A Natural Capital Account for the Tees Valley:

An exploration of natural capital accounting for County and City Regions

Executive Summary

September 2021

NATURAL ENGLAND

Introduction

This report is a Natural Capital Account for the Tees Valley. It follows the innovative approach to Natural Capital Accounting (NCA) we developed for our National Nature Reserves (NNRs). We have built on our ground-breaking Natural Capital Indicators as well as the mapping of the indicators in National and City/County scale Natural Capital Atlases. The report explores the extent to which it is possible to develop an approach that can be replicated across other areas and how local planning can be informed by NCAs and Natural Capital Atlases.
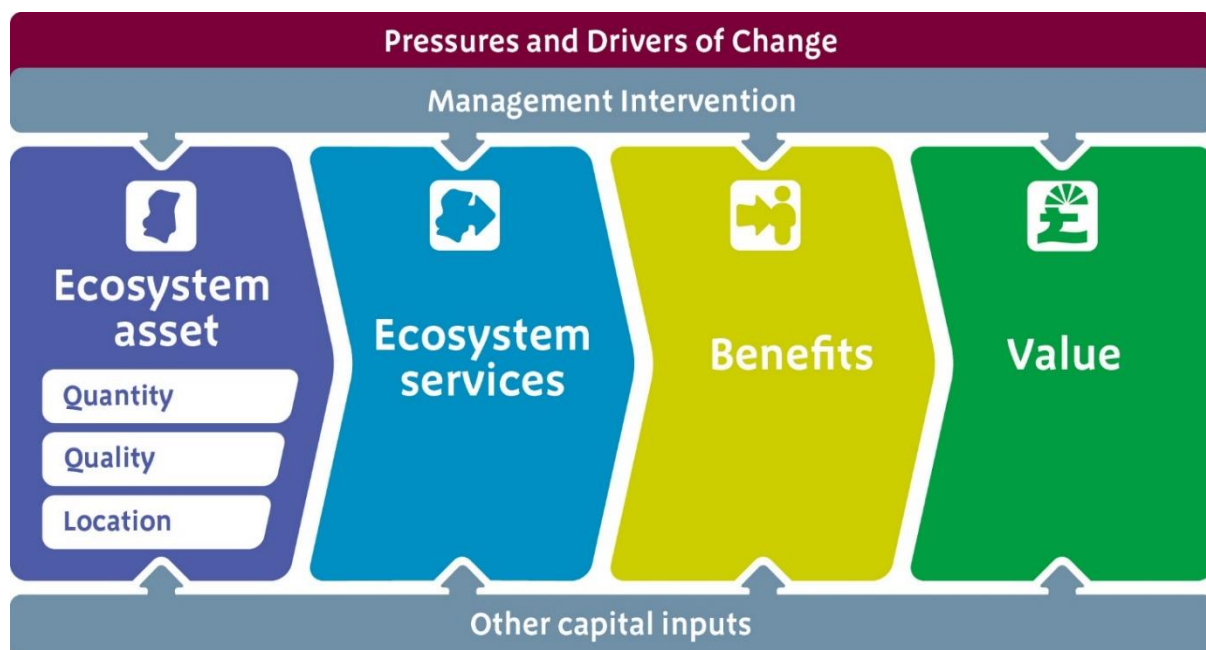
Natural capital

The natural environment provides a wide range of benefits to people. These include food, water, flood alleviation, thriving wildlife and places to enjoy. The Natural Capital Committee (NCC) has defined natural capital as "the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions".

Logic chains to aid the understanding of natural capital

A natural capital approach sees the natural environment as a stock of assets. These assets enable a flow of ecosystem services to people, who benefit from them, and therefore value them. Figure 1 shows this flow of services from natural capital assets to people as well as illustrating the factors which influence this flow of services.

Figure 1 Natural Capital Logic Chain

Natural Capital Accounts

Natural Capital Accounts (NCAs) are a way of organising information about natural capital to inform decision making. NCAs extend traditional accounts by putting economic values on benefits that are not provided through the market. In time they may perform a similar role to traditional accounts by becoming part of an organisation's external accountability and supporting internal decision-making. They also have an important role in communicating environmental benefits and the state of natural assets.

Our natural capital accounting method

We have developed an extended balance sheet to report on the quantity and quality of the assets, the ecosystem services, benefits and values alongside each other. Asset quality has been estimated using indicators mapped in our Natural Capital Atlases wherever possible. Our Natural Capital Atlases use natural capital indicators to explore the distribution and condition of natural assets both nationally and at County/City scale. Data sets have been used that describe aspects of hydrology, soils, nutrient and chemical status, vegetation, species composition and cultural benefits, as recommended in Natural England's Natural Capital Indicators Report.

Benefits and values have been estimated using only publicly available, national datasets. Where quantified data is missing, we have estimated the significance of ecosystem service provision and benefits qualitatively using the expert judgement of a small number of Tees Valley stakeholders. Definitions of significance ratings are shown in Table 1. We did this to reduce the risk of partial valuation being misinterpreted, for example incorrectly assuming that ecosystem services or benefits we could not quantify are insignificant, and to present a more complete picture to decision-makers.

Table 1 Significance ratings

Significance		The ecosystem service provides socioeconomic benefits that are…
0	None	Very low/minor or absent
1	Low	Relatively low across the selected area
2	Medium	'Medium' across the selected area
3	High	High across the selected area

To provide further transparency we use confidence levels (shown as a Red – Amber – Green traffic light rating) to indicate the quality and appropriateness of the information behind the value figures, as shown in Table 2.

Table 2 Key to confidence intervals

Definition	Colour	
We may have used some assumptions or estimation but consider these figures uncontroversial.	Green	●
We have used some assumptions or estimation and some of these may be open to question. Accuracy is better than + or -50%.	Amber	●
We are confident that the number is in the right order of magnitude. Order of magnitude implies that for an estimate of 5 that we are confident that the real figure is within the range 0.5 to 50.	Red	●
We can't offer a number which is likely to be in the right order of magnitude.	No number	

A Natural Capital Account for the Tees Valley

Tees Valley

This Account covers all natural capital, regardless of ownership, within the boundary covered by the Tees Valley Combined Authority (TVCA). The Tees Valley is an urban area in the North-East region of England consisting of five unitary authorities: Darlington, Hartlepool, Middlesbrough, Redcar and Cleveland, and Stockton-on-Tees. The region covers a population of approximately 650,000 people.

The TVCA describes the natural capital of Tees Valley as "a unique mix of natural assets, which have shaped the development and growth of our area for generations. These include: RSPB Saltholme; Roseberry Topping; Saltburn (surfing); Tees Barrage; Greatham Creek (seal watching); as well as various parks and Nature Reserves. The River Tees and expansive coastlines are also defining features in the region, providing the backdrop for significant industrial, community and visitor sites."

The Tees Valley extends over 75,000 hectares (ha), of which about 75% of this land is not covered by urban areas. Broad habitat types have been estimated and mapped using 2015 Land Cover Maps produced by the Centre for Ecology and Hydrology (CEH), as shown in Table 3 and Figure 2.

Table 3 Habitat extent by National Ecosystem Assessment Broad Habitats across Tees Valley

National Ecosystem Assessment Broad Habitat (NEA-BH)	Area across Tees Valley (ha)	% of Total
Enclosed farmland	44,461	59
Urban	20,597	27
Woodlands	4,789	6
Marine	2,013	3
Semi-natural grassland	1,409	2
Coastal margins	859	1
Open water, wetlands and floodplains	731	1
Mountains, moorlands, heaths	260	0
Total	**75,119**	**100**

The LCM2015 dataset only covers a limited proportion of the UK marine area. Alternatively, the Tees Valley Natural Capital Atlas maps marine habitats up to 12 nautical miles from the coastline. Using this definition, the extent of marine habitat is much more extensive than shown in Table 3, about 72,500 ha.

As shown in Table 3 the main land cover types are enclosed farmland (44,500 ha), urban (20,600 ha) and woodland (4,800 ha). Figure 2 shows how these broad habitats are distributed across the Tees Valley. Urban areas are particularly focused around the Tees Estuary and River Tees. Enclosed farmland is spread across the rest of the Tees Valley. Woodland is particularly predominant to the east of the Tees Valley in Redcar and Cleveland. Although only covering a small total area, there is an important area of mountains, moorlands and heaths found in the south east where the North York Moors crosses the boundary of Redcar and Cleveland.

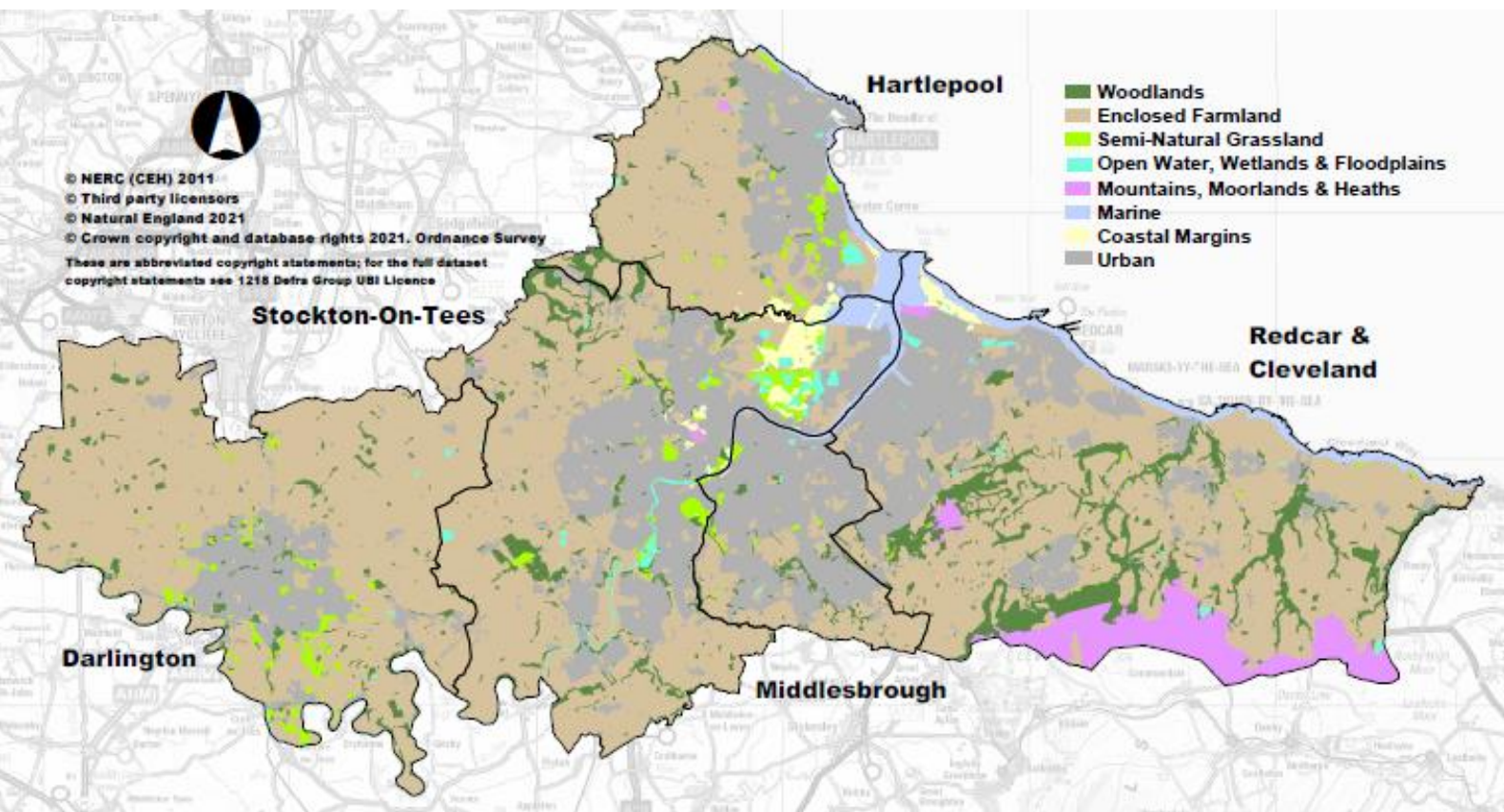**Figure 2** Map of the Tees Valley by Broad Habitat

Table 4 Headline Results

Ecosystem asset	Ecosystem services

Ecosystem asset

Natural capital asset baseline		
Asset Attribute	**Indicator**	**Value**
Extent	Total area (ha)	75,000
Hydrology	Ground water quantity status (% good) Water Framework Directive (WFD)	69%
	Hydrological status (% good) WFD	19%
	Bathing water quality (% good)	100%
Nutrient/ Chemical status	Surface water quality status (% good) WFD	37%
Soil/ sediment processes	Mean Estimates of Soil Organic Carbon in Topsoil, 0-15cm depth (tonnes per ha)	52.7
	Soil invertebrate abundance, mean estimates of total abundance in topsoil (0–8cm depth soil core)	40.0
Species Composition		
Vegetation	Nectar plant diversity, mean estimates of number of nectar plant species for bees (per 2×2m plot)	4.2
Cultural	% area of Sites of Special Scientific Interest in favourable condition	51%
	Public rights of way (km/ha)	0.012
	Area of designated historic environment assets (ha)	535
	Scheduled monuments at risk (ha)	148

Ecosystem services

Ecosystem service (common name)	**Indicator**	**Quantity** where available
Timber and other materials	Sales of wood and wood products (tonnes/year)	
Fish, marine products & game	Fish and marine products landed (tonnes)	1,500
Livestock	*Number of cattle, sheep and pigs*	*130,000*
Crops	*Cropped area (ha)*	*21,000*
Water supply	Quantity abstracted for public water supply	
Clean water		
Clean air	*Annual mean concentration of $PM_{2.5}$ at AURN network monitors ($\mu g/m^3$)*	*7-10*
Pollution regulation	PM2.5 removed by woodland (tonnes/year)	28
Erosion control		
Flood protection		
Pollination		
Pest and disease control		
Thriving wildlife		
Climate regulation	Carbon sequestration, t CO_2 equiv/yr Emission (arable & horticulture) Sequestration (other habitats)	(~157,000) ~84,000
Cultural – Experiential and physical use	Number of recreational visits (million/year)	25
Cultural appreciation of nature		
Cultural – Scientific and educational use		

Notes:
Gaps are shown as greyed out boxes where data was not available to measure an attribute.
Indicators in *italics* are best available proxies for services. Values in red are negative
Significance ratings based on exploratory exercise conducted with a small group of Tees Valley stakeholders.
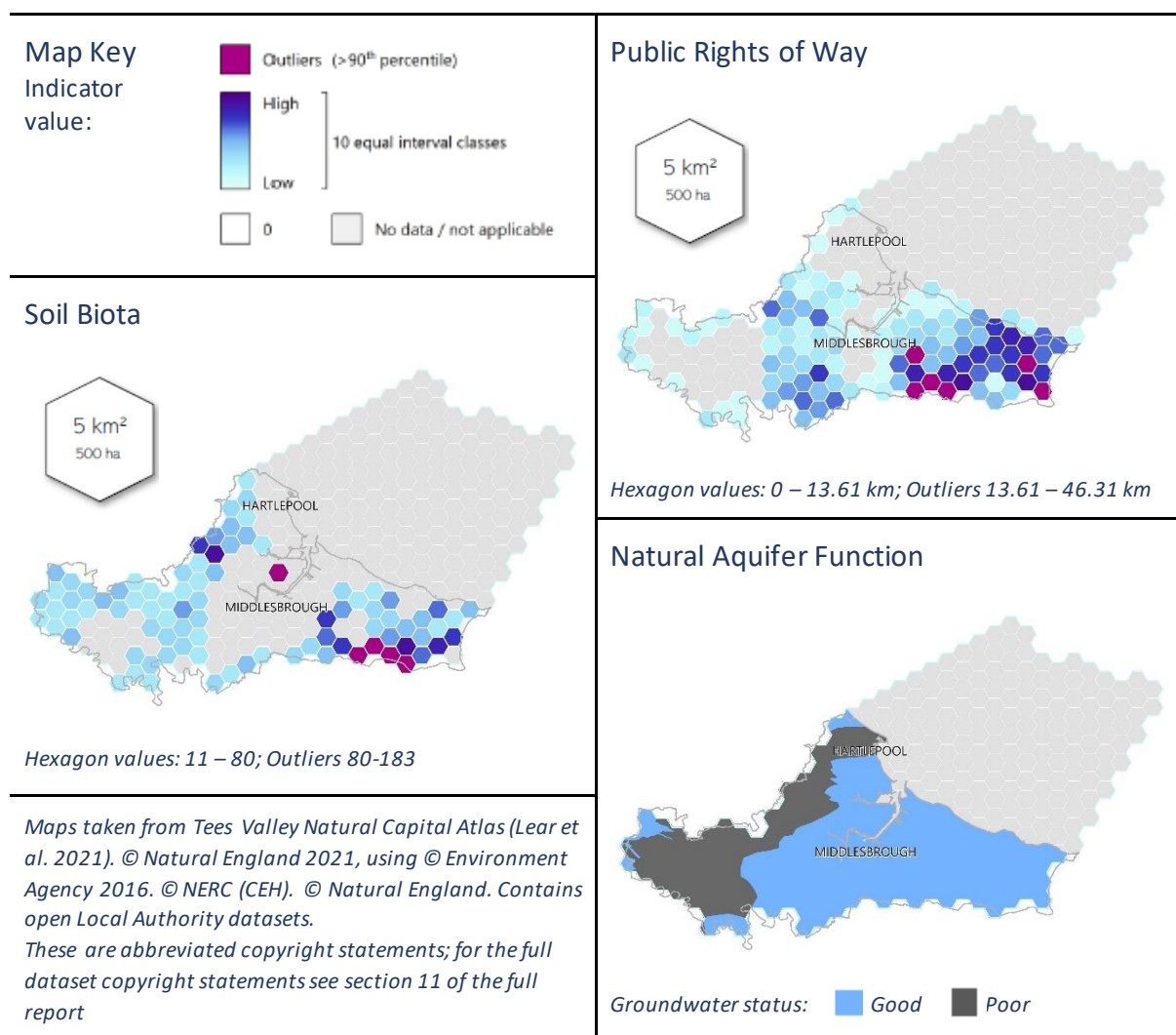Confidence in values: Red is low, Amber is medium, Green is high

6

A Natural Capital Account for the Tees Valley

Benefit	Significance (1 small to 3 large)	Indicator	Annual benefit	Asset value	Confidence in the values
Timber, hay and other materials	1	Timber and wood products, stumpage value			
Food	1	Net income from fisheries	£360,000	£11 million	🟡
	1	Resource rent from crop and livestock production	~ £0	~ £0	🔴
Clean and plentiful water	3	Value of water abstraction			
Clean air	3	Health benefits from PM2.5 removal	£8 million	£235 million	🟡
Protection from floods and other hazards	3	Value of flood protection benefits provided by natural capital			
Pollination and pest control	1	Value of pollination and pest and disease control			
Biodiversity	2				
Equable climate	3	Social cost of carbon emission (natural capital)	(£5 million)	(£395 million)	🔴
Cultural wellbeing	3	Social benefit of recreational visits (parks, beaches & paths)	£100 million	£3.0 billion	🔴
	3	Physical and mental health and other benefits			

Total quantified monetary benefits			£103 million	£2.8 billion	
Significance of unquantified monetary benefits			Very large		

A Natural Capital Account for the Tees Valley

Asset quality

Asset quality is described, on the left-hand side of the extended balance sheet (Table 4), using the approach developed for National Nature Reserves. Asset quality indicators have been chosen as a set of indicators that represent the state of the environment across a range of functions (e.g. hydrology, species composition), using nationally available and accessible data. Where possible these are based on the indicators mapped in the City/County Natural Capital Atlases. Atlas indicators have been supplemented with additional publicly available datasets where necessary.

The asset quality indicators included in the extended balance sheet provide both an indication of the ecological quality of natural capital assets in the Tees Valley and a baseline assessment against which changes in quality and extent of the natural capital assets could potentially be measured at a future date, where data are appropriate for doing so. Figure 3 shows examples of the Tees Valley maps for soil biota, Public Rights of Way and natural aquifer function. The maps show how the Tees Valley compares with the rest of the country and how the extent and condition of natural assets varies across the Tees Valley.

Figure 3 Asset quality indicators – Examples from the Tees Valley Natural Capital Atlas

Map Key
Indicator value:
- Outliers (>90th percentile)
- High
- 10 equal interval classes
- Low
- 0
- No data / not applicable

Soil Biota

5 km²
500 ha

Hexagon values: 11 – 80; Outliers 80-183

Maps taken from Tees Valley Natural Capital Atlas (Lear et al. 2021). © Natural England 2021, using © Environment Agency 2016. © NERC (CEH). © Natural England. Contains open Local Authority datasets.
These are abbreviated copyright statements; for the full dataset copyright statements see section 11 of the full report

Public Rights of Way

5 km²
500 ha

Hexagon values: 0 – 13.61 km; Outliers 13.61 – 46.31 km

Natural Aquifer Function

Groundwater status: Good Poor

Services

The ecosystem assets of the Tees Valley deliver a wide range of ecosystem services. Provisioning services include production of timber and wood products, fish and marine products harvested from the sea, crop and livestock production and provision of fresh water. Regulating services include climate regulation, water quality, flood protection and improvement of air quality via removal of particulates by vegetation. Cultural services include experiential, physical use, scientific and educational use and cultural appreciation of nature.

Walkers at Guisborough Forest. © Tees Valley Combined Authority/Enjoy Tees Valley

The quantity, quality and location of assets influence this ecosystem service delivery, as does management and external pressures. We can quantify only a proportion of these ecosystem services. Where we can quantify the ecosystem services we do so based on a combination of evidence and assumptions. For example, the number of recreational visits is based on a tool that predicts visits using a national data set, rather than detailed local measurements. Similarly, there is no public data set that provides an overview of crop or timber production at local authority level, so we have used indicators of asset quantity as a proxy for the ecosystem service for some services, for example cropped area rather than crop production.

Additionally, there are many important ecosystem services which we are unable to quantify. To give one example, land maintained as woodland can hold and slow down water, potentially reducing flooding downstream, but there is no national data set or tool that would enable us to estimate the scale of this effect for the Tees Valley without detailed modelling. Despite their importance, services that are often omitted from NCAs are regulating and cultural services such as flood mitigation, thriving wildlife and natural beauty.

Value and Significance of Benefits

Society values natural capital for the enjoyment people gain from the benefits it provides. Where possible we have estimated their monetary value. Where quantified data is missing, we have estimated the significance of ecosystem service provision and benefits qualitatively using the judgement of local stakeholders. We did this to reduce the risk of partial valuation being misinterpreted and to present a more complete picture to decision-makers.

Overall, we estimate the monetary value of quantifiable benefits from natural capital in the Tees Valley to be in excess of £100 million per year with a natural capital asset value of about £3 billion. As explained above, there are benefits of 'very large' significance that we have not been able to value in monetary terms and suggest that, based on the level of significance placed on these non-monetised benefits, these are likely greater than the quantified values.

From Saltburn towards the River Tees Estuary. © Steve Walker (CC BY-ND 2.0)

The majority of benefits which we could value were from recreation, which were estimated as being of the order of £100 million per year. The next most significant were the health benefits associated with improved air quality, at about £8 million per year. We also estimate small benefits associated with fisheries, crops and livestock.

Additionally, we quantify the contribution natural capital assets make to sequestering carbon. Focussing only on those habitats that sequester carbon, we estimate a benefit of about £5.7 million per year. However, these benefits are outweighed by the emissions from arable and horticultural habitats. Overall, we estimate that net carbon emissions from natural capital assets in the Tees Valley have an annual social cost of around £5 million. The unit cost of carbon emissions represents the cost of other measures to remove the equivalent amount of carbon at that point in time. It is therefore scheduled to rise sharply over the next 50 years. If emissions remain at current levels the annual cost of these emissions would reach £26 million in 2075.

Benefits that we cannot value in monetary terms provide large additional benefits and some are highly significant. Those identified as most significant were water abstraction, flood protection, biodiversity, and physical and mental health. Other non-monetised benefits include timber, pollination services and other cultural benefits that people gain from nature, such as scientific and educational opportunities and cultural appreciation. The £103 million per year figure represents only those services that can be valued in monetary terms, not those that are most important. It is therefore a significant under-estimate of the true value of natural capital across the Tees Valley.

Discussion and Conclusions

The results show the importance of natural capital in the Tees Valley, delivering annual benefits in excess of £100 million through recreation opportunities, improved air quality, thriving wildlife, water supply and flood mitigation. The significance that local stakeholders placed on benefits we could not monetise, shows the partiality of our value and that non-monetised benefits are likely greater than those we have quantified.

The presentation of information on assets, services, benefits and values together seeks to avoid this problem of partial accounts that occurs in natural capital accounting. We believe this approach is appropriate to inform strategic decision-making about natural capital assets. It is particularly appropriate for organisations who are concerned about the state of natural assets and the long-term provision of public goods. It is therefore particularly relevant to public bodies and charities, but also private sector organisations with a commitment to corporate responsibility.

Building the accounts on key attributes of the natural capital stock itself, enables us to understand how the state of our natural capital is changing, and can act as an early warning system for future changes in the provision of ecosystem services, benefits and values. This can be particularly useful when repeated over time such that changes are identified. This account, together with the Tees Valley Natural Capital Atlas provide an extensive baseline against which future assessments, of ecological asset quality, ecosystem service delivery and benefits, can be compared.

Where possible we include a comparison of the Tees Valley asset quality indicators with national estimates to provide context for the figures. However, we have not explored why differences exist so we do not comment on whether the assets are in good condition or otherwise. Nonetheless, this information combined with the national and Tees Valley Natural Capital Atlases, which both provide mapped representations that help demonstrate how natural capital across the Tees Valley compares with other areas, provide a good starting point for further consideration of this.

The Account provides evidence on total benefits across the Tees Valley. It does not assess how they vary within the region. Using the Account alongside the Tees Valley Natural Capital Atlas, provides not only estimates of overall quality and value of natural assets but also a representation of the distribution and condition of natural capital assets across the area.

Our approach was exploratory, with the objective of using Natural Capital Atlas indicators and supplementing this only with publicly available data and methodologies that could be used and replicated in other areas. This approach has shown the difficulty of producing an account in this way, with a limited number of relevant, spatially disaggregated, national datasets and models for services and benefits. There are huge opportunities for further data collection and modelling to fill gaps and improve the Tees Valley account, such as around timber production, flood mitigation and water supply. However, the complexity of the environment means that natural capital accounts will always be partial and it is important that this is recognised. A further improvement would be to incorporate costs of maintaining natural capital and how these are distributed across different sectors.

As noted above, this Account provides a baseline against which future assessments could be compared. However, most of the datasets used are not updated on an annual basis. This suggests that annual accounts would not be appropriate as they will not pick up on change. A more useful objective would be to increase the extent of services that have been estimated and valued, as recommended above, before considering whether to repeat the study.

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