facebook Live. [GR/BC]
- Good communication, and consequently a good public understanding of the benefits that are derived from the environment, produces an engaged public who are then positively motivated to support the project in better managing their subtidal areas. [TH]
- The whole engagement issue is another major priority that should be considered. The need to communicating to people just how and why our natural environment is so important risks being forgotten as a project focuses in on the technicalities of what is measured, how it is measured, etc., and communicating the bigger picture — explaining to people that the environment is actually really important, and that it's important for these reasons, and that it does all this for you — gets lost. Communicating these sorts of messages through improved engagement with stakeholders and the wider public improves environmental awareness, and creates an informed environment where the debate around how we protect the seas can be better promoted. [TH]

The final set of comments in this grouping related to the more focussed aspects of engagement and communication that effectively cross over into the more specific area of (public) education:

- The decision-making that NEIFCA already does helps to protect and promote some aspects of natural capital. However, it's possible that the Authority could improve the way it communicates impact assessments and the evidence that supports byelaw reviews, and ensure that its current actions are (more) consistent with the natural capital approach —whilst also trying to embed some of the natural capital language into the debate, so making it more explicit and bringing it to the surface. [TS]
- Because engagement is central to the application of the natural capital approach it's important to ensure that the value of these assets is widely understood – an issue that is especially important for 'virtual' environments that people are not able to interact with (e.g. seagrass meadows) in the same way they might see and interact with familiar physical environments such as woodlands. [GR/BC]
- The way that public engagement around a project is managed provides an opportunity to increase its wider impact and legacy. Celebrity 'endorsement' (for example Sir David Attenborough promoting the work of the Sussex Wildlife Trust and IFCAs to protect the kelp forests off the West Sussex coast) can be used as a way of generating, and maintaining, public interest in a project. In the Sussex work, for example, there was an increased appreciation amongst the public that the biodiversity that was being lost was important not only to the environment but to them as well; this increased engagement was evidenced by a significant increase in local fisheries byelaw consultation responses. [TH]

3.2.6 Networking

Finally, a number of issues were identified by interviewees that relate to the general topic of networking, namely: organisations cooperating to realise shared goals through collaborative working; promoting the use of existing networks; and involving academia in mutually beneficial partnership activities:

- From Natural England's standpoint the natural capital approach potentially provides an opportunity to get more join-up between bodies and stakeholders, and an opportunity to see the different sides and consider the wider implications as well. As there's not always the time and space in the 'day job' to really consider other things application of the natural capital approach may provide opportunities to get more people to take ownership of the coast and to recognise the importance of the areas; it's providing the opportunity to build relationships and to realise a more collaborative approach. It's also a big opportunity to get all of the agencies working in the same direction, which isn't necessarily the case with other aspects of environmental management. [CA]
- Local networks in Yorkshire are already used to help improve collaboration. For example NEIFCA has a science and governance group which talks about the fisheries research that's going on, and there's a Yorkshire Coast Biodiversity Group (headed by the Yorkshire Wildlife Trust) which talks about evidence gaps, etc. Whilst these informal networks are valuable, using them effectively is much more reactive than it is proactive at the moment (principally because of resourcing and priorities; delivery of those statutory obligations that Natural England is accountable for has to take priority). [CA]
- The presence of an academic institution that's interested in this area of work provides a good opportunity for progressing a local or regional project; connections with academic institutions and with ongoing academic research can be mutually beneficial. [TH]

4 Stakeholder views

4.1 Responses to online survey questionnaire

Despite reminders being sent out to stakeholders, only eight completed responses were received by the time the survey was closed on 18 March 2022.

The results from the final set of responses are presented below.

Note that, because of the low number of returns received, it was considered inappropriate to reproduce these data graphically.

4.2 Respondent affiliation

The eight respondents identified their affiliations as follows:

- Environment Agency
- East Riding of Yorkshire Council/Local Nature Partnership
- Hull and East Yorkshire Smile Foundation
- Hull Marine Laboratory, University of Hull
- North York Moors National Park Authority
- RSPB
- Scarborough Borough Council
- York and North Yorkshire Local Enterprise Partnership

NB To help preserve respondent anonymity, the ordering of this list of affiliations does not reflect the ordering of survey responses that are reproduced in the following sections of this report.

4.3 Review of responses

4.3.1 Data availability

Data deficiencies/gaps for all types of data are recognised by respondents. The largest number of respondents indicating major data gaps/deficiencies are associated with habitat condition, species occurrence/location and species condition data types. Possibly, a long tradition of natural science research on the Yorkshire coast means the data gaps/deficiencies are more well-known and understood. Two respondents noted:

- “Data often focusses on protected sites, more effort needs to be put on recording data of the hinterland, non-protected sites and connected land between protected areas. it is in this area where the most positive impact for wildlife can be felt, and where the natural capital figures will be most impactful.”
- “I do not work directly in marine and coastal management, but I am aware that the extent of underwater natural assets (e.g. sea grass, kelp forests) are not sufficiently mapped and condition assessed, in order to be included in decision making.”

Data gaps/deficiencies associated with natural capital assets data types (habitat and species location/occurrence and condition) are seen to be more likely to prevent the application of the natural capital approach to the Yorkshire coast when compared to data gaps/deficiencies associated with ecosystem services and goods/benefits data types. Although the impact of data gaps/deficiencies in ecosystem services and goods/benefits are thought to be less constraining, in the area of health benefits respondents recognised:

- “From a healthcare perspective it is difficult to quantify / measure the benefits of the coastal environment to people. While recreational value may be able to be monetised, the impact of interaction with the marine environment on mental wellbeing for example cannot easily be measured and quantified.”
- “One other trend that is likely to impact and needs to be accounted for is the increase in mental health issues and the opportunity of promoting the Yorkshire Coast and all things 'blue therapy'/ nature prescribing that comes with it.”

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Opportunities suggested for overcoming the data gaps/deficiencies include two specific data sources:

- “Habitat surveys are carried out on a biannual basis as part of the Cell One Coastal Monitoring Programme. Records location, type of habitat and whether there has been change in habitat area from previous survey”
- “There is practical work by Yorkshire Wildlife Trust via their Oyster bed and Seagrass Restoration Project (Contact: James Wood, Yorkshire Wildlife Trust) which involved some mapping, but this is limited to the estuary as far as I am aware.”

Approaches to collecting data were also proposed:

- “Development of a research project database containing proposals to address specific missing data sets, priced for completion by consultants but also as projects for college/university students.”
- “Data mapping exercises with as key stakeholders.”
- “Questionnaire sent around to non-key stakeholders and community groups to obtain more information on community reserves, projects and green.”
- “I can't comment on the marine environment but with the terrestrial environment, we have been using natural capital assessment to establish a baseline position and to identify opportunities for habitat connectivity, creation and enhancement. These opportunities are discussed with stakeholders and 'ground-truthed' to see how they fit with other priorities and we're then left with a map of potential areas for project development. We have also put in place, a number of monitoring programmes to assess how interventions achieve those opportunities. I'm sure this process could be replicated for the marine environment.”
- “Identify gaps, join up with partners to capture new data (save overlap costs), and adopt new methods which allow a large landscape scale assessment within the marine environment (don't get too bogged down in the precise detail).”
- “A modelling approach can be used in the absence of field data, but this can lead to errors.”

4.3.2 Progressing the application of a natural capital approach to the Yorkshire coast

On progressing the application of a natural capital approach to the Yorkshire coast (see Table E2), all the suggested factors provided in the questionnaire were considered at least ‘moderately important’ to the respondents. ‘Sustainable funding/grants and resources’ and ‘Positive coordination between different agencies/public bodies’ were given only ‘high’ or ‘very high’ levels of importance in responses. ‘An agreed local framework’, ‘High-level of support from, or engagement with, local stakeholders’, ‘Buy-in from the wider public’ and ‘Effective working across ‘artificial’ boundaries (such as local authority areas)’ all received a mixture of ‘moderate’, ‘high’ and ‘very high’ option responses. Half of respondents considered ‘An agreed local framework’ and ‘Buy-in from the wider public’ to be just ‘moderately important’.

A number of additional factors that might affect the application of a natural capital approach to the Yorkshire coast were identified by four of the survey respondents. These factors included:

- “Lack of standard monitoring framework - we need agreed national monitoring standards to meeting NCEA approaches, so each local area is monitoring at the same level of detail.”
- “Effective measures for recording health and wellbeing impacts (high importance).”
- “Positive working between different sectors (e.g. healthcare provision and coastal management) (high importance).”
- “We need to spread ideas and best practice from other areas, and introduce to our area. We need to share data and make the most of existing data by making it open (F.A.I.R principles).”

Other points mentioned included:

- “Engaging the public is an important thing to do.”
- “We need to look at both residents and visitors. The ideal would be to create 'natural capital ambassadors' in the resident population.”
- “We need to define key educational messages and approaches to change public behaviour for the positive.”

4.3.3 Opportunities for embedding a natural capital approach into regional decision-making or policy development

The open question, about opportunities for embedding a natural capital approach into regional decision-making or policy development, elicited a wide range of suggestions for what respondents considered to be new opportunities. These comprised:

- “I think LNRS will use a natural capital approach to determining opportunities for nature recovery across the marine and terrestrial environments. This gives an opportunity to embed the Natural Capital assets into the fundamental understanding of the value of the place, its habitats, its species and the opportunity to enhance all of these aspects. This should underpin all policy development and decision making for coastal and marine environment.”
- “Opportunities exist to create habitat on new and existing coastal structures. For example, creating rockpools in rock armour at Runswick Bay. Current plans for repairing the seawall at Robin Hood's Bay includes using textured surfaces for seaweed and shellfish adhesion. Promoting habitat creation could help secure further EA funding, whilst in certain areas of the coast it could help with coastal defences (i.e.: saltmarsh creation, kelp forest restoration etc.)”
- “A local-policy equivalent of HM Treasury's 'Green Book' guidance (a standard to which local businesses and projects must be measured against, so that the local environment is fully accounted for in regional policy design and projects).”
- “It will be a big change in the way we think about the environment, but by incorporating NCA into policy development and also within planning, it will allow areas of priorities to be identified, and appropriately managed.”
- “Modify the ENCA guidance to fit the Yorkshire area, in affect it would be a regional plan for enabling a natural capital approach, being a one-stop shop for businesses, private sector, industry and the public to research and understand the natural capital value of the local area.”
- “Increased awareness of the health and wellbeing benefits of the outdoors and nature, and a national focus on Green (and Blue) Social Prescribing across the new Integrated Care System.
- “Creating/restoring habitat as part of carbon sequestration projects. Accreditation schemes would need to be set up, but for example, CEH are currently exploring a national saltmarsh carbon code via a pilot in the Humber Estuary.”
- “The YNY LEP did a major study on natural capital around 2020, but this did not include marine/coast. Perhaps this needs to be repeated so that we can truly understand the value of the natural capital, ensuring its part of our future economic strategy and plans.”
- “With devolution, we need to be ensuring that we request and direct investment into the right things for the future of our region.”

One respondent suggested it will need to be facilitated:

- “So again, I think it comes down to the evidence we collect, having standard approaches which can be adopted as best practice, will help the transition into this new way of thinking.”

Further constraints were also identified:

- “Mapping would need to be required to understand the scale of habitat potential along the Yorkshire Coast.”
- “Example: Yorkshire's coastal fisheries are underpinned by the primary production of seaweeds, phytoplankton, benthic microalgae and seagrasses. We do not [know] which of these are important in supplying organic material to the food chain, and therefore their contribution to natural capital. Without this knowledge, coastal management is not easy.”

4.3.4 Areas of potential coordination/cooperation

The suggested groups/organisations that could potentially work together within specific stakeholder typologies have been pooled below:

Strategy and policy makers	Defra (family); Environment Agency; Natural England; Local authorities; existing coastal forums; MMO; NHS England; Humber Coast and Vale Health and Care Partnership; Public Health Teams; Local Nature Partnerships including YMNP, and Local Economic Partnerships.
Research and education	Universities (Hull, York, Leeds, Durham, the FSC); Natural England; RSPB; Wildlife Trusts and other conservation charities; YMNP; Education Manager (Richard Adams) at Anglo American; Healthcare Providers; voluntary, community and social enterprise groups; MMO; North Eastern IFCA; and Defra (family).
Fisheries	Local IFCAS and other local fishing industry groups; council Harbour Masters; Defra; Natural England; RSPB; and Wildlife Trusts.
Conservation	North Yorkshire Moors National Park Authority; National Trust; Defra (Family); Natural England; JNCC; Environment Agency; Yorkshire Wildlife Trust and local conservation charities; Marine Conservation Society; Yorkshire Water; Internal Drainage Boards; RSPB; Wildfowl and Wetlands Trust; Environment Agency; local councils; game keepers; healthcare providers; NGOs and voluntary, community and social enterprise groups; YMNP and other local nature partnership; and Coastal CaBA (Catchment Based Approach) Partnership.
Heritage and culture	North Yorkshire Moors National Park Authority; Historic England; NGOs such as the National Trust; voluntary, community and social enterprise groups; and planning authorities.
Community engagement	Yorkshire First; Parish Councils; Schools; Conservation charities; Humber Coast and Vale; East Riding of Yorkshire Council and other local authorities; town councils; local partnerships; wildlife trusts; Coast and Vale Community Action (CAVCA); Healthcare providers; NGOs and voluntary, community and social enterprise groups; Natural England.

One respondent commented that another important stakeholder typology might be for organisations associated with aspects of the economy, such as: the Yorkshire Coast BID and Local Economic Partnerships.

4.3.5 Next steps

In terms of the next steps, there was some consistency between the eight respondents as to what might be done. Some respondents identified levels of importance for specific next steps and these are also included below. The suggested next steps are broadly grouped according to whether they were associated with process, funding and skills, stakeholder engagement, working with local communities, data gaps and data collection, and specific projects.

Two respondents laid out 'next step' processes to pursue and are reported below:

- "Secure funding to undertake a natural capital mapping exercise (and implement); compare with existing data - fill in gaps; identify opportunities to enhance natural capital; consult with stakeholders; devise a natural capital action plan; and secure funding, implement and monitor."
- "Identify key stakeholders with knowledge across a variety of sectors, list those stakeholders then begin consultation; stakeholder engagement; and data collection."
 - These three actions are linked and are completely essential for building a natural capital framework for the Yorkshire Coast;
 - Community engagement, raising awareness and policy review are then secondary outputs after the initial plan has been developed."

There is clearly a degree of agreement between these two suggested processes.

Requirements for funding and skills were identified:

- Secure funding to undertake a natural capital mapping exercise (and implement).
- Building skills and knowledge - sharing techniques, skills, human resources and data is HIGH IMPORTANCE. We have too few resources between us in this area e.g. no local research vessel, lack of a coastal marine station.

Stakeholder engagement features quite prominently:

- Identify key stakeholders with knowledge across a variety of sectors.
- Talk to other organisations/stakeholders to ensure joined up thinking, many organisations have Natural Capital teams being set up, so drawing together this information will be important, and save overlap (HIGH IMPORTANCE).
- Identify key stakeholders with knowledge across a variety of sectors, list those stakeholders then begin consultation.
- Stakeholder engagement to understand reasons people access the coast or not (HIGH IMPORTANCE).

Working with local communities was identified:

- Engage local communities (this will be a long-term approach, so need to start now, to get people thinking differently) (MEDIUM IMPORTANCE).
- Raising community awareness of health and wellbeing aspects of the coast (HIGH IMPORTANCE).

Identifying data gaps and data collection:

- Identify data gaps – again speaking to different organisations to establish a map of gaps, so these can be filled (HIGH IMPORTANCE).
- Data collection on potential change in natural capital seems high priority. How much do we have now, what is it, and what could it become? This can obviously be challenging due to cost if majority is offshore, but it could be a good way to create new relationships with organisations or voluntary groups who have the skills but would not be aware of this work, e.g. SCUBA diving societies.
- Data collection on health and wellbeing activities occurring in coastal environments (HIGH IMPORTANCE); on who is accessing the coast for health and wellbeing (HIGH IMPORTANCE); on accessibility of coastal environments - (HIGH IMPORTANCE);
- Data collection on all aspects of blue carbon, as this is key to understanding energy flows in the Yorkshire coastal system (high).

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Some specific activities were also identified:

- Work with the LEP and partners to find funding to do a marine and coast focused Natural Capital Study.
- Ensure that any work on this is fed through to the LEP so it can be included within the economic planning for the region, with LGR and devolution in train.
- A natural capital plan and implementation is a primary output but community engagement, raising awareness and policy review are then secondary outputs after the initial plan has been developed.
- Identify opportunities to enhance natural capital.
- Devise a natural capital action plan, secure funding, implement and monitor.

5 Recommended next steps and priority actions

5.1 Recommendations/priorities

The recommendations arising from this study are provided below (Table 5.1).

Table 5.1 Recommendations

Recommendations	Priority	Cost band	Notes
1. Undertake a participatory system mapping of the Yorkshire Coast nexus, including natural capital assets, ecosystem services, and beneficiaries including values. This will provide a high-level understanding of the assets, stakeholders and relationships within the system. To develop this mapping requires a multidisciplinary, multi-stakeholder approach, facilitated by system practitioners (e.g. Centre for Systems Studies, Univ. of Hull; Centre for the Evaluation of Complexity Across the Nexus, Univ. Surrey).	H	£££	Note that there are both: - targeted projects to make available data more accessible/open access e.g. NEIFCA data currently available on request, whereas a change in procedures and some up-front investment could provide users with direct access; and - issues surrounding same data being held in multiple repositories – local and national, raising the question of which level data should be held at. Currently a JNCC ‘Stabilisation Review’ is being undertaken looking at procedures for holding data (linked to indicators).
2. Undertake a scoping study to identify the location, quantity and condition of natural capital assets that make up the Yorkshire Coast based on known evidence.	H	££	e.g. Solway Review, updated through the SMILE project, was used to help inform priority natural capital assets for future projects. Some relevant information may come out of the current study considering the EA NCAT system.
3. Establish collaborative research networks with ecological and socio-economic researchers/research groups in the region (e.g. NEIFCA, Univ. Hull, Univ. York, consultants) to address priority evidence gaps (e.g. emulating SW England).	H	£	For example, a prioritised list of Yorkshire coastal/marine NCA for undergraduate, masters and PhD dissertation/thesis topics might be provided on an ongoing basis to specific academic programme directors as a way of improving the evidence base in a coordinated way; these could be topics based in natural sciences, social sciences or interdisciplinary.
4. Ensure that any new natural capital project has a well-integrated structure .	H	£	Incorporate representation from across different levels of governance (government agencies, NGOs, academia, citizen actors) and spatial scales (involving local, regional, national, and international) e.g. as advocated in key practitioner interviews.

Recommendations	Priority	Cost band	Notes
5. Ensure that, for any new natural capital work, there is a clear project vision – a clear statement of what is to be achieved.	H	£	Visions should be as clear and simple as possible, shared, meaningful to local people as the NCA builds on engagement and, at the same time, big enough to fit/align with what is happening at the national level. Such a vision might usefully draw on the 25-Year Environment Plan, which relates to nature restoration e.g. as adopted by the Marine Pioneer projects and advocated in key practitioner interviews.
6. Create a single repository for information, make that information open access and easily accessible, and include ecological, social and economic information; work with NEYEDC to help realise this.	M	££	Information should be detailed; scale is important. Existing national data (Natural England’s Natural Capital Atlas) uses a 5km ² hexagonal grid, whereas Oxford-Cambridge Arc natural capital plan (at the Local Authority level) uses 1km ² ; others have advocated parish level); will need to be updated on a regular and frequent basis. As an interim alternative, rather than a single repository, consideration could be given to sharing basic meta-data to signpost where data is held as well as where/when future surveys (or other forms of data collation exercise) are planned.
7. Further develop and maintain a programme of stakeholder activities to promote engagement and to elicit the value of the Yorkshire coast to communities.	M	££	Examples might include local nature restoration, litter picking and other such projects, opportunities to promote citizen science work, coastal/marine photography competitions, children’s short story competitions, cultural heritage event days, and videos and webinars (e.g. Solway Firth Partnership).
8. Employ the ‘ community voice method ’ (as advocated by the MCS, and currently being used by the Oceans of Value project and elsewhere) to elicit qualitative, social and cultural assessments of the value of the Yorkshire coast and to promote wider engagement.	M	£	Also make use of aspects of local cultural heritage to establish or strengthen project links to coastal communities etc.
9. Recognise the extent to which NCA is already embedded e.g. NEIFCA byelaw reviews and proposals, and draw on local experience.	L	£	Celebrate the wins! More importantly start to build a library of existing applications to help support future assessment work and/or engagement activities.

5.2 Concluding comments

Much of this recommended work will need specific resources and support from national bodies. If this ambitious programme of work is to be achieved and used to support Yorkshire's marine and coastal environment, significant investment in the YMNP will be required, with particular focus on data collection and sharing, knowledge exchange, and in the working relationships between partner organisations.

The YMNP recognises the importance of aligning their work with progress elsewhere, including terrestrial, to maintain connectivity and consistency for 'cross-ecosystem' partners. The tools and methods employed in the application of natural capital approach to the terrestrial environment provide helpful lessons for employing natural capital approach in coastal and marine environments. However, too great reliance on linking it with terrestrial accounting may be counter-productive at this time, and more rapid progress might well be made through a more focussed drive to use the lessons from existing marine and coastal work to help inform the application of the approach to the Yorkshire coast. As noted above, such a drive would inevitably be dependent on the availability of adequate funding.

From our engagement with stakeholders, evidence elsewhere, national guidance, and our own expert opinions, the (methodological) challenges that have been identified to the application of the natural capital approach to the Yorkshire coast are likely to be able to be addressed by YMNP in the short- to medium-term. Consequently, substantial progress should be able to be made against the recommendations over the next few years.

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ANNEX A TOOLS TO SUPPORT THE NATURAL CAPITAL APPROACH

1. **Ecosystems Knowledge Network (EKN) Tool Assessor** (developed by EKN, funded by JNCC and Defra) (<https://ecosystemsknowledge.net/tool>).
 - Not a tool but an online resource that supports NCA as it describes and assesses a range of tools for application, often with a spatial dimension, and includes coastal and marine settings.
2. **Defra Biodiversity Metric** (Developed by Defra in 2012, updated 2019 and 2021 by Natural England) (<http://nepubprod.appspot.com/publication/6049804846366720>)
 - Biodiversity measurement tool for calculating biodiversity net gain, based on area and relative quality of the habitat, and underpinned by ecological evidence. Biodiversity value of habitats calculated in non-monetary terms, and includes intertidal and terrestrial habitats (with work underway to develop an approach to marine net gain for English waters).
3. **Environmental Benefits from Nature Tool** (Developed for Natural England and Defra by a consortium led by Univ. Oxford) (<http://nepubprod.appspot.com/publication/6414097026646016>)
 - Measures changes in natural capital benefits from habitat changes, including coastal and marine habitats, by indicating how biodiversity enhancements affect 18 ecosystem services (e.g. flood protection, recreation, water quality). It does not incorporate quantification or valuation of ecosystem services.
4. **Natural Capital Atlases** (produced by Natural England) (<http://publications.naturalengland.org.uk/publication/6672365834731520>)
 - Maps of England, with a resolution based on 5km² (hexagonal) cells, were developed according to indicators of quantity, quality and location of ecosystem assets, including coastal, intertidal, subtidal and marine inlets. Each of these indicator maps provides a list of relevant ecosystem services and relevant natural habitats.
5. **Natural Capital Register and Account Tool** (produced by the Environment Agency) (available directly from naturalcapital@environment-agency.gov.uk)
 - Value, quantity and quality of natural resources in a location, with some relevance to coastal settings. Coverage of ecosystem services is limited (e.g. excludes flood regulation by saltmarsh).
6. **Managing Ecosystem Services Evidence Review (MESER) Tool** (Created for Natural England, originally known as the Ecosystem Services Transfer Toolkit) (<https://meser.simomics.com/#/>)
 - Searchable on-line literature review tool of how management interventions affect provision of ecosystem services, including those provided by coastal and marine habitats, though it does not provide valuation evidence.
7. **Local Environment and Economic Development (LEED) toolkit** (Produced by the Defra network of the Environment Agency, Natural England and Forestry Commission, working in partnership with several Local Enterprise Partnerships (LEPs), local authorities and Local Nature Partnerships in England) (<https://ecosystemsknowledge.net/apply/local-economy/LEED>)
 - Allows LEPs to make sense of complex environmental information and is designed to provide non-technical outputs to feed into Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis to support LEP Strategic Economic decision-making and Plans. Follows an ecosystem service approach (rather than NCA) and can allow for coastal and marine ecosystem services.
8. **Environmental Valuation Reference Inventory (EVRI)** (produced by Environment and Climate Change Canada, with funding from a number of national governments including Defra, UK) (<https://www.evri.ca/>)
 - An international searchable online database of empirical studies on the economic value of environmental benefits and human health effects, including coastal and marine studies. It is designed to support analysts use a value transfer approach.
9. **Natural Environment Valuation Online (NEVO)** (Developed by LEEP, Univ. Exeter, with funding and direction from Defra) (<https://sweep.ac.uk/portfolios/natural-environment-valuation-online-tool-nevo/>)
 - Users can explore and visualize (using map-based interface) the impact of changes in natural capital management on flows of ecosystem services in England and Wales. It assesses the value of

ecosystem services related to agriculture, recreation, forestry, carbon emissions, biodiversity, and water quantity and quality. This tool is not of direct relevance to coastal or marine settings.

10. **Outdoor Recreation Valuation Tool (ORVal)** (Developed by LEEP, Univ. Exeter, with funding and direction from Defra) (<https://www.leep.exeter.ac.uk/orval/>)
 - Predicts the number of visits to existing and new greenspaces in England and Wales, including beaches and other coastal locations, and the associated welfare value of those visits, involving both quantification and valuation of outdoor recreation. It uses aggregated landcover groups based on UK Centre for Ecology & Hydrology (CEH) Land Cover Map.
11. **Woodland Valuation Tool** (Developed in 2015, updated in 2018. Produced by LEEP, Univ. Exeter, with funding and direction from the Forestry Commission) (<https://forestry.gov.scot/publications/680-woodland-valuation-tool>)
 - Database of studies of the social and environmental benefits of trees and woodlands in England, Scotland and Wales. Not direct relevance to coastal and marine settings.
12. **Ecosystem Services Valuation Database (ESVD)**, version December 2020 (TEEB, supported by FAO). (<https://www.es-partnership.org/esvd/>)
 - A database of value estimates for policy appraisal. The ESVD contains 4,820 value records based on 955 studies. Where possible, value estimates have been standardised to international dollars per hectare per year, for all relevant beneficiaries at 2020 prices. Values are reported by biome (e.g., open sea/ocean, coral reefs, coastal systems).
13. Natural Capital Project, **Integrated Valuation of Ecosystem Services and Trade-offs (INVEST)** Stanford University. (<https://naturalcapitalproject.stanford.edu/software/invest>)
 - INVEST enables decision makers to assess quantified trade-offs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. The toolset includes distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems, as well as ‘helper tools’ to assist with locating and processing input data and with understanding and visualizing outputs.

In addition, a number of reports describing specific methods and frameworks are highlighted below:

14. Participatory mapping of natural capital and benefits: method guidance document. Report to Marine Management Organisation and Suffolk Marine Pioneer by Daryl Burdon Ltd., Willerby UK. (Burdon and Potts, 2020) (<https://www.suffolkcoastandheaths.org/wp-content/uploads/2021/01/Participatory-Mapping-Guidance-Document-Final-200520.pdf>)
 - This guidance document promotes participatory mapping as a direct means of co-producing knowledge with stakeholders and communities. It facilitates local spatial mapping of the distribution of natural capital features, benefits, values and trade-offs. In the context of ecosystem services valuation, stakeholders provide local, spatially explicit information about ecosystem services and benefits, use and value (both monetary and non-monetary), negating the need to use proxy data derived from literature or modelling. The approach was adopted in the Suffolk Marine Pioneer project (see below).
15. Hooper, T., and Austen, M. (2020) Application of the natural capital approach to Sustainability Appraisal. Final Report. October 2020. Report prepared as part of the South West Partnership for the Environment and Economic Prosperity (SWEEP) and the Marine Pioneer programme. (https://sweep.ac.uk/wp-content/uploads/Sustainability-Appraisal_Method-summary.pdf)
 - This report applies natural capital principles to Sustainability Appraisal, a mechanism for integrating the natural capital approach into local decision-making. It provides a systematic baseline of the current status and trends in assets, services and benefits, and the degree to which they are at risk. This allows for the selection of detailed sustainability objectives and indicators, and for the full implications of plan options to be assessed. The method for collecting baseline information has four core elements: an asset register (in which information on the status of natural capital is compiled), an ecosystem services inventory (to list services, benefits and values); an asset-service matrix (to connect services to the assets from which they are derived); and a risk register (which summarises threats to continued system functioning).

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16. Van Rein, H., Molloy, L., Lourenço, G., Day, J., Hooper, T., Hartley, M., Chambers, A., Parker, R., Benson, L., Hedley, C., Young, M and Morgan, V. (2022) Natural Capital Approaches for Improving Marine Planning: A proof of concept 'quick-win' project for the Marine Natural Capital and Ecosystem Assessment Programme. JNCC. (<https://data.jncc.gov.uk/data/a0a9b99c-823c-4396-9445-325a99502876/JNCC-Report-702-FINAL-WEB.pdf>)
 - Government report, including an East Marine Plan Area case study referenced throughout, is intended to demonstrate the various tools available for making informed decisions about the extent and condition of marine natural capital and associated ecosystem services. It emphasizes how asset and ecosystem service maps can be developed using a combination of available GIS layers and literature-based evidence. The research is ongoing.

ANNEX B DETAILS OF PLACE-BASED UK APPLICATIONS OF THE NATURAL CAPITAL APPROACH

B.1 Solway Firth Partnership

Solway Firth Partnership (SFP) was established as an independent charity in 1994. A range of different projects have been undertaken since then ensuring strong engagement and on-going dialogue with stakeholders and the general public. In 1996, the ‘Solway Firth Review’ was published (sometimes referred to as the ‘State of the Solway Review’), which aimed to establish:

“the baseline suite of information which exists for the Solway, to be used as a basis for future management, planning and monitoring, identifying conflicts between sectors in a space of increasing use, identifying data gaps needing to be filled, and providing increased data accessibility”⁷

The ‘Solway Marine Information Learning and Environment’ (SMILE) Project, funded by EMFF, ran from February 2018 to July 2021 with the aim:

“to update the 1996 ‘State of the Solway Review’, using innovative communication methods to gather pan-estuary information, learn from stakeholders and promote a better understanding of the Solway Firth ecosystem. The update was required in the light of new demands made on the estuary’s resources and in the context of marine planning. The Review will provide some of the evidence by which a sustainable approach to planning and management may be achieved; thereby helping to deliver the ecosystem based marine planning frameworks developed for the Solway. The SMILE Project offered a significant opportunity to develop the foundations for a cross-boundary ecosystem approach to support the future management of the Solway Firth through data and local information.”⁸

In 2019-20, independent consultants EKOS undertook two projects which sought to inform a Socio-Economic Analysis of the Scottish Solway (funded by EMFF through Marine Scotland) and a Socio-Economic Analysis of the English Solway (funded by EMFF through the MMO). These reports were closely associated with the SMILE Project and overseen by SFP and the SMILE Project. SMILE has provided a regional assessment and a repository for evidence/data on environmental, social and economic aspects of the Solway Firth, e.g. the location of natural capital assets and their condition.

SFP has six core areas of work: Partnership; Planning (this includes the SMILE project); Environment; Fisheries; Energy; and Awareness (which includes collaborations and partnerships).

SFP is currently applying the natural capital approach to three Natural Capital Assets: salt marsh; sea grass (*Zostera marina* and *Zostera noltii*); and native oyster beds (*Ostrea edulis*). The selection of these assets (over other assets, including reed beds, seaweed, and honeycomb worm reefs) was widely accepted as each is associated with high value ecosystem services and previously the focus of substantial research. At the time of writing, the natural capital approach work is at a ‘developmental stage’, having only recently commenced, with evidence gaps being identified and planning being undertaken for survey work. Some engagement with specific stakeholder groups has been undertaken but wider engagement has not yet started as SFP are examining the feasibility of different public engagement options (e.g. a proposal for an oyster hatchery was found infeasible due to competition, biosecurity interaction with community and public engagement and the conflicting messages of restoring the wild native oyster bed while funding hatchery reared oysters on the coast around the wild oyster beds).

The SFP experience demonstrates the importance of establishing shared aims and maintaining ongoing dialogue/engagement with stakeholders; at an early stage establish an understanding of the state of the

⁷ https://www.solwayfirthpartnership.co.uk/solway-review/#chapter_1

⁸ https://www.solwayfirthpartnership.co.uk/wp-content/uploads/2021/08/SMILE-Project_Final-Highlights-Report-August-2021.pdf

natural capital assets (location, quantity and quality, and a socio-economic assessment) based on available data/evidence; and creating an open access data/evidence repository.

B.2 Oceans of Value Project

The Scottish Wildlife Trust's 'Oceans of Value' project⁹ has taken two approaches to capturing the range of values that are placed on the marine environment: (1) a desk-based natural capital assessment and (2) stakeholder engagement using the Community Voice Method.

The focus has been on the seas surrounding the Orkney Islands (out to 12 nautical miles), which is one of the most well-studied marine environments in Scotland. Orkney is also one of the next regions in Scotland to develop a Regional Marine Plan, intended to manage all marine activity in the region and ensure environmental sustainability. "By mapping out the natural capital assets in Orkney's marine environment, and identifying the ecosystem services they provide, it would be possible to identify which assets are of most importance to the community, businesses and industries in Orkney. An assessment of the health of these assets and the threats they face would further provide key information for marine planners" ().

(i) **Marine Natural Capital Assessment:** The desk-based approach aimed to identify and assess the marine natural capital assets, including their location and condition, and whether they are being used/managed sustainably; the assets that are most important for environmental health, society and businesses in Orkney; the assets that are most valuable in fighting against climate change and those most vulnerable to climate change; the assets that are most important for maintaining ecosystem services and the ecosystem services provided by Orkney's marine natural capital asset and those that are most beneficial to the Orkney community; and whether the benefits of these services are felt outside of the Orkney marine region.

The assessment project report indicates that Marine Natural Capital Assessments can provide the framework for delivering key objectives of marine spatial plans, but further investment in data collection and monitoring is required to fulfil this potential (ADAS et al., 2021; Behrendt et al., 2021). Recommendations included:

"Participatory approaches that draw upon different value perspectives can be beneficial in promoting a holistic view of natural capital whilst helping to build the evidence base around the links between the generation of services and the associated beneficiaries. Any future natural capital plan or natural capital assessments of the Orkney marine region should look to engage key stakeholders (private, public and community representatives) to support a local place-based approach to marine planning and decision making."

"Investigate the establishment of a regular monitoring and evaluation process for Orkney's marine natural capital and evaluate where data already collected could be repurposed. Regular updates against a baseline account would provide ongoing understanding and evidence of the extent and condition of marine natural capital assets and ecosystem services." (ADAS et al., 2021, p.10)

Despite Orkney being a relatively well studied marine area, the assessment report argues "there remains a lack of suitable data to inform natural capital assessments and develop clear, location-specific conclusions and recommendations. Better understanding of key relationships and thresholds would greatly inform future assessments of ecosystem services and natural capital in marine environments" (p.11). Specific limitations comprised:

- "For some services there was little information and assigning a level of service provision and discriminating between habitats was difficult.
- As linkages between natural capital assets and ecosystem services are highly uncertain, or variable, depending on specific conditions, they are hard to elaborate across larger scales with high levels of confidence. Provision of ecosystem service is likely to be influenced by a number of factors and is likely to vary over time and space. These aspects have received little attention for most marine

⁹ <https://scottishwildlifetrust.org.uk/our-work/our-projects/living-seas/oceans-of-value/>

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habitats. The assessment of ecosystem services in this study was, therefore, generic rather than location specific and it was assumed that delivery was homogenous over a habitat extent.

- Assessment of provision was categorical (none/negligible, low, medium, high). The assessments largely consider the potential to provide services rather than the level to which the service is realised. For example, habitats and associated species may support the sequestration or breakdown of wastes and contaminants but where water quality is high and these are absent, the service potential is not realised.
- Similarly, if target species are not fished from a habitat then the habitat is not providing that service, although it may of course support this indirectly through migration of adults and juveniles, propagule supply or nursery functions.”

(ii) **Stakeholder valuation and the Community Voice Method:** To capture the different values members of Orkney’s community hold for the marine environment, the researchers set out to interview a range of stakeholders in a process known as the Community Voice Method.¹⁰

The method includes the following stages:

- Video interviews with stakeholders;
- Analytical assessment of interview transcripts to identify key phrases;
- The development of a short film, based on the analysis results;
- Running a workshop where the film is presented and further feedback is captured;
- Final report of findings.

Through this approach, it is intended to capture key information on how different stakeholders value the marine environment (why it is important to them), how the environment has changed in their lifetime, and how they would like to see it managed in the future. The film and final report of the Community Voice Method component of this project are expected to be completed by December 2022.

B.3 Isles of Scilly Inshore Fisheries and Conservation Authority (Fishing gear permit byelaw)

Hooper (2021) describes the process of review for the Isles of Scilly IFCA’s Gear Permit Byelaw 2013. The byelaw is designed to manage fishing activities to protect habitats and species within the Special Area of Conservation (SAC) and wider District. A formal consultation on revised byelaws was opened following preparation of an Impact Assessment. Hooper notes that the IFCA’s Byelaw Working Group proposed that the aims for the updated trawling byelaw should include:

- maintain the quality of the marine environment and the ecosystem services it provides;
- ensure that the economic benefits are sustainable and spread across businesses and society.

Hooper notes how the IFCA reports the “natural capital approach enables a more holistic view of options to be taken”.

In developing the evidence base, a natural capital asset and risk register (Ashley et al., 2020) was commissioned, which used the same general process and methodology as the Marine Pioneer approach (Rees et al., 2019). The asset and risk register included:

- For habitats: the extent, extent trend, condition and condition trend (combining quantified data, where available, with use of a three-point categorical scale);

10

<http://communityvoicemethod.org/#:~:text=The%20Community%20Voice%20Method%20was,landscapes%20and%20resource%2Dbased%20livelihoods.&text=The%20Community%20Voice%20Method%20is,conversations%20about%20important%20local%20issues.>

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- For commercial fishery species: the quantity and condition of the stocks (and trends in these) and the quantity and trend in benefits in terms of food landed (again combining quantified data and categorical scales);
- Matrices showing the risk (on a categorical scale) to (i) continued delivery of ecosystem services from subtidal habitats; and (ii) the continued suitability of subtidal biotopes as habitats for commercial fishery species.

The asset and risk register excluded abiotic services (Makowska et al., 2022).

The Impact Assessment noted that the most significant part of the risk register approach was considering how risks would change under management scenarios. The limitations of monetary valuation, due to uncertainties and reliability concerns, was also raised and led to economic values for benefits not being presented.

This application demonstrates that the natural capital approach can be used to support specific management strategies for fisheries. Here the approach adopted included the use of a natural capital asset register to organise evidence; Hooper suggests it also demonstrates how the concepts have been embraced, “particularly ecosystem services and to a lesser extent economic perspectives and valuation” (p.7).

B.4 Sussex Inshore Fisheries and Conservation Authority (Nearshore trawling byelaw)

Hooper (2021) describes the process by which Sussex IFCA resolved to approve a revised Nearshore Trawling Byelaw. Natural capital concepts informed the revision process, including the Impact Assessment making repeated reference to the marine natural capital review commissioned by Defra (Hooper et al., 2019) and to the work of the Natural Capital Committee. Hooper states that in developing the evidence base for the proposal, the IFCA sought explicitly to consider:

- the type and extent of natural capital assets within the district, their sensitivity, diversity, associated ecosystem goods and services and value;
- an indication of current natural capital assets condition and risks to these.

Hooper notes, the assessment included natural capital methods and concepts:

- adoption of the principles from the asset register developed by Rees et al. (2019) to determine extent and condition of habitats and species;
- a matrix of ecosystem service provision by the main habitat types (to EUNIS Level 3) on scale of zero (very low) to five (very high);
- a multicriteria analysis to attribute “environmental value” (on a four-point scale) to the different habitats, which was also used as a proxy indicator of potential risks to the flow of services and benefits;
- commissioning a valuation of the ecosystem service benefits that could arise from the recovery of kelp beds off the coast of West Sussex.

A best available evidence approach was adopted for the evidence base, including a habitat map developed from video, grab and dive surveys, the identification of essential fish habitat from small fish surveys, and condition information based on historic evidence and on a proxy linked to the vulnerability of habitats to pressures to which they are sensitive. Fisheries information was drawn from various sources, including fishing activity sightings data, effort maps, and MMO landings data.

Hooper argues that this depicts a comprehensive application of the natural capital approach throughout a decision process, including the overarching framework, the language adopted and tools used to assimilate the supporting evidence, and was robust enough to support the development of legally enforceable management measures.

B.5 Suffolk Marine Pioneer

The Suffolk Marine Pioneer (SMP) is one of four pioneer projects supported by Defra to inform the development and implementation of the UK's 25 Year Environment Plan. It tested the local application of the natural capital approach in the context of estuarine salt marsh in Suffolk. The approach is outlined in 'Suffolk Marine Pioneer: Policy Brief: Applying the natural capital approach in England'¹¹ (Suffolk Marine Pioneer, n.d) where it is stated their position is "unique in that the project developed around established partnerships, familiar with working in innovative and collaborative ways to address challenges faced by communities adapting and managing dynamic environments" (p.3). Figure B.1, below, is reproduced from the Policy Brief and indicates that their approach starts with a vision for a preferable state of a given environment. Next, a baseline identifies the current state, relative to the vision. An understanding of what action is necessary to bridge the gap between the baseline and the vision is then built through constructing an evidence base. The evidence base is considered critical as this identifies opportunities for environmental enhancement. The most suitable opportunities emerge through an options process, with those preferred taken forward to be implemented through the plan.

The importance of engagement is made clear in:

"the specifics of each stage of the natural capital approach will likely be informed by the people, partners and priorities at each location. A common recommendation however is the need to actively involve stakeholders early in the process, as successful place-based decision making must deliver genuine benefits for the people living and working in the area. Identifying what this means in practice, can only come from those familiar with the environment" (p.4).

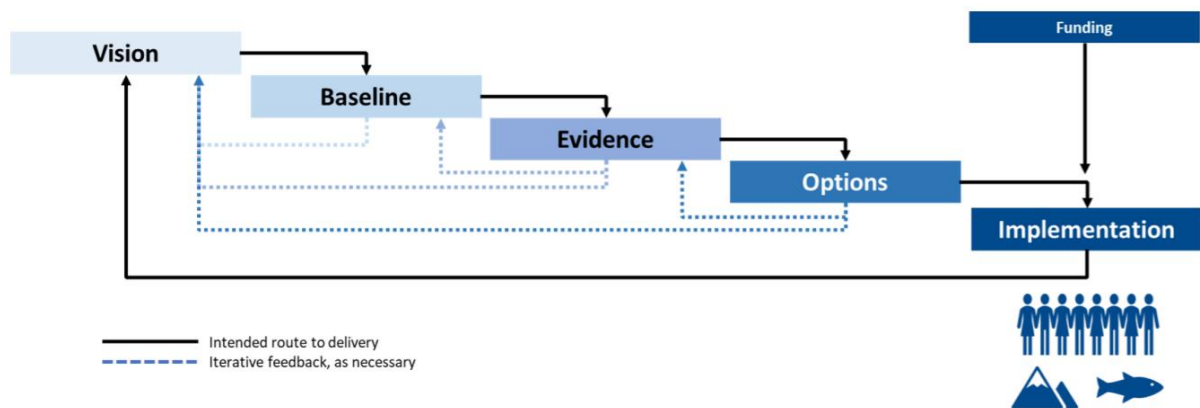


Figure B.1 Schematic of the application of the natural capital approach by Suffolk Marine Pioneer project

Source: Suffolk Marine Pioneer: Policy Brief: Applying the natural capital approach in England (n.d.)

SMP also highlight the importance of **governance**. That is,

"the natural capital approach is likely to be delivered in partnership because the natural assets informing the approach will be owned, managed or benefit multiple parties. To ensure just and fair development of the natural capital plan, early establishment of a clear and transparent governance structure is necessary. This is because people are fallible to external influences that perpetuate personal self-interest at the expense of more equitable benefit ... In any partnership, debates concerning who should benefit are inevitable, as each party seeks to preserve their interests. Governance structures must therefore mitigate any such debate in a proactive fashion to ensure objectives, role and responsibilities are well defined and agreed" (p.6).

Evidence collection involved processing publicly available data, modelling and participatory approaches. For example, a simple (and transferrable) methodology, developed by the University of Essex, based upon

¹¹ <https://www.suffolkcoastandheaths.org/wp-content/uploads/2021/01/Suffolk-Marine-Pioneer-Policy-Brief.pdf>

physical attributes of a salt marsh to determine condition was applied, which allowed the ability to quantify ecosystem services.

To bridge the gap between decision-makers understanding of the lived reality, the Pioneer took a stakeholder participatory approach. This approach allowed for a wider perspective of value to be evaluated and inform decision-making and helped to mitigate community concern that external influences would override local interest and empowered constructive dialogue around natural assets, benefits provided that can inform plan implementation. For example, SMP used ‘participatory mapping’ to engage and involve stakeholders in the evidence gathering process. Following the ‘Suffolk Marine Pioneer Participatory Mapping Policy Briefing’ (e.g. Burdon and Potts, 2020); Burdon et al., in press, “participatory mapping is a direct means of co-producing knowledge with stakeholders and communities which facilitates local spatial mapping of features, benefits and values. It can provide rich data on the distribution of natural capital features, benefits, values and trade-offs ... In the context of ecosystem services valuation, stakeholders provide local, spatially explicit information about ecosystem services and benefits, use and value (both monetary and non-monetary), negating the need to use proxy data derived from literature or modelling” (p.1). A SWOT analysis of the participatory mapping is provided in the Policy Briefing with the summary reproduced below (Figure B.2).

<p style="text-align: center;">CURRENT STRENGTHS</p> <ul style="list-style-type: none"> • Empowers local stakeholders. • Local detail scale of the approach. • Includes the full range of benefits. • Powerful communication tool. • Knowledge sharing and co-production. • Captures local knowledge. • Does not rely on existing data. 	<p style="text-align: center;">CURRENT WEAKNESSES</p> <ul style="list-style-type: none"> • Scalability to regional or national level is challenging. • Workshops are subjective. • Small sample sizes may not reflect whole community so requires mitigation. • Stakeholder fatigue requires managing. • Current system low on time and staff. • Does not weigh up or value the benefits.
<p style="text-align: center;">FUTURE OPPORTUNITIES</p> <ul style="list-style-type: none"> • Provide evidence to inform new national and place-based policy. • Designation and management of MPAs and HPMAs. • Application to the offshore environment e.g. offshore wind. • Provides spatial baseline information. • Raise awareness and communicate natural capital, climate change, net gain etc. 	<p style="text-align: center;">FUTURE THREATS</p> <ul style="list-style-type: none"> • Current lack of spatial baseline data. • Investment in people’s time if rolled out across the UK. • Challenge to inform regional and national policy from local scale. • Lack of join-up between jurisdiction and ecosystems. • Scepticism to transferring power/control to stakeholders.

Figure B.2 A SWOT analysis of a participatory mapping approach

Source: Suffolk Marine Pioneer Participatory Mapping Policy Briefing, (Burdon and Potts, 2020).

B.6 North Devon Marine Pioneer

The North Devon Marine Pioneer¹², initiated in 2016, is one of four pioneer projects supported by Defra to inform the development and implementation of the UK's 25 Year Environment Plan. It aims to explore how a specific geographical area can be best managed for the benefit of the environment, economy and people. Key objectives of this project are to: illustrate how natural capital assets are linked to ecosystem services and benefits that impact well-being; establish the direct and indirect link between stakeholders and natural capital; identify the relevant evidence base for valuing ecosystem service benefits in both monetary and non-monetary terms. Ashley et al. (2018) documents the framework adopted by the project which involved an assessment of marine natural capital, including mapping habitat extent of the accounting boundary, establishing links between natural capital assets and ecosystem service and benefit provision and identifying indicators to measure ecosystem service flows. A 'Geodatabase' was created which consolidated existing social, economic and environmental data for the area to support the work.¹³

A second document, Rees et al. (2019), reports on the application of the marine natural capital framework developed in previous work, producing a site-specific asset register and risk register, as well as identifying ecosystem service provision linked with these assets. The natural capital asset register identifies extent and condition based on best available evidence for the North Devon Marine Pioneer, as well as extent within Marine Protected Areas and specific management areas. Condition is assessed using the best available evidence on habitats and species within designated Marine Protected Areas and water body assets within the scope of the Water Framework Directive and/or Marine Strategy Framework Directive. A modelled approach is also used as a proxy indicator to reflect the condition of seabed habitats in relation to sensitivities to pressure and activities contributing to those pressures. Through this evidence, a matrix approach is used to determine ecosystem service flows. A total of six ecosystem service flows are investigated as part of the report. The risk register is developed for the North Devon Marine Pioneer building on Mace et al. (2015) to consider not only the asset-benefit relationship but also the severity of risks to the provision of ecosystem services.

It is argued that the Asset and Risk Register strengthened inshore approaches to sustainable fisheries management. It is argued that it "provided robust scientific evidence to inform Devon and Severn IFCA activities and MMO licensing decisions, providing additional leverage to promote a more holistic ecosystem-based approach to marine" (SWEEP, 2020).

Members of the project team, in direct response to stakeholder requests, also developed a framework and guidance for incorporating the natural capital approach into Sustainability Appraisal (Hooper and Austen, 2020). Sustainability Appraisal is a legal requirement for planning authorities and, therefore, this represents a mechanism for integrating the natural capital approach into local decision-making. It provides a systematic baseline of the current status and trends in assets, services and benefits, and the degree to which they are at risk. This allows for the selection of detailed sustainability objectives and indicators, and for the full implications of plan options to be assessed. The method for collecting baseline information has four core elements: the asset register in which information on the status of natural capital is compiled; the ecosystem services inventory, to list services, benefits and values; an asset-service matrix which connects services to the assets from which they are derived; and the risk register which summarises threats to continued system functioning. The team argue "Streamlined reporting within impact assessments ensures the natural capital of an area – at strategic and site levels – is properly valued and considered in planning decisions, and environmental improvement ambitions are realised" (SWEEP, 2020).

¹² <https://sweep.ac.uk/portfolios/north-devon-marine-pioneer/>

¹³ <https://sweep.ac.uk/wp-content/uploads/002-Impact-Summary.pdf>

ANNEX C RECORDS OF INTERVIEWS WITH KEY PRACTITIONERS

C.1 Simon Pickles, North & East Yorkshire Ecological Data Centre

<text to insert – awaiting confirmation of agreement from participant>

C.2 Tara Hooper, Joint Nature Conservation Committee

<text to insert – awaiting confirmation of agreement from participant>

C.3 Georgina Reid & Beth Churn, Solway Firth Partnership/Cumbria Wildlife Trust

Background

Georgina Reid is working on the development stages of the Solway Marine Natural Capital Project (Solway Coast and Marine Pilot Project, SCAMPP) – and is focussed on the Scottish side, looking at marine natural capital on the Solway Firth, and using innovative methods to help restore, expand, or reintroduce marine natural capital habitats.

CSMNCP (Cumbrian Solway Marine Natural Capital Project) is a joint venture involving the Solway Firth Partnership and the Cumbria Wildlife Trust.

Solway Firth Partnership is an independent charity. The development work has been funded through Crown Estate Scotland and South of Scotland Enterprise, and Dumfries and Galloway Council is the lead in Borderlands (the Borderlands region comprises the five local authority areas of: Carlisle City, Cumbria County, Dumfries and Galloway, Northumberland County and Scottish Borders).

The SCAMPP is currently in the development stage, but a business case is being prepared to draw down on funding from the Borderlands Inclusive Growth Deal to initiate the pilot itself hopefully within the next 12 months.

Scope – assets & services

For the Scottish side the focus is saltmarsh, native oysters (*Ostrea edulis*) and seagrass (*Zostera marina* and *Zostera noltii*) – not just because those three habitats are already present, but they also are important in terms of carbon storage (for saltmarsh and seagrass), and the local Solway native oyster bed supports the last remaining sustainable wild oyster fishery in Scotland.

There was some discussion about other potential assets (reedbeds, seaweed, honeycomb worm reef):

- Reedbed habitat considered as the (landward) sub-element of saltmarsh;
- Honeycomb worm reef (*Sabellaria alveolata*) may offer benefits but lack the same supportive research base, or the availability of potential management/conservation methods - doing anything to maintain or improve their condition is currently not feasible (short of some work by the MMO looking at colonisation of hard, artificial structures);
- Seaweed relevance to the Solway was discussed regarding harvesting, biodiversity, carbon sequestration, and the provision of subtidal habitat. Seagrass also provides these benefits (excluding harvesting), as well as providing stability to sea floor sediments, and nursery habitat for fish and benthos. There's also research on the benefits of seagrass meadows to other habitat-providing species (such as blue mussel) which in turn can deliver their own ecosystem services and benefits.

Proposal for the selection of just three principal habitats not yet tested through wider engagement with the public, but has broad informal support amongst stakeholders.

The scope of ecosystem services considered by the project on the Scottish side is largely driven by the three selected habitats, all of which have significant impacts on, for example, carbon storage – whilst it's recognised

that these habitats represent high value natural capital, and give rise to high value ecosystem services, the project doesn't currently make use of any particular framework for, or set of predefined relationships between, assets and goods/services that are delivered through them. Other (national/international) research on the value of specific habitats (especially, for example, the role of saltmarsh in carbon storage) will be used to help frame further pilot projects and to create innovative approaches and test new methodologies.

Local interest in, and a local identity founded on, oysters presents the potential to increase the benefits from ecosystem services relating to both education and tourism. There's lots feeding-in from these. Similarly, saltmarsh is becoming an increasingly-used nature-based solution especially given increasing pressures due to sea level rise, climate change, and resultant coastal flooding.

Data

A previous project, SMILE (Solway Marine Information, Learning and Environment) created a regional assessment for the Solway Firth and developed an online story map – a hub of information – through an update of the 1996 'State of the Solway Review'. This means, for example, that there is already an economic assessment analysis of both sides of the Solway Firth (established through SMILE). Topics of the Solway Review are grouped into four main chapters: clean & safe, healthy & biologically diverse, physical, and economically productive. Although intended to inform the regional marine planning process, SMILE provides a valuable source of, and repository for, information to support the SCAMPP on the Scottish side.

You need to know where you have assets, and what condition they are in, before you examine how to protect and maximise the benefits that they give rise to, or tell people about how valuable these assets are, so the SMILE project represents an excellent foundational piece of work for the SCAMPP, without which the SCAMPP would be a lot harder to progress.

Data type may vary according to its source (originating survey). For seagrass, for example, it's not just spatial location, but condition data (e.g. if it's a thin bed, its health, if it's got seeds/not got seeds) that's important; and availability of condition data can vary by source. For seagrass in the Solway data is mostly point (presence/absence). Information can be collated to a single (Google) map allowing different data sources to be viewed simultaneously.

As well as the SMILE project, the region has a number of SACs, SPAs and SSSIs and a lot of information can come from those (designation) sources.

Because SCAMPP is still in its development stages, any identified data gaps are being flagged but not filled through commissioned (targeted) research (insufficient time/resource capacity). However, a reasonably complete baseline of information is necessary to improve the project's ultimate success - to help support this, condition information is being sought and, through networking, other local initiatives augment the available baseline information through their planned summer surveys.

Data on vulnerability of the three principal habitats to local activities also important (e.g. seagrass vulnerability to bait collecting and anchoring.)

We are aware of a lot of information, but it's often difficult and time-consuming to collate.

Engagement

Engagement with the general public is limited at the development stage, focus instead has been on gathering information, and trying to decide how to go forward, be innovative, and include the public. More broadly, we have started to engage with key individuals (e.g. local botany group members) and specific people around Dumfries and Galloway, as well as people more nationally, as well as people involved in different projects across the UK.

Being an independent charity is helpful because, over many years, Solway Firth Partnership has built up a reputation and a dialogue with the public, for example: taking on community projects; administering the Robin Rigg Community Fund (funding from the Robin Rigg Wind Farm); coordinating a litter-picking project; delivering the SMILE project; delivering the Solway Coastwise project (which was about engaging people through the history of the coast through place names). All these projects have engaged with the public and formed a long-term dialogue and connection with them. Because of previous experiences, there may be predispositions or opinions held by the public toward certain organisations or people (due to ways that they've interacted with them in the past). They maybe don't realise that they already have preconceived

notions towards organisations or agencies – and it's likely to be something that is very individual to each person, but the structure of Solway Firth Partnership has been helpful in engaging with the public.

Solway Firth Partnership's core activities can be categorised across six areas: partnership, planning, environment, fisheries, energy, and awareness - projects fit into one or more of these topic areas, and all identify the importance of the environment and its associated natural assets, so the natural capital approach is already embedded in much of the Partnership's activity, without even considering it as a conscious element.

Because engagement is central to the application of the natural capital approach it's important to ensure that the value of these assets is widely understood – an issue that is especially important for 'virtual' environments that people are not able to interact with (e.g. seagrass meadows) in the same way they might see and interact with familiar physical environments such as woodlands.

Solway Firth Partnership does a lot of work to engage with as many people as possible across all of its projects; there was engagement work in the SMILE project and, even with the impacts of COVID – which hit right in the middle of SMILE – people were asked to get involved by sending in photos that showed their connection to the Solway (that work formed part of the update to the State of the Solway Review).

The Partnership hosts live webinars – e.g. the 'Coastal Conversations' series developed by Solway Firth Partnership and the Solway Coast AONB, which started during lockdown. Webinars are coordinated through Eventbrite and available via, and archived on, the Partnership's YouTube channel. Spaces for participation in the live meetings – which cover a variety of different topics - often sell out on Eventbrite; they are also streamed live on Facebook live (with people from all over the world joining to observe). This wide geographic scope of stakeholders in the Solway is perhaps a reflection of the interesting and unique nature of the Solway Firth area which is linked to the Isle of Man, Ireland, Northern Ireland, the Clyde (through their interest in Loch Ryan), England, and the rest of Scotland

Scope (2)

Beth Churn is working on the Cumbrian Solway Marine Natural Capital Project (CSMNCP), on the Cumbrian side of the Solway. This work is identifying the gaps and opportunities for marine natural capital but, in contrast to the Scottish side of the Solway, the Cumbrian coast doesn't have known (or historic) areas of key habitats. It's not apparent if that's because the habitats/features have never been present, or aren't currently present - or whether just it's not been surveyed. Consequently a lot of work is related to identifying, and then trying to find data for, key habitats and species. Natural England, at a recent workshop, has suggested creating an inventory of all the natural capital assets (habitats and species) rather than picking a few key ones as, without supporting data, it's not currently clear what the priorities are. However, suggestions from the workshop included prioritising: the restoration of saltmarsh and sand dunes, and the improvement of water quality were suggested as priorities by other stakeholders. It was noted that restoring habitats that can mitigate climate change or which support biodiversity will, in general, tend to underpin other benefits and ecosystem services.

The project is currently still in its infancy, and is very short project (November 2021 to March 2022). Solway Firth Partnership put in a bid to the Environment Agency's Championing Coastal Coordination (3Cs Fund) to conduct the complimentary work down the Cumbrian coast while the SOSE and Crown Estate Scotland funded development work was being conducted on the Scottish side, and nominating Cumbria Wildlife Trust to deliver the work. So the project is very short - about four months – but has a broad scope, so producing a full inventory of all regional species and habitats within the timeframe of the project is consequently a big challenge.

The project needs to identify what the priority assets are, and identify supporting (historical) data. Although Cumbria was one of the pilot counties for the Local Nature Recovery Strategies. Although the county didn't cover marine habitats, it did a lot of coastal work; there is a lot of coastal habitat mapping which may provide a starting point.

Sources for data have been very scattered; a lot of statutory designations means that there's lots of information from Natural England and Cumbria Wildlife Trust (especially from surveys to underpin MCZ designations for *Sabellaria* reefs), and from online mapping (Natural England Natural Capital Atlas; part of the coastal species and habitats mapping done to support the Local Nature Recovery Strategy for Cumbria).

There is also a lot of information available on the state of saltmarshes and sand dunes through the condition assessments for Cumbria's protected sites. As well as information on saltmarsh from the Environment Agency's ReMeMaRe project. Using the available information, a natural capital logic chain (using the template from Natural England's natural capital indicators project) was completed for the Cumbrian Solway's saltmarshes, to assess the state of the asset.

Although not directly relevant to the Yorkshire coast, approaches taken by the Orkneys Oceans of Value project (looking at a natural capital assessment of Orkney's waters) provides an assessment of how the ecosystem-based approach and natural capital are enshrined in marine planning from a national perspective and may be of value.

Also, the (MMO) North East Marine Plan review is incorporating marine natural capital work and may have some relevance to the Yorkshire coast.

C.4 Aisling Lannin, Marine Management Organisation

Background

Aisling is the MMO's Head of Research: discussion points raised were largely based on her work on the Marine Pioneer between 2017 and 2021 (and also the work that Defra is now doing through the natural Capital Ecosystem Assessment program), in addition to her other operational work in the MMO.

Challenges

1. Approach

The natural capital approach is just a tool that is applied in a project environment; any such tool needs to build on good groundwork in order to work, and agreement on the project's objectives is critical in providing this.

It is also important to define the project outcome at an appropriate level - the simpler the outcome that you're trying to achieve the better. For example the Marine Pioneer used the 25-year Environment Plan vision to frame its output objectives, recognising the need to restore the marine environment, and to ensure both that it's providing for current needs and its use is sustainable (in both the short- and long-term).

2. Leadership

The natural capital approach requires a multidisciplinary approach involving not only consideration of social, economic, and ecological aspects, but also drawing on network- and systems-thinking. In addition it needs collaborative input from across different perspectives, including the (statutory) government perspective, the theoretical and academic perspective, and the practical (implementation) perspective, and should involve not only representation from the people who are living it and who are involved in it, but also people who have an outside or independent perspective.

As well as the multi-layered quality that this approach produces (involving government, non-government, and citizen actors), projects should also aim to be multi-scale, with connections across the local, regional, national and international scales. The resultant network and system needs people to actively manage and service it (termed 'system health specialists' in the Pioneer Projects), and layered on top of that system is good governance.

Currently we have a range of different statutory organisations, business owners, and private individuals all making different decisions for different reasons. All of those decisions need to be networked so that they're all working towards achieving the goal of restoration and sustainability. It's recognised that this requires a huge amount of investment, facilitation, effort, but the overall focus needs to be maintained.

Using the natural capital approach requires not only ecological information but also social and economic information. This is not best served by organisations that operate in 'silos', as information needs to be linked across the disciplines. The information also needs to be linked to the governance, or decision-making, system, and should be available on an open access platform that allows all of the people engaged in the system to see, understand and analyse that information. In turn this means that you need people - data custodians - looking after the data and regularly making sure that it's optimised, fit-for-purpose, and readily analysable. A lot of ecological data currently sits within government agencies, NGOs or private organisations and, because transparency, and honesty, are really critical for people to engage with the decisions that are being made and to then make their contribution to the delivery of the vision, all of that need really needs to be open and accessible.

This was achieved on a small scale in the Pioneer work where open access mapping software was used as a repository for all of the ecological information that the academics pulled together for the project, which was based on Natural England, MMO, and JNCC information together with other information from the MCZ process, information held by the local council, information relating to designated sites, etc.

The open access approach also facilitates inter-organisational cooperation, for example where Natural England offered support a local authority to look at and analyse ecological information. Because of cuts, the local authority had lost their ecologists so, whilst they were able to undertake the sustainability appraisal, they were unable to initiate the process by deriving the ecological inputs themselves. With Natural England accessing the same data sources as the local authority, the intermediary outputs produced by Natural England could then be used by the local authority in their sustainability appraisals. In that way, Natural

England were able to apply the natural capital approach and see it effectively embedded into the local authority's sustainability work and planning.

The natural capital approach can be used as a way of supporting, or providing a better framework for, marine planning. For example, marine planning for subtidal areas hasn't ever really engaged with fisheries. Although ecologists and academics want to talk about fisheries in terms of carbon budgets, and impacts on the natural assets, etc. this isn't easily understood by the participants in the fisheries sector. However, if you start talking to them about sustainable catches for the future then you've got the right framework for using your natural capital information and your good governance decision-making system to actually deliver for fisheries. The fisheries sector can be engaged by identifying the common objective of sustainability into the future generations. By recognising that achieving such sustainability requires restoration and that, in turn, this requires dialogue on exploitation rates, on environmental protection measures, and on the transition to more sustainable methods means that, subsequently, discussions can be framed from an ecological point of view.

Investment as an opportunity

The Marine Pioneer found that it was critical to link your investment system to your natural capital framework (or, more accurately, the framework for achieving the vision). Because it expresses value, natural capital information is useful as it naturally lends itself to discussing investment (which is not always monetary) – once you start getting into the values part of a natural capital assessment, then you can begin to talk about what kind of investment you need - that investment might be in improving the state of the assets, or it might be in improving the outcome from particular shared values that society has, or it might be improving livelihoods, but all of the potential investments can be considered 'on the same page' as all parties are working towards the same vision. Understanding the investment opportunities in this way means that incentivisation programs can then be orientated so as to support restoration activities. For example, local flood defence programmes, or local authority investment in small businesses, can all be based around their ability to contribute to the central restoration ambition. NGO's have quite a lot of money to invest, and Government has green funding and natural capital funding – then, because business people can understand this investment language and innovative finance and they also signed up to the social values that they want to live by, they can also begin to invest in the same model.

It's very important that the natural capital approach doesn't become purely monetary, and that there is meaningful and genuine engagement in social capital. This favours the participatory process as an optimal approach. Also important to note the criticality of co-design, participation, co-production and co-delivery within this process, balancing across different groups and using combinations of top-down and bottom-up processes to create a decision-making process where shared values are taken into account.

The multi-scale and multi-layered system described earlier prevents what is essentially a local approach remaining local, and avoids the risk of it not getting picked up and incorporated into the bigger picture together into a bigger picture.

To support this the process shouldn't be driven from the top: it should be enabled from the top, but facilitated from the regional level and delivered from the local level. Also, it shouldn't be a static system but should be dynamic, with constant interchange between levels and with regular feedback based on evaluation (not monitoring, which is unidirectional - but evaluation, which incorporates an element of learning/review and response/adjustment).

In terms of the MMO's ambitions, the reality is that the government has said that they're interested in the natural capital approach. However, the government has not yet been fully clear about what that means and has not set it into policy. The MMO is in the business of delivering policy - that's their responsibility and they're interested in the natural capital approach. Quite a lot of MMO resource has been put into the Defra program, the natural capital ecosystem assessment, but it's not apparent that the NCA has learned the lessons from The Pioneers.

The MMO is responsible for licensing a range of marine activities, and for managing their environmental impact. Whilst EIA is used to support that process, a natural capital approach could be incorporated into EIA and may help with decision-making. The MMO's marine planning function is also considering where the approach may fit with their work and has recently considered the range of decisions that may benefit from the application of a natural capital approach. The MMO makes both statutory and regulatory decisions, whilst

other decisions are made regarding policy ambitions; different parts of the natural capital approach could fit into different areas of the MMO's work.

In terms of fisheries, the MMO doesn't currently employ the natural capital approach, and neither does it impact on our MPA management, but the people involved with MPAs understand that it should be a whole site approach. There are often issues around MPAs that arise due to perceived conflict and entrenched viewpoints whereas if all parties were working towards the same thing, we could probably get to a better point with MPAs. They don't work because we don't always have the right data and information (although sometimes that's actually more about who's analysing the data, and for what purposes, or because there is no shared ambition around restoration – the default position is often about maintaining the status quo (but the status quo often implies sites continuing in poor condition).

It's about changing behaviour and culture, and it's about connecting things up, and people don't like to be that connected - because they've got their own things they're trying to achieve – their own agendas.

It's about changing behaviour and culture, and it's about connecting things up; people don't like to be that connected - because they've got their own things they're trying to achieve, their own agendas – so we go back to a simple shared vision: we need to reorient toward restoration and come up with something collaborative where individual partners can get on with their own little bits, but also where all those little bits can be joined up.

Back to that simple vision: there is a need to reorient toward restoration and come up with something collaborative where individual partners can get on with their own little bits, but where there is also somebody who can join up all the pieces and evaluate whether the sum of those parts is achieving the whole of the objectives.

In terms of prioritising actions for the YNMP, the recommendation would be first for there to be an overarching vision, which is at a scale where it is meaningful to local people but is also big enough to fit with the national vision. There also needs to be an understanding around how all the different bits fit together.

It's been said that one of the biggest barriers to applying the natural capital approach is the availability of information. Not only important to identify what sort of information you need, and who's best to provide it, but the information has to be made publicly available and open-access, so it can be easily downloaded, analysed and used. It also needs to be linked across the social, economic, and environmental dimensions. You can't allow people to make decisions just based on just one thing, just one aspect of the system.

Natural capital information needs to be very detailed, which means that the best scale to have it at is the local scale. It would be great if we were at the stage where the data standards could be agreed for the local scale so that local data from different areas could be easily combined or amalgamated to derive regional- or national-level datasets, but we're not really in that position yet.

The OxCam Arc (Oxford-Cambridge Arc) have written a natural capital plan and they've gone into quite a high level of detail at the local authority level. Seeing their reports on their data might help with better understanding data needs and planning for its management. In terms of the Pioneer work that was done, there was not sufficient funding to cover the collection of new information so they made use of existing sources (e.g. Natural England information, Local biodiversity information, MCZ information, information held by universities) and they found the available detail was sufficient. Whilst that was in a region where there is a good concentration of data that was available through Natural England – and it is unlikely that the same would be the case for the Yorkshire coast – a strong collaborative approach to sourcing and providing initial data sets should go long way to satisfying the project's initial information needs.

The Pioneer work was set it up thinking about it from the point of view of assets and ecosystem services, and the value derived from those ecosystem services. A risk assessment then considered the pressures acting on the assets and identified the implications for ecosystem service provision (e.g. in terms of food production, recreation opportunity, etc.). This provided a simple risk assessment interface for managers who, rather than struggling to interpret the underlying ecological interactions, could base their decision-making on the potential impacts on likely impacts on ecosystem services.

That's the usefulness of the approach; rather than just pulling all the ecological information together and expecting everybody to understand and appreciate the implications of decision-making based solely on

ecology, the key 'so what?' connections are made in the background and the managers can base their decision-making on the implications.

If an environmental economist is able to attach monetary values to what's being analysed, it's then possible to talk to the treasury or the people who hold the purse strings and have discussions around returns on capital investments, and costs associated with inactivity. Similarly by talking about societal values rather than the valuation, it's possible to persuade people to change their behaviour in a given direction.

By understanding what people value about their local environment it's possible to present them with options for the future, indicating the likely benefits of certain actions (or of inactivity). This approach supports a level of collective decision-making and builds community support that could not otherwise be achieved.

The early stages of the Pioneer focused on gathering data, but subsequent system mapping suggested that large bodies of data were not, in fact, going to directly help in changing behaviours to better support environmental outcomes. System mapping (see, for example, work done by the Centre for the Evaluation of Complexity across the Nexus, SECAN; also, The University of Hull has a group of system thinkers and hosts a Centre for System Studies) has been used to produce explanations of what actually effects change, and that turns out to be much more around the softer skills of behaviour change, communication, participation, engagement, empathy - and that's where the bulk of YMNP's efforts should go.

Parallel to that, YMNP needs sound supporting data, and needs data custodians, ecologists, and economists looking after it so that the flow of information is trusted and as accurate as it can be, and is also illustrative (and not abstract) - it needs to illustrate the situation we're in to people. Part of successful delivery is political, part is philosophical, and part is psychological, and the whole needs to be multidisciplinary in its approach.

C.5 Tim Smith, NE Inshore Fisheries & Conservation Authority

Tim Smith, Environmental and Scientific Manager at North Eastern Inshore Fisheries and Conservation Authority (NEIFCA).

Rather than managing resources specifically to benefit or protect those ecosystem services that contribute to an area's natural capital accounts, or undertaking accounting exercises for natural capital, the NEIFCA's current involvement with natural capital tends to be more incidental and occurring as a consequence of their operational management of species and habitats.

For example NEIFCA has byelaws in place to protect eelgrass which will in turn have a positive benefit as regards promoting carbon sequestration. The supporting documentation for the revision of the site boundary mentions this benefit, but the primary purpose of the byelaw is to protect the species from damaging activities. That's not a management decision that has been taken in respect of natural capital, but instead is a decision that is based on the IFCA's legislative duty to protect the site.

In the case of the IFCA and its application of byelaws, the key role of natural capital is in providing additional (discriminatory) information to support the assessment of alternative options. By looking at the ecosystem services and the benefits that come from different elements of the ecosystem, and from different types of natural capital, it is possible to develop a feeling for which are more important in terms of the local stakeholders, and which are more important in terms of the local economy, and this understanding can then start to help shape how a particular byelaw might be promoted, or how the priority ordering of byelaw reviews might be adjusted.

Fish stock management is probably NEIFCA's primary areas of focus, and the fish stocks themselves are probably the main asset that NEIFCA are concerned with. Although carbon sequestration is also important, NEIFCA do not have sufficient resource to undertake specific studies to look at quantifying carbon sequestration. This is further complicated by the scale of the area that needs to be considered. Recent studies on the carbon sequestration benefits of benthic habitats in the North Sea have been published, one by Natural England and the other by the Wildlife Trusts. The difficulty of looking at marine carbon sequestration is the scale of area needs to be considered. It's not clear how significant (or meaningful) a study at the (relatively small) scale of the NEIFCA would be.

This same issue of scale also affects fish stocks, as both fin-fish and shellfish stocks that are managed by NEIFCA extend out beyond the Authority's six nautical mile boundary, leaving them to manage what is effectively only part of the overall stock.

There are no surveys that the NEIFCA can easily go out and deliver that will directly help natural capital accounting. They already apply an ecosystem approach to support their systematic review of impacts on Marine Protected Areas (MPAs), and it is also considered when they introduce management outside of MPAs as well. For example, deliberations around NEIFCA's scallop dredging byelaw consider the interaction of different gear types (mobile scallop dredges and static gear pot fisheries) with each other, and with different substrate types (sediment habitats and cobble/reef habitats). It is perhaps fortuitous that the permitted areas for each fishery can be aligned with different substrates with potting taking place over cobble/reef habitats, areas where scallop dredging would not be possible. There are questions however over the carbon sequestration value of the sediment habitats that are fished by the scallop dredges. The recent review paper by Tara Hooper that suggested byelaw review by both the Isles of Scilly and the Sussex IFCA's applied a natural capital approach – although both areas appear to be relatively 'data rich'. In contrast, the current situation in the NEIFCA is that the data isn't there to support such an approach, although there is a potential process for incorporating a natural capital approach that has already been considered. This would involve having access to habitat (asset) maps together with an assessment that provides a score or value to each of those habitats. The spatial distribution of habitats and values could then be married up to current management and the changes/revisions that are under consideration.

The NEIFCA's main focus is on the management of wild capture fisheries; generally, stakeholders in those fisheries are under constant pressure from, and losing grounds to, other activities (other marine activities, and marine developments such as wind farms). Given the current levels of fishing effort, justifying the closure

of an area outside of an MPA purely on the grounds of the protection of its habitat and its consequential value as a natural capital asset, would be a hard sell. It would need stakeholder buy-in to proceed; if they don't accept it, they would not follow the byelaws and there would be compliance and enforcement issues.

NEIFCA does have some protected areas that have been in for a lot of years; most of these are to reduce gear conflict, whilst some overlap with designated areas and important habitats that will have natural capital value as well. There have been discussions in Scotland around the three-mile inshore ban on trawling; part of the argument being promoted there is that a ban would allow the recovery of the inshore habitats and an associated increase in the levels of ecosystem services that the areas provide. On the question of whether a similar ban would benefit the NEIFCA it has been noted that the area has got very different fisheries in the north, around the Tees, where the trawl grounds are primarily beyond the three-mile mark anyway, out on the nephrops grounds. North Yorkshire is also different; a lot of the whitefish trawl grounds in North Yorkshire are within the three-mile limit (around Whitby and Runswick Bay, and a bit further down the coast). There are other fisheries going on offshore, but in general terms there's very little effort, and there doesn't seem to be any significant issue with gear conflict between trawling and static gear, so suggesting the closure of the inshore fishery on the basis of promoting natural capital purposes would be unlikely to get stakeholder buy-in. Again, it's an issue of scale; to say that the intention is to protect a small inshore habitat on the specific basis of carbon sequestration, when the area involved is almost negligible compared to the wider North Sea, would not be a strong argument.

Generally, when NEIFCA are talking about introducing a byelaw, the more stakeholders that are involved, the more difficult the process becomes, so proactively adopting a natural capital approach with the specific intention of improving buy-in and input from stakeholders is not an obvious choice of a way forwards. If it's a byelaw to restrict fishing in some way then, once there is pressure from fishermen and from the other end of the spectrum of views (for example from the nature conservation NGOs), there is a challenge to find an appropriate (and politically acceptable) balance between those two views – one looking to protect the areas and the other wishing to exploit the resource(s) there. The stronger the 'protection' voices in the room are then the more difficult the process can become. However, a natural capital approach may provide some opportunities; if, first and foremost, it can be demonstrated that there are benefits to the stock and to the economy (for example benefit associated with the higher sale price of goods from, say, a Nephrops creel fishery rather than those from a trawl fishery) then it may be possible to leverage buy-in and support from fishermen who are able to realise some of the potentially increased benefits arising from a modified fishery.

The decision-making that NEIFCA already does helps to protect and promote some aspects of natural capital. However, it's possible that the Authority could improve the way it communicates impact assessments and the evidence that supports byelaw reviews, and ensure that its current actions are (more) consistent with the natural capital approach –whilst also trying to embed some of the natural capital language into the debate, so making it more explicit and bringing it to the surface.

As noted earlier it's difficult to do a stock assessment for lobster and crab fisheries (NEIFCA's largest fisheries) when they extend beyond the district. Local stock assessments are undertaken, but they are used alongside cefas findings, with more attention tending to be given to stock trends than to absolute values. However, for other species, the Association doesn't have the information at the local level to be able to manage the stocks as a whole. Again, a lot of the white fish are managed at an international level, maybe even wider than North Sea. How can NEIFCA's management decisions influence those stocks and, by extension, how can local management promote benefits from natural capital assets such as these?

Through its use as evidence in byelaw reviews NEIFCA generates significant amounts of information, especially stock assessment data, and this needs to be managed and stored. In terms of stock data specifically this is an issue that NEIFCA has been tackling and, following a review exercise, promotes the adoption of specific forms of data and improved access to that data.

NEIFCA hold just their own data, uploading metadata to both MEDIN (Marine Environmental Data and Information Network) and Marine Recorder. Data that is stored in-house is shared with other agencies, proactively or on request. For examples NEIFCA shellfish data, derived from quayside landings data and from offshore surveys, is sent to cefas for inclusion in their stock assessments. Because NEIFCA work closely with them, Natural England will know what data NEIFCA hold so can request it when they are reviewing their

condition assessments for specific MPAs. NEIFCA could put all of its data onto MEDIN or Marine Recorder, or something like that, so that it was more easily accessible (instead of just the metadata that is currently uploaded) but that would require resources that aren't currently available and so, outside of NEIFCA, the data is just available on request. Also certain data would have to be updated as some is not currently in the right format that is required by many of these data archive centres, so there'd be an initial process to convert the data to include all the relevant fields that were needed to be uploaded. Subsequently though, once the system was in place, new data would just be recorded directly in the format needed for subsequent upload to the data centre. Any risk associated with putting data up onto a national (open access) data centre and losing the local context of that data would be minimal shouldn't prohibit it being up there because data records can be annotated to show why the survey was undertaken in a certain way. In general they will tend to employ fairly standard methods and, as long as you've got all the information associated with it (e.g. gear types, mesh size, bait used) data interpretation should be unaffected.

As regards those organisations that are collecting and using data, the current system of decentralised data storage is not exactly fit for purpose; everyone is saying the same thing: we don't know what everyone else is doing, and when we do know that they've got a survey that they've done in an area then there are issues in trying to get that data in the right format.

All natural capital data in one place sounds like a good idea, but what counts as natural capital data? The range of information that is captured in the marine environment can be so diverse, and is collected for different reasons; it's hard to see how a data repository solely for natural capital would work and wouldn't just become a duplication of wider marine data storage that is going on.

But centralising natural capital data, however it's defined, isn't necessarily the best way forwards. It's probably more a case of having a natural capital 'tag' associated with the datasets that are held by different organisations in different places. Green data storage and handling in the UK needs to be addressed as a whole, but the best way forward, at least in the interim, is probably to have some kind of natural capital tag associated with it.

JNCC is currently running its 'Stabilisation review' to look at sources of evidence that inform indicators for the UK Marine strategy, and is effectively going to come up with recommendations for a new system of data storage and handling in the UK, probably to replace marine recorder, so that a range of agencies will be able to upload and share data.

In terms of taking the natural capital approach forwards and embedding it more into NEIFCA's work public education, this is probably less about a bottom-up approach (raising public awareness of the links between different habitats and different services, harnessing public support and understanding to help drive the adoption of the approach) and more about an organisational, top-down process. More public information on the benefits or services that species or habitats provide is unlikely to influence the Authority in its decisions. The biggest barrier to its adoption is likely to be simply having a clear, top-down instruction to just pick up this approach and use it. The practitioners in the organisation also need to fully understand what they're trying to achieve. Currently there don't seem to be any clear steer on what we're trying to achieve with this approach other than large-scale overall aims and objectives. NEIFCA has targets for fish stocks that drive operational management, and clear objectives relating to protecting MPAs, habitats and species from damaging activities. Natural capital may be another thing that is going to be a hard sell in an industry that is already feeling under pressure and squeezed out.

C.6 Briony Fox, North York Moors National Park Authority

Background

Briony Fox is Director of Conservation at North York Moors National Park Authority (NYMNP); the NYMNP is the Local Planning Authority for the National Park. From a coastal perspective their remit runs to mean high-water, although they have a broader interest just from a holistic landscape and seascape conservation perspective and are interested in, and supportive of, the conservation of the area beyond the mean high-water. A lot of what happens in the terrestrial environment has an impact on what happens in the marine environment, and vice versa as well. This is particularly true for some of the Park's iconic species, such as the freshwater pearl mussel population in the River Esk which relies on salmonids to act as a host species during its larval phase. and the life cycle of salmon. With both salmon and sea trout populations forming an integral part of the overall River Esk salmonid population there is an obvious interest in the conservation and management of these two species during their marine phase.

NYMNP has a particular interest in the coast, both from a landscape conservation perspective as well as from the human perspective (including both visitors and residents). One of the challenges around the natural capital approach and ecosystem services is that, for the wider public, it's a new concept and there is a relatively limited spread of knowledge and understanding regarding its application. At the same time there's a lot going on in terms of landscape management practices, particularly on the terrestrial side; whilst there may not be as much happening on the marine side there's nevertheless a lot of jargon flying about (the biodiversity crisis; nature recovery; climate change mitigation; climate change adaptation; net-zero; new land management systems such as Environmental Land Management schemes, ELMs) and there is a risk that the public — and, to an extent, operational staff within NGOs or government agencies — may be being 'caught in the headlights' and are just waiting to see what's going to happen; which of these things that are all up in the air at the moment is going to become the main consideration and will begin to provide a focus for peoples' energy.

It's important that people don't look to, for example, the natural capital approach, as a panacea and apply the approach without considering the broader circumstances and implications. Given the way that the maintenance of 'fixed' states of designated SSSIs is currently promoted, often without consideration of their wider setting with regards to climate change or to changes in land-use pressures, it could be asked whether it remains appropriate to continue to fund the preservation of a site, and to maintain a state of stasis, when the original environmental frame of reference has shifted.

With reference to climate change there have been suggestions (both from the public and from within some professional circles) that, as kelp is able to effectively sequester carbon, we should be considering planting and 'farming' kelp forests in the North Sea — without due consideration of what the potential impact(s) might be on other marine habitats. People are thinking that there's a panacea to resolve a problem by undertaking an action, without necessarily thinking about the broader consequence of that action.

In this sense, the level of understanding amongst the general public, organisations, and agencies regarding the jargon or language being used, the incentives for change, and the different but related strands of work, is one of the big challenges. Generating a consensus of understanding and prioritising actions are both of key importance.

NYMNP undertook a natural capital assessment of all of the habitats along the River Esk from the source to the coast, looking at how private investment can support nature based solutions to enhance water quality and store carbon within the Esk valley — looking at potential opportunities for woodland or hedgerow creation, and grassland and soil management, to both enhance chemical water quality, and reduce sediment loads, and exploring those two areas with land owners to assess their appetite for being involved in a project like that, where private finance might support their farm business in return for these public goods. In effect it's where the Environmental Land Management (ELM) scheme will eventually go to. The first six months of the project were spent talking to farmers about the opportunities, and discussing the background to the work — what's meant by natural capital, nature-based solutions, and private investment. The project has approached natural capital in two stages (and a similar approach could probably be applied to the marine environment). Initially, a 'computer-generated' natural capital assessment was produced, based on satellite

imagery and other publicly available data and mapping the natural capital of Eskdale, and any areas of uncertainty where the technology might not pick up the differentiation between different types of habitat were ground-truthed. Subsequently that dataset was used to generate a model of natural capital opportunities (habitat connectivity opportunities, for example), taking into account the main constraints (such as SSSIs or sites of archaeological interest). This was then followed up with face-to-face discussions with people on the ground. This 'human aspect' often identified unforeseen barriers that would mitigate against the suggested opportunities (for example where the benefits of current land-use outstrip the benefit of improving natural capital through increased connectivity, e.g. tree planting). Equally there may be recreational or social aspects to land-use that are identified.

So there are two aspects; the academic aspect (saying this is the natural capital of the place, and this is what can be done to enhance it), and the human aspect of it (which is about emotion, history, and perception). The practical issue is how to move from the academic to the desired outcome, whilst accounting for that human aspect. How do you take those people who have an interest — the fishermen, the marine archaeologists for example — along the process to promote a natural capital assessment that is bringing in those other factors that sit alongside the strict academic calculations?

For the Esk valley project, NYMNPA undertook the initial computer-based natural capital assessment for the whole of the Esk valley and then ground-truthed about 30% to get some sense of the differences between the computer-generated information versus what might potentially be deliverable. A workshop was held, with local land-owners invited to hear the initial proposals. Each of the farmers, the land-owner or estates, were offered a natural capital map for their holding and, as well as a drop-in session at Danby village hall, one-to-one farm visits were offered to further ground-truth the mapping with them. Overall it was very resource intensive, but it was viewed as a pilot project and the intention was to end up with a model that could be rolled out to other catchments or geographical areas.

In the terrestrial conservation world, looking at nature recovery at the landscape scale is favoured more than just doing work for a particular species or for small pockets of habitat, so NYMNPA started work to draw up a conservation management plan for Bransdale in the North York Moors. This dale is mostly owned by the National Trust, but is also part-owned by an estate and by the Forestry Commission. NYMNPA wanted to initially develop a shared vision for the dale, shared across the local land-owners and tenants (farmers, shooting tenants) and then to understand what opportunities exist for interventions to promote nature recovery, before undertaking a natural capital assessment to see what assets are present and what opportunities there may be (with information being taken forward into the local nature recovery strategy).

There are grounds for suggesting that there should be a parallel process that could be applied to the coastal marine environment. Given the lack of knowledge and data available regarding marine habitats, especially on the North Yorkshire coast, such an approach would present challenges, but working to secure stakeholder buy-in from the outset, and undertaking the journey to establish a shared vision of where the partners want to get to whilst taking people along with you is a sound and constructive way forwards. How it might sit with the wider marine environment is debateable but, certainly regarding the coast, it's possible to break the environment down into defined coastal types. This has been done, finessing the coastal landscape down into different types of coastline through an updated Landscape Character Assessment (this work is soon to be released into the public domain).

The evidence base for the coastal and marine environment is not as strong as for the terrestrial environment, and NYMNPA generally collects very little data on the coast (this is likely due, at least in part, to the loss of the Heritage Coast Officer position around 2015). Whilst, across the terrestrial environment, there are regular bird of prey surveys, wading bird surveys, floristic surveys, woodland surveys, etc., there is no regular data collection on the coast. It is recognised that there are a lot of gaps in the data, but. One of the Authority's archaeologists is a specialist marine archaeologist, and he's got particular interest in wreck diving, so there is quite a good source of information on marine archaeology, but that's just fortuitous, rather than planned. Where information is required to support operational work it is usually sourced from the data centre, or from other bodies such as the Yorkshire Wildlife Trust or the RSPB.

From a land-management perspective, the pressure on land-use is changing, and so the range of subsidies and support for managing land is changing too. Landowners, farmers and other tenants may not yet be ready

for the change though; whilst they might understand what ecosystem services the land in their holding can provide and, through a natural capital assessment, can understand what land-use changes need to happen to best deliver those ecosystem services, they might not yet be ready to make the necessary changes, (sufficient) incentives for the changes might not be there, or they might not be ready emotionally to make the changes. In this context there may be a need to incentivise the move from managing land for food production (which generates a tangible income for the farmer or the land manager — it's often subsidised, but it's still income). Where's the tipping point between food production and providing those ecosystem services for the public good? An assessment may call for land to be managed quite differently; where's that tipping point between the financial incentive to manage it one way and to manage it another? Whilst they're good tools to have, they're not necessarily instantly applicable or instrumental in effecting a change in the way things are done. Sometimes there's a bit of a journey to go on with the landowner, which will encompass (amongst other things) an understanding of the implications of any proposals, who benefits, who (if anyone) loses, and the nature and value of the benefits that are realised. Ultimately it might be that actually what needs to happen is for a massive incentive program to be introduced to encourage people to do things in a different way.

As regards data storage, it would be much easier for everyone if all the data was held in one place, and that there was confidence that the data was complete and up-to-date.

In terms of its own internal priorities, NYMNPA has just released a revised management plan which makes reference to a specific objective that refers to supporting the improvement of the marine and coastal habitat (a high level objective that will be translated to more local detail through the local nature recovery strategies). In this context NYMNPA can work with the Yorkshire Marine Nature Partnership to better understand the Authority's position with respect to the range of other organisations and agencies that are involved in the coast. There is an aspiration to have more of an involvement and to support other organisations, with continued funding contributions to YMNP.

C.7 Alice Lord, Natural England

Background

Alice Lord – Natural England

The Landscape Pioneer was one of Defra's tests of the 25 Year Environment Plan. The Pioneer was specifically asked to test the natural capital approach and to look at innovative finance, working in partnerships and developing more integrated decision-making.

Work on the Landscape Pioneer and on Natural England's Upland Ecosystem Service Pilots provided the source for where much of the thinking behind the Natural Capital Evidence Handbook originated, presenting what is, in effect, Natural England's best practice for applying natural capital evidence.

The Pioneer project went through a process with the partnership to attempt to develop a strategic plan, and to identify a series of investment cases. We wanted to know whether, if a natural capital framework (a natural capital approach) was applied, could the economic value of the benefits be considered directly and so allow the identification of those more valuable benefits that would be the best to support through subsequent management and possible to develop an investment case for. As part of the experiment the project wanted to look through the lens of a natural capital framework to assess whether thinking specifically about the economic value of benefits helps to identify which benefits (and hence assets) are best to support - if you've got really high value benefits, are they — because they're producing (or have the potential to produce) a lot of value — the ones to focus on to support the building of an investment case? And how can you then discuss and deliberate this evidence with partners to decide your priorities as a group? Subsequently, can you then work out how to address any strategic issues and build an investment case?

Whilst that sounds simple in theory, in practice it was really quite hard to develop strategic investable solutions to problems because the problems were identified relative to specific places and in terms of ecosystem services. For example, if you have poor environmental quality, and the problem is mostly related to farmland, what is the strategic thing to do? To answer this the project used 'root cause analysis', which basically reiteratively asks the question, "Why?" until you get to the root problem, which is usually something such as 'society', 'how society works', 'market forces' or something similar. The issue then is that, when addressing these root causes, it's hard to do it in any way other than through public finance, or regulation (requiring more policy), or changes to governance, whereas the things that are a bit less strategic and more akin to management interventions (e.g. planting woodlands next to rivers) are actually the things that are more easily investable.

It became apparent that by taking a perspective that considered changes to governance, incentives or changes to people's capacity, in contrast to considering the on-the-ground changes to land-use or land management that were being sought, provided a good way of framing different solutions. This meant that we could think about the strategic changes needed as well as the specific on the ground changes needed to improve the environment in North Devon. For farmers or woodland managers this equated to the provision of motivations, and changes to governance to affect how partnerships work together in a place — for example with objectives based around changes in land-use or land management.

The benefits or public goods produced after an area is improved (for example where an arable area is converted to grassland) are often not delivered to clearly defined individuals, or to one specific location, but are widely dispersed making it more difficult to identify where the beneficiary funding should be drawn from (because you don't really know who's benefiting; you can't identify, for example, one company or one individual). Put another way, it can be hard to identify the specific beneficiaries who might gain from the interventions that are put in place; the interventions lead to public goods, so effectively everyone, across all organisations, benefit. That same problem may present a challenge when applying the natural capital approach to the Yorkshire coast. One exception to this was where water companies were involved, but that's because they are potentially making a saving (where water quality improvements led to reduced expenditure through water treatment costs).

In terms of investment, it's hard to identify beneficiaries that would be willing to pay, particularly in rural settings. However, one of the lessons from the Landscape Pioneer was that if you're applying a natural capital approach, and ideally applying it from the start, you need to have a wide range of stakeholders who are concerned with the supply of both the services and the benefits included or represented in your project

partnership. Through consideration of their wants or needs, you can begin to work out which elements they might want to pay for.

It's perhaps important to note though that the setting has changed since the Landscape Pioneer work. Whilst the 25-Year Environment Plan is a major driver now, the Pioneer projects were an initial exploration of the role of innovative, or green, finance. In this context the term 'blended finance' may be more appropriate as there's the recognition that you're always going to need public funding for some elements, or for initiating the more innovative projects. Such financing models are relevant today with, for example, the Local Nature Recovery Strategies being encouraged to look for blended funding.

There is explicit recognition that we are often talking about public goods, which aren't going to be captured by individual or specific stakeholders, and therefore you need a wider recognition of the need for some public funding. Indeed, the concept of public money for public goods was very much at the heart of the 25-Year Environment Plan when it was published.

Lessons learned from the Landscape Pioneer (and the other Pioneers) indicate that private investment is really difficult to source (there's a lot more risk involved for the individuals concerned; people want returns on their investments) — if you've got some public funding going in it may help to absorb some of the risk (and so make it more attractive to private investment). At the time of the Landscape Pioneer, there were also fewer demonstration projects and less progress in private investment in nature. This has now developed through a series of initiatives, so the issue may be closer to being cracked, but is still a new challenge.

In the context of the challenges that the Yorkshire coast would face, and with regard to particular approaches that were used on the Landscape Pioneer, stakeholder mapping is one approach that would be recommended. Whilst it's (inevitably) more difficult to engage with stakeholders in the 'high influence/low interest' group it's important to find the hooks to get them on-board. Whilst some organisations aren't really used to engaging with the environmental sector, the natural capital approach is helpful because it provides a bit of a lever to talk about how the environment impacts on, or influences, their work. Stakeholder mapping isn't necessarily a precondition, but it's certainly useful to do, especially at the beginning of a project, providing a review of who's in the partnership, and who the partnership works with and talks to. If nothing else, it's a useful exercise to make you think about the stakeholders that you're working with, and to provide some indication of the amount of handholding or the amount of pushing that you need to do with each of them. It's a fairly standard technique, but it has some very specific benefits; when you're working with a bunch of stakeholders and need that sort of day-to-day or week-to-week interaction with them, it's useful to know where they're sitting in the interest-influence matrix.

Another analysis that was undertaken (by the Treasury and eftec (an environmental economics consultancy)) looked at mapping where different public-sector and partner organisations actually spent their money — what habitats were being invested in, and whether the money was spent collaboratively or not. It suggested that certain areas (principally the coasts and designated sites) got more funding than others. This might be as expected (because a lot of the investment money came from agri-environment schemes (funded via the Rural Payments Agency), and from Natural England, the Environment Agency, and the Wildlife Trusts) but the amount of money that was actually spent collaboratively was very low. It was an interesting exercise that led to a more strategic understanding of what the different organisations are doing in a place and how they're working together, and indicated that designations do drive a high amount of spending.

In addition to stakeholder mapping and the spatial analysis of where (and how) money was spent, another early exercise undertaken by the Pioneer project was to establish an evidence base. This was accomplished by first setting-out what the project wanted to know, and filling in as much as possible using pre-existing data. Because a lot of the evidence that we have about the environment is qualitative and in people's heads, rather than recorded on maps and in reports a series of large tables were drawn up, with placeholders for all of the information that the project wanted to collect. The tables were split by broad habitat type (though with hindsight it may have been better to structure it by place, at least initially, and then move down through more complex levels of detail), set out to capture everything that the project wanted to know about its area and habitats, including habitat quantity, habitat quality, how much money was being spent on (being invested in) environmental management, the services that would be produced (and their trend and trajectory). Subsequently the tables were completed as far as possible based on evidence that existed in

reports and on maps, and then the project's partners and stakeholders were invited to add their own information by writing directly on the tables, recording their own evidence and the knowledge that they held in their heads. Then they went through a review phase where they went around in groups to peer-review, to discuss it and add further to it. This process built a strong evidence base which was strongly supported which had a high degree of buy-in from the stakeholders. In effect they owned the evidence base because it included their evidence.

This process was all tabular; the project also tried to use a mapping approach, but it was concluded that opportunity mapping was only really suited to relatively small scale use and, when you get to a larger scale, it becomes hard for people to provide robust information because their experience tends to be localised; they can't be expected to know everything about the wider area and so their comments tend to become more generalised. As part of this process stakeholders were also asked to provide thoughts on ecosystem services along with information about values (initially requesting qualitative valuations before considering quantitative information). One of the lessons from this exercise was that, in the beginning, the process was performed to an excessive level of detail; the project subsequently ended up not using some of the evidence that had been generated or gathered because the level of detail was too high. In hindsight it would have been better to have worked at a more strategic level, identifying what the project's priorities were and then gathering more focused evidence about those specific priorities (i.e. starting from an understanding of what the project vision and objective(s) are, and how data/information might best support their delivery).

Data collection is helpful, but at what level? A project is obviously going to want to map the geographic scope of its habitats and to understand their quality, but the Natural Capital Atlases (which map natural capital indicators at a 5 km² scale) probably provide an adequate level of evidence to start with.

At the beginning of a project mapping evidence is useful for starting a conversation with partners, and you want that evidence at a strategic level to be able to do that. Subsequently, more detailed information can be collated as required; it's a case of needing evidence at the right level for each stage of the process.

Inevitably, the evidence base is likely to be problematic (and thin) for the marine environment (at least initially) and any project will have to work with what's available; this is why qualitative evidence is so useful about understanding things such as habitat quality, as there is never going to be quantitative evidence for everything.

Ultimately it's a question of being able to engage with beneficiaries or other stakeholders and begin discussions around natural capital. The atlases could provide that for a place if the scale worked, but if the scale didn't work then an alternative data source may be required (for example with stakeholders helping to identify information and developing that evidence-base themselves).

Whilst the Landscape Pioneer recognised the importance and value of collecting the known evidence and then supplementing that by proof checking with stakeholders (and also giving them an opportunity to fill some of the gaps) the development of a data repository for this evidence was not seen as being important.

Building up an evidence-base, and understanding the state of the play, were important parts of the process, but once you move forward from that, it's more about understanding your interventions. Stakeholders didn't tend to go back to look at the initial spreadsheets in any great detail; their development was more part of the process, a framework that supported the thinking behind the project and provided a means of bringing different people together, and for testing out techniques such as financial mapping and root cause analysis and just kind of testing a few different things that we went through and bringing it all together, that was probably more important for the Pioneer.

Although, the evidence-base was important (for example in helping to identify those assets that were in poor condition — and why that was, and which services were declining or not well-provided), the project was looking for strategic solutions rather than investment opportunities per se, and used the root cause analysis exercise to identify what the problems were before considering what the strategic solutions might be. It is unlikely that the strategic problems could have been flagged directly from the evidence spreadsheet, and so it would not have been possible to have identified potential strategic solutions.

With reference to the EA Natural Capital Register and Account Tool, it mostly draws on habitat extent evidence, which means that if the objective is to understand more about the quality of ecosystems environment and the services that are provided, then it is not appropriate for this context — particularly if

aspects of the project relate to restoring natural ecosystem function. However, it can be a useful tool for communicating the potential values of the benefits provided. To understand about ecosystem function, information from Natural England's Natural Capital Indicators or Natural Capital Atlas may be more useful, along with consideration of the Natural Capital Evidence Handbook which sets out a process around how to apply a natural capital approach for strategic place-based decision-making. That may be seen as a biased view, as Natural England wrote the handbook and the evidence that's in it, but experience with both the Landscape Pioneer and the Bassenthwaite Upland Ecosystem Service Pilot suggests that these sources provide a sound starting point for consideration.

Natural capital accounting can be useful in terms of getting figures about the value of benefits, and being able, for example, to say to a partnership or community, "Look, we've got these coastal areas, these coastal habitats, providing this much of a benefit for preventing coastal flooding". Accounts can provide persuasive evidence to policy makers about strategic issues. But — when you want to get into the detail of understanding who to collaborate with, or what to do and how to best plan interventions that deliver multiple benefits — that's when you really need a strategic understanding of a place, what benefits are being provided, and what benefits people want from that place.

Finally, and with regard to looking at the built environment or the historic built environment; the Natural Capital Indicators includes indicators for cultural quality and for designated historic environment assets. It's not really possible to unpick archaeology or historic sites from the environment; they produce cultural benefits, but they're not separate to the place that they sit within. A project needs to acknowledge and consider such assets together with the wider (natural) environmental assets that are identified.

C.8 Claire Argent, Natural England

<text to insert – awaiting confirmation of agreement from participant>

C.9 Antony Firth, Historic England

Background

Antony Firth: Head of Marine Heritage Strategy, a new post in Historic England (since November 2021) responsible for coordinating Historic England activities with respect to marine heritage. Antony is a member of YMNP's executive committee and, although he is based outside of the region, he has close ties to the Yorkshire coast. As well as his interest in heritage/cultural capital, he has been working on a First World War history of U-boat attacks and shipping along the East Coast, together with some specific work on the wreck of HMS Falmouth, off Bridlington, that led to the development of a three-dimensional model of the ship itself, which continues to get hits on the Internet.

Historic England has been involved in marine heritage for coming up to 20 years, but how it carries out its activities is organised functionally so that marine colleagues sit alongside land-based colleagues doing similar projects. Other staff within Historic England work on the analytics side and have been engaged in assessing the value of the historic environment; its (public) social, economic and environmental value – although their focus is mainly land, so they haven't done an awful lot of work expressly on the coast. There's also interest in pulling together the cultural sector as a whole and following an approach, paralleling that of natural capital, looking at what DCMS (Department for Digital, Culture, Media and Sport) terms Cultural and Heritage Capital, with Historic England providing them with support.

Natural capital isn't great at capturing heritage, despite the fact that heritage can be considered fairly fundamental to the concept of capital value. None of the value that we gain from the natural environment arises without some kind of human input, and that's effectively a cultural input, although it may have a historical dimension too, so even the concept of value is itself a human construction. The way in which we place values on things is a human activity and is not a fundamental property of the system so, on all sorts of levels, natural capital is problematic. Because it's framed as value coming to society from nature, it's not very good at dealing with the interactions with between society and nature which give rise to value - so coming at it from a cultural heritage point of view, natural capital is quite flawed in that respect.

Natural capital is problematic for people in the cultural and heritage sectors, and that's reflected in some of the struggles out there being over cultural ecosystem services, which don't work brilliantly in that people have struggled to be able to put numbers (values) on them. So it seems to be an area which isn't very well developed and which, conceptually or practically, is a difficult thing to do. However, because natural capital is now deeply embedded in policy, a fairly fundamental schism is developing between nature and culture, which isn't great for dealing with people or for supporting the role of people in caring for the environment or environmental stewardship.

It's important that the natural capital approach finds some way of accommodating the fact that none of these (natural capital) values are wholly natural. The involvement and engagement of people with their environment through time is almost the definition of archaeology and is fundamental. Every time the two are split apart, opportunities are missed – whether that's opportunities to engage, or to change behaviours, or to understand what's actually going on. Anything that enables the natural capital approach to cope with the human dimension is a good thing. Unfortunately though, as the cultural and heritage sector advances this idea of cultural and heritage capital, and struggles with how the contribution of the natural environment to culture and heritage is accommodated, it threatens to reinforce the split. It's not necessarily the best way to go, but that's where we are, and we need to work with that. Irrespective however, natural capital accounting matters to Historic England because a lot of the value of the natural environment is realised through things that Historic England is responsible for there, and so inevitably feeds into operational decision-making around site management.

The natural capital approach seems to work at quite a high level of generalisation (in the way it uses landscape or habitat character) which, in a sense, is a homogenised approach (with all examples of a given habitat being considered in the same way). However, culture and heritage are never homogenised; they are always specific to place. The natural capital approach also applies an area-based methodology, with the value per unit area for a given habitat multiplied up by the area of habitat that is present. In comparison, cultural heritage tends to be very limited in area, but very intense in value, and that's not something that's captured

well by the generalised area-based natural capital approach. That may be becoming an outdated view based on the situation as it was a few years ago, but these are fundamental methodological issues in the natural capital approach which don't lend themselves to recognising the value arising out of the cultural dimension of the environment.

Cultural heritage can be important as a means of accessing value arising from the natural environment, and that's not something that's easily captured. For example, the value of sea angling might be considered as being a value that arises from the natural environment (i.e. from fish stocks) but the way in which people are getting access to that value is often through forms of cultural heritage. Sea anglers, if they're not fishing from the beach, will often make use of historic structures which are not part of the natural environment — such as harbours, piers or jetties. Consequently, how people obtain value isn't well reflected in the assessment. There is the danger that the perceived value is assumed to be coming directly from the natural environment (straight from the fish stocks that are there); there is no recognition or acknowledgement that the infrastructure needs to be maintained to enable the stocks to be accessed (for example with shipwrecks providing cover, and nursery and foraging habitats, for fish stocks that are exploited by anglers or commercial fishers).

The role of the historic environment in enabling access to, and in enabling people to realise the values of, the natural environment is important — it helps inform investment decisions and if you miss these things then you effectively miss the points at which you might get a better return. So, for example, investing in seaside infrastructure supports people gaining enormous value from walking next to the sea — looking out on and enjoying the marine environment — but unless you invest in making sure that the pier or promenade that they're walking along is safe then they're not going to be able to enjoy those benefits. There are large numbers of people that are gaining positive experiences or value from the natural environment through infrastructure (such as the jetties at Whitby, and many other places along the Yorkshire coast) and these are quite often not only heritage assets, but are actually designated heritage assets (e.g. listed or scheduled). However, although the role of the historic environment in enabling access is important, it's hard to capture a measure of that importance. This might be done, for example, through visitor numbers, or through traffic or parking surveys.

By better understanding how, through the nature and the character of a place, people gain value from the from the marine environment, it may be possible to better identify where additional investment could enable more people to gain value from the natural environment in that place. This might include investment decisions about maintenance, or it may be investment in actions relating to public engagement and events, or interpretation and the provision of information. For example, if there is a jetty, but it's currently not safe to walk on, a natural capital approach could be used to show how much value would be generated through investing in making it safe, along with signage and interpretation materials for the public.

Understanding how overall value arises through the cultural dimension in the coastal and marine environment is seriously understudied. There's not very much research or data, and it's actually very difficult to get numbers because the statistics that are available aren't framed in those terms. Surrogates may be visitor numbers or traffic volumes for example, or more detailed information (for example on the use of specific sites or 'marks' for sea angling — although data may be skewed if the more successful anglers want to keep their best locations secret. There may be some potential in looking at VMS (fishing activity) data in relation to the locations of known wrecks or other point features.

As regards cultural heritage there are also instances of more intangible aspects — for example specific fishing practices, or experiences of the seaside — the myriad different ways in which people are interacting with the coast and the sea, which is mediated through culture, and which are important. Trying to arrive at some sense of the value of such interactions is important too, but it's an underdeveloped area in many respects, both methodologically and, to some extent, conceptually.

Heritage can be tremendously evocative and, by providing a platform for engaging with the public, can act as a valuable entry point into discussions regarding site management — it presents a good way to draw people into questions and debate that perhaps might relate more to the natural environment.

There is scope for instigating research on the ecosystem services arising out of shipwrecks, and certain other structures on the coast, through their role as habitats (both individually and, potentially, as networks). Although shipwrecks in particular are hotspots for marine life, they are currently not well captured, partly because habitat characterisation systems are generally based on natural substrates and so are not able effectively characterise the 'habitat' of a shipwreck. Habitat characterisation is also based around relatively large areas, whereas shipwrecks are small but 'intense' point features, so they don't fit well in the current system.

If you were to consider a shipwreck, irrespective of its heritage (historical) interest or of any commemorative value it may have to the families of people who sailed or died on it, it provides value because of the ecosystem services that it gives rise to. In turn these arise from it simply being a complex bit of seabed habitat that provides a broad range of niches and environments. Shipwrecks act as fish aggregators and as nursery areas, and people derive services from them (for example by exploiting the fish stocks as anglers or commercial fishers, or as divers enjoying the unique nature of the wreck's physical habitats) independent of its role as a cultural object — it's just a complex bit of seabed. But if it is possible to identify the level of benefits arising from a typical shipwreck on the Yorkshire coast then there is a way of making a case for why they should be looked after, and why access to them should be maintained, whilst management is put in place to ensure that their degradation is prevented. The case of shipwrecks demonstrates that the natural capital that we observe today has, in many cases, been shaped by human interventions — both historic and current.

Many of the structures in and around Yorkshire ports and harbours are historic, even if they have been augmented and have modern additions to help protect them. Given that heritage is something that communities buy-into, and which presents a way of engaging with people over their coastal and marine natural environments, it makes sense to place heritage considerations at the core whenever public engagement type activities are being planned.

Valuation of benefits associated with the heritage aspects of tourism (which is clearly a major activity in the region) is another area that the historic environment community hasn't really got to grips with. There's quite a lot of work going on regarding the well-being value (health benefits) of the sea and so on, but that's being considered entirely in natural terms, "We're going to the seaside, and it will have a sandy beach, blue skies, and a beautiful view". In practice though there are cultural aspects to consider too, the history and heritage of the place. A visitor wouldn't necessarily separate the natural and cultural aspects but it is becoming apparent that what people gain from the coast seems to be key in understanding just what that natural capital is.

ANNEX D STAKEHOLDER SURVEY QUESTIONNAIRE - RESPONSES

D.1 Responses to online survey questionnaire

Despite reminders being sent out to stakeholders, only eight completed responses were received by the time the survey was closed on 18 March 2022.

The results from the final set of responses are presented below.

Note that, because of the low number of returns received, it was considered inappropriate to reproduce these data graphically.

D.2 Respondent affiliation

The eight respondents identified their affiliations as follows:

- EA
- East Riding of Yorkshire Council/LNP
- HEY Smile Foundation
- Hull Marine Laboratory, University of Hull
- North York Moors National Park Authority
- RSPB
- Scarborough Borough Council
- YNY LEP

NB To help preserve respondent anonymity, the ordering of this list of affiliations does not reflect the ordering of survey responses that are reproduced in the following sections of this report.

D.3 Data availability

D.3.1 Data deficiencies

Table D.1 (below) presents the distribution of responses to the questions relating to data deficiencies, and to the significance of perceived data gaps. Note that the six columns of data represent the responses specific to each of the six separate aspects of assets or ecosystem services, goods and benefits that were considered in the survey.

Table D.1 Response distribution for questions on data deficiencies, and the significance of perceived data gaps

Questions; response options	Data type					
	1.1 - Natural capital assets - habitat occurrence/location	1.2 - Natural capital assets - habitat condition	1.3 - Natural capital assets - species occurrence/location	1.4 - Natural capital assets - species condition	1.5 - Ecosystem services	1.6 - Goods/benefits
Are there deficiencies or gaps in these data types?						
Yes - major gaps/deficiencies	5	7	6	6	3	2
Yes - but only minor gaps/deficiencies	1	0	0	0	3	5
No - good sets of data are available	1	0	0	0	0	0
Don't know	1	1	2	2	2	1
<i>If there are deficiencies or gaps in these data types, how significant are they in terms of impacting our ability to apply a natural capital approach (NCA) to the Yorkshire coast?</i>						
Only minor significance, or unlikely to impact application of NCA	0	0	1	0	2	2
Moderate significance, may affect application of NCA	2	3	3	4	1	3
Highly significant and likely to prevent application of NCA	4	4	2	2	3	2
Don't know	2	1	2	2	2	1

D.3.2 Overcoming the challenge of missing data

The following bullet points give the responses that were received to the question: “**Can you comment on how the challenges posed by missing data are dealt with in other areas of marine / coastal management?**”:

- I can't comment on the marine environment but with the terrestrial environment, we have been using natural capital assessment to establish a baseline position and to identify opportunities for habitat connectivity, creation and enhancement. These opportunities are discussed with stakeholders and 'ground-truthed' to see how they fit with other priorities and we're then left with a map of potential areas for project development. We have also put in place, a number of monitoring programmes to assess how interventions achieve those opportunities. I'm sure this process could be replicated for the marine environment.
- Habitat surveys are carried out on a biannual basis as part of the Cell One Coastal Monitoring Programme. Records location, type of habitat and whether there has been change in habitat area from previous survey.
- Development of a research project database containing proposals to address specific missing data sets, priced for completion by consultants but also as projects for college/university students.
- Data mapping exercises with as key stakeholders.
- Questionnaire sent around to non-key stakeholders and community groups to obtain more information on community reserves, projects and green.
- Land within urban areas.
- Data often focusses on protected sites, more effort needs to be put on recording data of the hinterland, non-protected sites and connected land between protected areas. it is in this area where the most positive impact for wildlife can be felt, and where the natural capital figures will be most impactful.
- Identify gaps, join up with partners to capture new data (save overlap costs), and adopt new methods which allow a large landscape scale assessment within the marine environment (don't get too bogged down in the precise detail).
- Current trends, made more significant with COVID, will mean that the YC is likely to see increased tourism footfall in future. Also, with growth in remote working, more people are looking to move to our region to have a high quality of life. Both these trends need to be accounted for both positively (the economic value this will deliver to the region) and negatively (the potentially harmful impact of environments).
- One other trend that is likely to impact and needs to be accounted for is the increase in mental health issues and the opportunity of promoting the YC and all things 'blue therapy'/ nature prescribing that comes with it.
- The other contribution of the Yorkshire Coast is its strategic importance in helping the region achieve its circular, carbon-negative ambition by 2040. Without enhancing our marine and coastal eco-systems we will not achieve this ambition and we will fail on our commitment to become 'England's first carbon-negative region'. This positioning has a value in its own right as this is a key USP that will attract green investment and jobs to the region.
- From a healthcare perspective it is difficult to quantify / measure the benefits of the coastal environment to people. While recreational value may be able to be monetised, the impact of interaction with the marine environment on mental wellbeing for example can not easily be measured and quantified.
- A modelling approach can be used in the absence of field data, but this can lead to errors.
- I do not work directly in marine and coastal management, but I am aware that the extent of underwater natural assets (e.g. sea grass, kelp forests) are not sufficiently mapped and condition assessed, in order to be included in decision making.
- There is practical work by Yorkshire Wildlife Trust via their Oysterbed and Seagrass Restoration Project (Contact James.Wood@ywt.org.uk) which involved some mapping, but this is limited to the estuary as far as I am aware.

D.4 Progressing the application of a natural capital approach to the Yorkshire coast

D.4.1 Consideration of the relative importance of a range of factors in supporting NCA application of the natural capital approach to the Yorkshire coast

Table D.2 (below) presents the distribution of responses to the questions relating to the relative importance of a range of factors in supporting the natural capital approach to the Yorkshire coast. Note that the six columns of data represent the responses specific to each of the six possible factors that were initially suggested in the survey.

Table D.2 Response distribution for questions on relative importance of suggested factors in supporting the application of a natural capital approach

Question; response options	Suggested factor					
	3.1 - An agreed local framework	3.2 - Sustainable funding/grants and resources	3.3 - High-level of support from, or engagement with, local stakeholders	3.4 - Buy-in from the wider public	3.5 - Positive coordination between different agencies/public bodies	3.6 - Effective working across 'artificial' boundaries (such as local authority areas)
What is your assessment of the relative importance of each factor in supporting NCA application of the natural capital approach to the Yorkshire coast						
Not important	0	0	0	0	0	0
Very low importance	0	0	0	0	0	0
Low importance	0	0	0	0	0	0
Moderate importance	4	0	1	4	0	2
High importance	2	3	3	3	4	2
Very high importance	2	5	4	1	4	4
Don't know	0	0	0	0	0	0

D.4.2 Other factors

A number of additional factors that might affect the application of a natural capital approach to the Yorkshire coast were identified by four of the survey respondents. These factors, which are not covered in the table above, are presented below:

- Lack of standard monitoring framework - we need agreed national monitoring standards to meeting NCEA approaches, so each local area is monitoring at the same level of detail.
- Engaging the public is an important thing to do.
- We need to look at both residents and visitors. The ideal would be to create 'natural capital ambassadors' in the resident population.
- We need to define key educational messages and approaches to change public behaviour for the positive.
- Effective measures for recording health and wellbeing impacts (high importance).
- Positive working between different sectors (e.g. healthcare provision and coastal management) (high importance).
- We need to spread ideas and best practice from other areas, and introduce to our area. We need to share data and make the most of existing data by making it open (F.A.I.R principles).

In addition to the above, four respondents indicated that there were 'other barriers' that were not (fully) addressed by the suggested set of factors, but did not provide any further details.

D.5 Opportunities for embedding a natural capital approach into regional decision-making or policy development

The following bullet points give the responses that were received to the question: “**What opportunities exist for applying a natural capital approach into regional decision-making or policy development?**”:

- I think LNRS will use a Nat Cap approach to determining opportunities for nature recovery across the marine and terrestrial environments. This gives an opportunity to embed the Nat Cap assets into the fundamental understanding of the value of the place, its habitats, its species and the opportunity to enhance all of these aspects. This should underpin all policy development and decision making for coastal and marine environment.
- Opportunities exist to create habitat on new and existing coastal structures. For example, creating rockpools in rock armour at Runswick Bay. Current plans for repairing the seawall at Robin Hood's Bay includes using textured surfaces for seaweed and shellfish adhesion. Promoting habitat creation could help secure further EA funding, whilst in certain areas of the coast it could help with coastal defences (ie: saltmarsh creation, kelp forest restoration etc.).
- A local-policy equivalent of HM Treasury's 'Green Book' guidance (a standard to which local businesses and projects must be measured against, so that the local environment is fully accounted for in regional policy design and projects).
- Modify the ENCA guidance to fit the Yorkshire area, in affect it would be a regional plan for enabling a natural capital approach, being a one-stop shop for businesses, private sector, industry and the public to research and understand the natural capital value of the local area.
- It will be a big change in the way we think about the environment, but by incorporating NCA into policy development and also within planning, it will allow areas of priorities to be identified, and appropriately managed.
- So again I think it comes down to the evidence we collect, having standard approaches which can be adopted as best practice, will help the transition into this new way of thinking.
- The YNY LEP did a major study on natural capital around 2020, but this did not include marine/coast. Perhaps this needs to be repeated so that we can truly understand the value of the natural capital, ensuring its part of our future economic strategy and plans.
- With devolution, we need to be ensuring that we request and direct investment into the right things for the future of our region.

- Increased awareness of the health and wellbeing benefits of the outdoors and nature, and a national focus on Green (and Blue) Social Prescribing across the new Integrated Care System.
- Example: Yorkshire's coastal fisheries are underpinned by the primary production of seaweeds, phytoplankton, benthic microalgae and seagrasses. We do not know which of these are important in supplying organic material to the food chain, and therefore their contribution to natural capital. Without this knowledge, coastal management is not easy.
- Creating/restoring habitat as part of carbon sequestration projects. Accreditation schemes would need to be set up, but for example, CEH are currently exploring a national saltmarsh carbon code via a pilot in the Humber Estuary.
- Mapping would need to be required to understand the scale of habitat potential along the Yorkshire Coast.

D.6 Areas of potential coordination/cooperation

The following lists of bullet points present the suggested combinations of groups and organisations that could potentially work together within different (specified) stakeholder typologies.

D.6.1 Strategy and policy makers

- Defra - EA/NE, Local Authorities
- Existing coastal forums
- (Don't know enough about this area)
- DEFRA, MMO
- (?)
- NHS England; DEFRA; Natural England; Humber Coast and Vale Health and Care Partnership
- (n/a)
- Local Councils, LNPs, Yorkshire Marine Nature Partnership, LEPs, Public Health Teams, Defra Family

D.6.2 Research and education

- Universities - Hull, York, Leeds, Durham, the FSC
- Local universities and conservation charities
- NE, RSPB, WT, YMNP
- Local universities
- Richard Adams, Education Manager at Anglo American
- Universities; Healthcare Providers; VCSE groups
- researchers coordinate with fishers and offshore wind on productivity studies
- MMO, NEIFCA, YMNP, Defra Family, University of Hull

D.6.3 Fisheries

- (I don't know)
- Local fishing industry groups and council harbour masters
- IFCA, NE, RSPB, DEFRA, WT
- Local IFCAS
- (?)
- NGO's
- na
- NEIFCA

D.6.4 Conservation

- NYMNP, YWT, MCS, YW, IDB, RSPB
- Environment Agency, local conservation charities, local councils
- RSPB, Natural England, Wildlife Trust, National Trust, Game keepers Association, WWT
- Environment Agency, Natural England, JNCC
- (?)
- Healthcare providers; NGOs and VCSE groups; Natural England
- (n/a)
- LNPs, YMNP, Defra Family, Coastal CaBa Partnership

D.6.5 Heritage and culture

- HE, NYMNP
- Historic England, NGOs such as the National Trust, Planning authorities
- don't know enough about this area
- National Trust
- (?)
- NGOs and VCSE groups;
- (na)
- Unknown

D.6.6 Community engagement

- Yorkshire First, Parish Councils, Schools
- Conservation charities
- Humber Coast and Vale, East Riding Council, town councils,
- local partnerships, wildlife trusts
- CAVCA
- Healthcare providers; NGOs and VCSE groups; Natural England
- (na)
- Local Authorities, NGOs (potentially via environmental partnerships named above)

One respondent commented that another important stakeholder typology might be for organisations associated with aspects of economics, and that such a typology might usefully include: the Yorkshire Coast BID, and the LEP.

D.7 Other UK examples of natural capital applications

One respondent suggested examples of the application of a natural capital approach from another area of the UK:

- North Devon Marine pioneer

D.8 Next steps

The following bullet points give the suggested next steps as identified by the eight respondents:

- Secure funding to undertake a natural capital mapping exercise (and implement);
Compare with existing data - fill in gaps;
Identify opportunities to enhance natural capital;
Consult with stakeholders;
Devise a natural capital action plan;
Secure funding, implement and monitor.
- Unsure.
- Identify key stakeholders with knowledge across a variety of sectors, list those stakeholders then begin consultation;
Stakeholder engagement;
Data collection;
 - These three actions are linked and are completely essential for building a NC framework for the Yorkshire Coast;
 - Community engagement, raising awareness and policy review are then secondary outputs after the initial plan has been developed.
- Talk to other organisations/stakeholders to ensure joined up thinking, many organisations have NC teams being set up, so drawing together this information will be important, and save overlap (HIGH IMPORTANCE);
Engage local communities (this will be a long term approach, so need to start now, to get people thinking differently) (MEDIUM IMPORTANCE);
Identify data gaps - again speaking to different organisations to establish a map of gaps, so these can be filled (HIGH IMPORTANCE).
- Work with the LEP and partners to find funding to do a marine and coast focused Natural Capital Study;
Ensure that any work on this is fed through to the LEP so it can be included within the economic planning for the region, with LGR and devolution in train.
- Data collection on health and wellbeing activities occurring in coastal environments (HIGH IMPORTANCE);
Data collection on who is accessing the coast for health and wellbeing (HIGH IMPORTANCE);
Data collection on accessibility of coastal environments - (HIGH IMPORTANCE);
Raising community awareness of health and wellbeing aspects of the coast (HIGH IMPORTANCE);
Stakeholder engagement to understand reasons people access the coast or not (HIGH IMPORTANCE).
- Increase data collection on all aspects of blue carbon, as this is key to understanding energy flows in the Yorkshire coastal system (high) Building skills and knowledge - sharing techniques, skills, human resources and data is HIGH IMPORTANCE. We have too few resources between us in this area e.g. no local research vessel, lack of a coastal marine station.
- Data collection on potential change in natural capital seems high priority. How much do we have now, what is it, and what could it become?
 - This can obviously be challenging due to cost if majority is offshore, but it could be a good way to create new relationships with organisations or voluntary groups who have the skills but would not be aware of this work, e.g. SCUBA diving societies.