



Accounting for National Nature Reserves:

A Natural Capital Account of
the National Nature Reserves
managed by Natural England

December 2018

Executive Summary





Moor House – Upper Teesdale NNR © Natural England / Allan Drewitt

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Forward

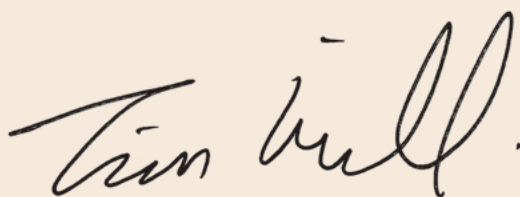
England's National Nature Reserves (NNRs) are the crown jewels of our natural heritage. They are some of our most important sites for wildlife and geology in England. They conserve biodiversity and geodiversity, and provide 'outdoor laboratories' for research. They provide opportunities to access, enjoy and engage with our natural heritage. They also provide a much wider range of benefits to society. This makes the NNRs important natural capital assets. We need to understand them to ensure they are resilient, because we want them to continue to provide benefits for generations to come.



In this report, we have developed an innovative approach to Natural Capital Accounting (NCA). Our new approach documents the full range of benefits that the NNRs provide. We have built on our ground-breaking Natural Capital Indicators report and sought to understand:

- the state of our assets;
- what ecosystem services they provide;
- what the benefits are,
- and the economic value of the benefits.

Importantly we report across all these components, side by side. This is to inform comprehensive decision-making and avoid the recognised pitfalls of partial accounts. I believe that these accounts demonstrate not only how important NNRs are, but also how a more inclusive approach to NCA is essential if we are to invest in, and manage, our natural capital assets for the full suite of benefits that they offer.



Tim Hill,
Chief Scientist, Natural England





Juniper Gill, Ingleborough NNR © Natural England/Neil Pike

Introduction

This report is a Natural Capital Account for the National Nature Reserves (NNRs). NNRs protect some of England's most important habitats, species and geology. They embody our natural diversity, from multi-layered geology to ferny woodlands, ancient grasslands and heaths, wetlands, moorlands and wild coasts. They also support research, education and recreation. They cover approximately 0.7% of England's land surface.

We have taken an innovative approach to Natural Capital Accounting (NCA). We've used an extended balance sheet, which displays the state of our assets, services, benefits and their economic value next to each other. Our account is grounded in the ecological evidence. We've highlighted evidence gaps and given confidence levels to indicate uncertainties in the results. This is all essential to support transparent decision-making.



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”.

The concept of natural capital is broad. It includes the living and non-living parts of nature, and the systems they make up. These systems sustain life on Earth. If properly managed, natural capital can provide benefits indefinitely. Some benefits of natural capital can be measured and valued, but many are difficult to define and quantify. These are therefore often invisible in decision making. This can result in natural capital being inadvertently degraded or destroyed. The solution is therefore to include information about the benefits of natural capital in decision making. Our ability to do this is improving rapidly, but is still a developing area.



Natural Capital frames the environment as a productive asset, in order to include it in economic decision-making. So it asks the same questions about land that we might ask about machinery — such as a tractor. For example:

- What benefits does it provide?
- For how long?
- How well?
- What state is the asset in?
- What maintenance and investment is required?

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: Natural England Natural Capital Logic Chain

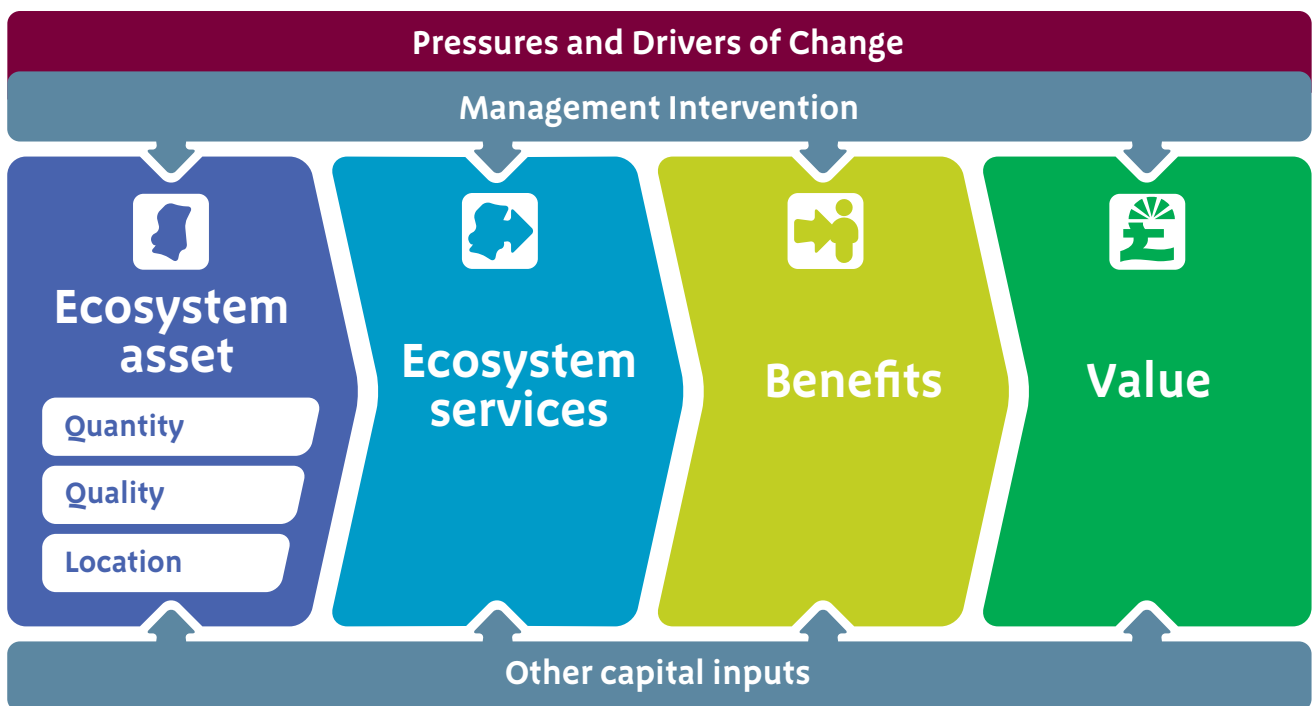


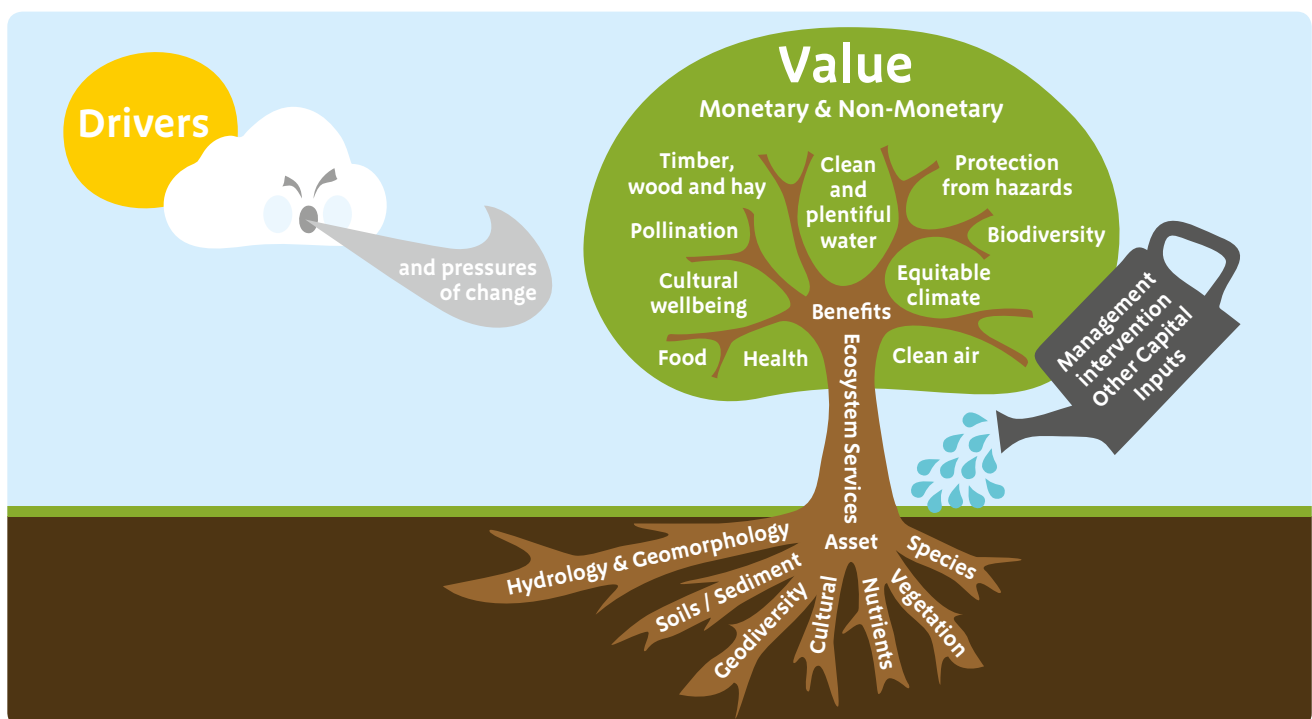
Figure 1, above, shows this flow of services from natural capital assets to people. The core of the diagram shows the flow from asset, to service, benefit and value. To give a simple example, an NNR might provide a hay crop. This can be used for animal fodder and has a market value. The three white boxes show three properties of the asset which are critical to delivery of benefits. These are quantity, quality and location. In our example, the value of hay produced will be affected by the quantity of NNR farmed for hay but also the quality of the land. Location is not critical for hay farming, but is critical for some other ecosystem services. For example recreation land is much more valuable near centres of population.

The bars on the top and bottom of the diagram illustrate factors which influence this logic chain. Starting at the top, the natural environment is subject to many pressures and drivers, such as climate change, which can alter assets and resulting services. Environmental assets are managed, and changes in management will also impact our logic chain. Finally, realising the benefits normally requires inputs of manufactured, human or social capital. For example footpaths to provide access.

This logic chain is a simplification of a highly complex system. Often many assets are contributing to each ecosystem service. Similarly, many services may be contributing to each benefit. There are synergies and trade-offs which are not captured in this logic chain. However, this simplification helps us systematically identify important relationships and asset attributes.

The work in these accounts has built on careful identification of key attributes and indicators of each part of the logic chain (see “Natural Capital Indicators: for defining and measuring change in natural capital” NERR076). Figure 2, below, illustrates the key attributes of the quality of our natural capital in the roots that enables the flows, benefits to society and values in the canopy.

Figure 2: **Key attributes of Natural Capital**





Our Natural Capital Accounting Method

This account includes all the NNRs that are managed by Natural England — alone or in partnership with others. Natural Capital Accounts (NCAs) are a way of organising information about natural capital to inform decision making. They extend traditional accounts by putting economic values on benefits that are not provided through the market. For example, many rural areas provide recreation opportunities, but the value of these is not included in the land owner's accounts. These non-market benefits are valued using a range of techniques from environmental economics. NCAs calculate asset values for environmental assets by adding up the future stream of expected benefits.

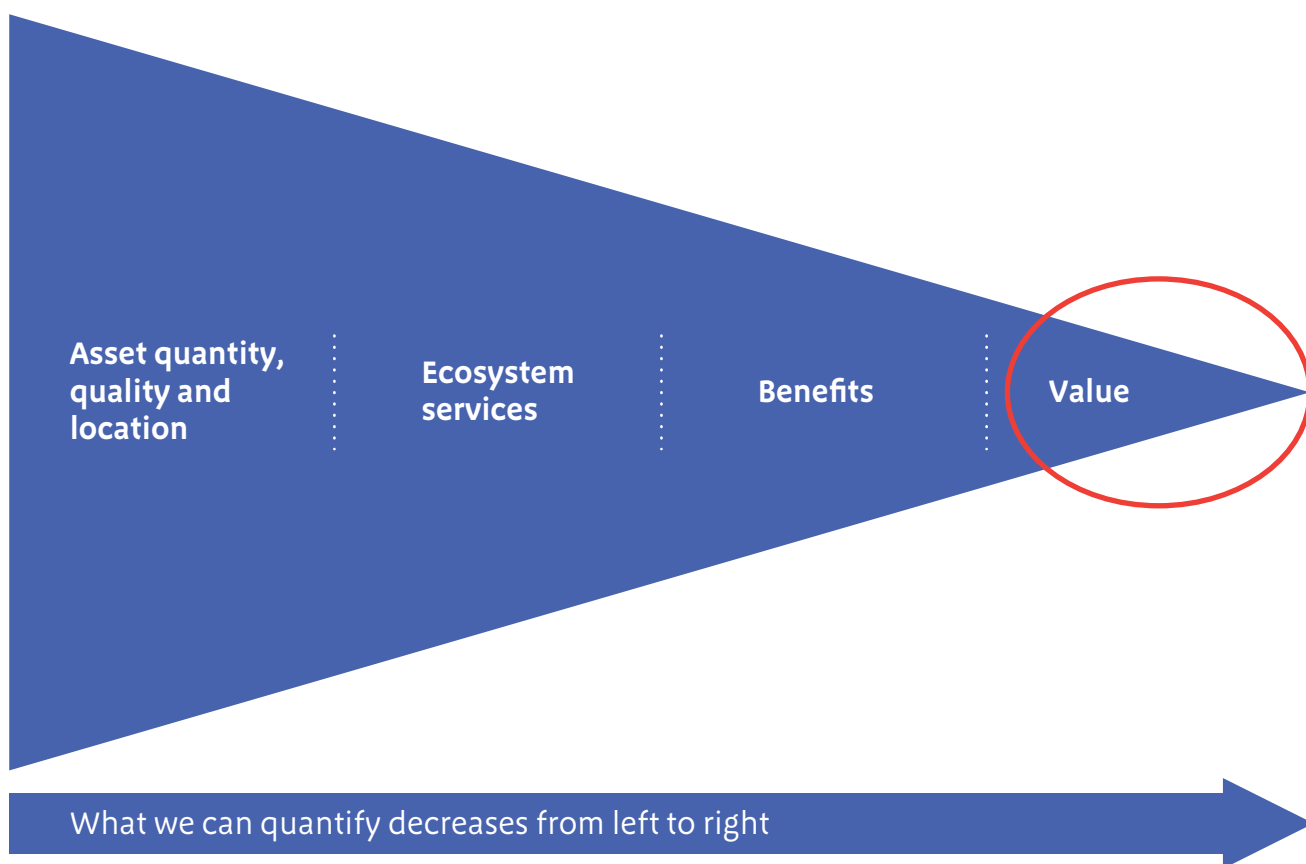
Traditional accounts play two important roles. Audited accounts are part of an organisation's external accountability, whereas management accounts support internal decision-making. In time Natural Capital Accounts may be able to play both these roles. They also have an important role in communicating environmental benefits provided by organisations.

Methods for NCAs are still developing and different approaches are being adopted by different organisations. There are not yet auditable standards like those for traditional accounting. One group of Natural Capital Accounts is strategic: it focuses on relatively large areas. The Office for National Statistics Accounts fall into this category. Another group focuses on organisational boundaries. Most of the organisational accounts use the Corporate Natural Capital Accounting (CNCA) tool. CNCA is designed to measure progress towards a future target scenario. The asset value is set based on this scenario. This means that the reader needs to understand the future target scenario to interpret the asset value and any changes to it. We cannot predict future scenarios with confidence. We also want the accounts to be understandable without significant investment in understanding the methodology. For this reason we have not used CNCA.

Public bodies and private sector organisations have different needs from NCAs. For private sector organisations NCAs may provide extra information about public benefits, which sit alongside evidence about their core market indicators. This may usefully broaden decision-making. But for public bodies their role is to provide public benefits, and these will dominate the account. There is not yet an approach to NCAs designed for public bodies, and this has been a focus for this study.

NCAs usually report using a final balance sheet that reports on the costs and monetary values of the assets. Natural England has used the natural capital logic chain as the basis for our natural capital accounts, seeking to report on each part of the chain: assets, services, benefits and values using the indicators identified in our Natural Capital Indicators report. This approach aims to provide decision makers with a more complete picture of the state of the assets, flows, benefits and the values derived from them. Often, understanding values is insufficient to know whether or not the asset is able to continue to provide benefits into the future. Figure 3, *overleaf*, shows us that typically we lose information as we go from left to right along the logic chains, from assets through to values. This is particularly important for assets such as NNRs whose purpose is to provide a range of public goods which are difficult to value. Thriving wildlife for example. Also, values on their own, may not relate closely to the quality of the asset. For example, we can value woodland recreation based on an average trip value, but this tells us nothing about which qualities of woodlands which are important for recreation. Similarly, we can produce asset values based on the assumption that benefits will continue at current levels, but the critical question is ‘will they?’ To get a handle on this we need to understand the state of the assets. This can also act as an early warning to potential changes in the provision of services, benefits and values into the future.

Figure 3: Loss of information across the logic chain






We have developed an extended balance sheet which reports on the quantity and quality of the assets, the ecosystem services, benefits and values alongside each other. Where quantified data is missing, we have estimated the significance of ecosystem service provision and benefits qualitatively using expert judgement. We did this to reduce the risk of partial valuation being misinterpreted and to present a more complete picture to decision-makers.

We have used confidence levels (shown as a **Red – Amber – Green** traffic light rating) to indicate the quality and appropriateness of the information behind the value figures.



Lower Derwent Valley NNR – Wigeon © Natural England / Peter Roworth

Table 1: **Key to confidence levels**

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. This is due to unquantifiable uncertainty in the science, valuation or the relationship between them. What we do know, and our confidence, will be discussed qualitatively.	No number





Sand Dunes, Holkham NNR, Norfolk © Natural England/Allan Drewitt

Results

The two page spread, *overleaf*, provides a summary of the results. It does this across our logic chain (Figure 1) from Ecosystem Asset, Service, Benefits and Values. We deliberately present all this information together to avoid the benefits and values being divorced from the state of the underlying assets which support them. These results are most meaningful in context. Our qualitative judgements about the most important services and benefits are highlighted to draw attention to the most significant ones. For the economic values we have used rounding and confidence levels to indicate the level of approximation. The rest of the results section gives more information on each section of the logic chain in turn.

Table 2: **Headline Results**

Ecosystem asset			Ecosystem services			
Natural capital asset baseline			Ecosystem service	Significance (1 small to 3 large)	Indicator	Quantity where available
Asset Attribute	Indicator					
Extent	Total area (ha)	66839.7	Timber, hay and other materials	2	Sale of timber	3000t
Hydrology	Ground water status (% good) Water Framework Directive (WFD)	24.1	Game and fish	1		
	Surface Water status (% good) WFD	18.6	Water supply	1		
Nutrient/ chemical status	Mean sulphur dioxide concentration (µg m-3)	0.32	Livestock	1		
	Mean nitrogen acid deposition (kg N ha-1 year-1)	12.3	Water quality	1		
Soil	Mean Estimates of Soil Organic Carbon in 30cm Topsoil (% of total) from NATMAP	9.13	Air quality	1		
Vegetation	% of NNR (ha) under a Site of Special Scientific Interest (SSSI) which is in favourable condition	51.3	Erosion control	1		
	Nectar plant diversity – Mean Estimates of Number of Nectar Plant Species for Bees (per 2x2m plot)	5.05	Flood protection	1		
Species composition	Soil Invertebrates Abundance – Mean Estimates of Total Abundance of Invertebrates in Topsoil (0–8cm depth soil core)	65.3	Pollination	1		
	Tranquillity (mean score)	13.8	Thriving wildlife	3		
Cultural	Scheduled monuments at risk (ha)	74.7	Pest and disease control	1		
			Climate regulation	3	Carbon Sequestered – tonnes of CO ₂ equivalent	185,000
			Recreation, tourism and volunteering	3	No. of recreational visits	5.5 million
					No. of volunteering hours	150,000
			Scientific and educational	3	No. of educational visits	37,000
			Cultural appreciation of nature	3		

Benefits and values

Benefit	Significance (1 small to 3 large)	Indicator	Annual benefit	Asset value	Confidence in the values (Red is low, Amber is Medium & Green is High)
Timber, wood and hay	2	Sale of timber	£56,000 	£2 million 	●
Food	1	Income from grazing	£281,000 	£9 million 	●
		Sporting rights income	£28,000 	£1 million 	●
Clean and plentiful water	1				
Clean Air	1				
Protection from floods and other hazards	1				
Pollination and pest control	1				
Biodiversity	3				
Equable climate	3	Carbon sequestered	£12 million ■	£1 billion ■	●
Health	2				
Cultural wellbeing	3	No. of recreational visits	£22 million ■	£710 million ■	●
		No. of volunteer hours	£1.8 million ■	£60 million ■	●
		No. of educational visits	£123,000 	£4 million 	●
Total quantified monetary benefits			£36 million ■	£1.8 billion ■	●
Significance of unquantified benefits			Very large		
Total annual costs			£14 million		●

Assets

The NNRs managed by Natural England are spread across England and cover 0.7% of the land surface. Figure 4, below, shows their extent and location.

Figure 4: **Extent of National Nature Reserves (NNRs) Managed by Natural England**

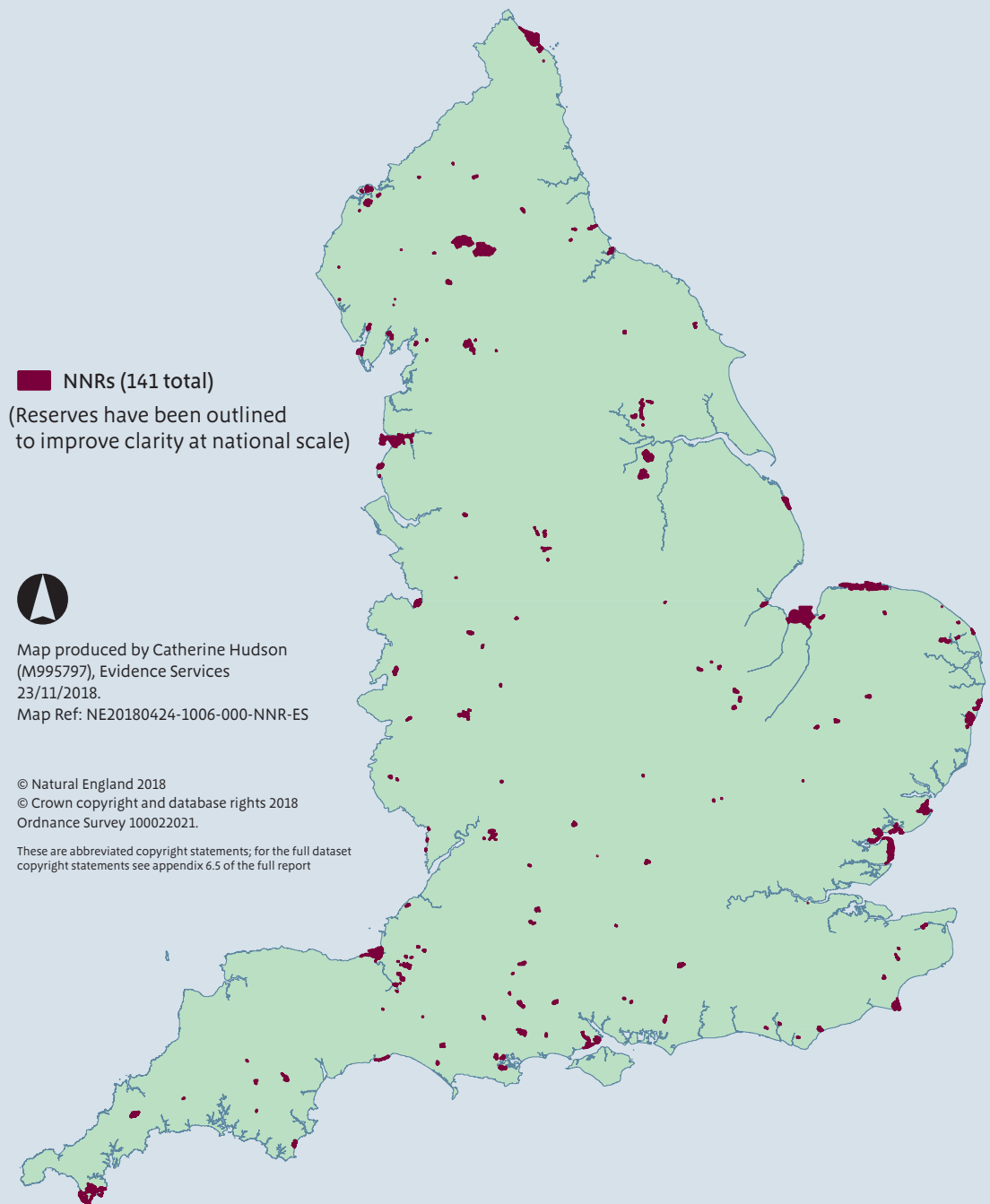


Table 3, below, shows the breakdown of NNRs into National Ecosystem Assessment habitat type. We have habitat data for 64,544 hectares of the Natural England managed NNRs estate. 2,295.7 hectares was not classified because it was below the high watermark. Some of the largest habitat types were beaches¹, saltwater and bog. On land the largest habitat types were broadleaved woodland and grassland.

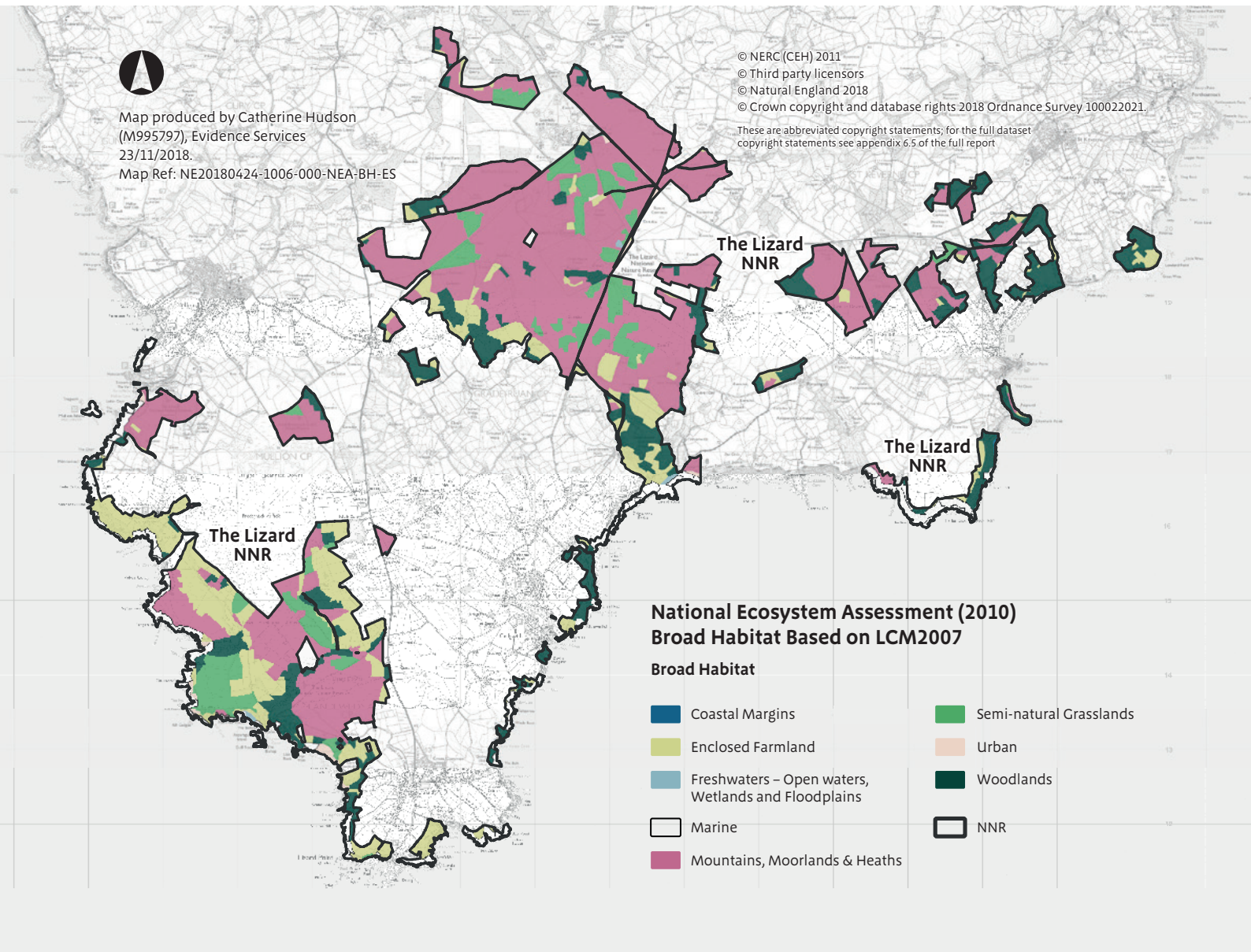
A map of the Lizard NNR is offered *overleaf* as an example.

Table 3: Hectarage values for National Ecosystem Assessment (NEA) Broad Habitats across NE-managed NNR estate

National Ecosystem Assessment Broad Habitat (NEA-BH)	Area across NE NNR Estate (ha)	% of Total
Woodlands	7,843	12
Enclosed farmland	5,508	9
Semi-natural grassland	4,613	7
Open water, wetlands and floodplains	8,568	13
Mountains, moorlands, heaths	8,630	13
Marine	21,680	34
Coastal margins	7,529	12
Urban	174	0
Total	64,544.1	100

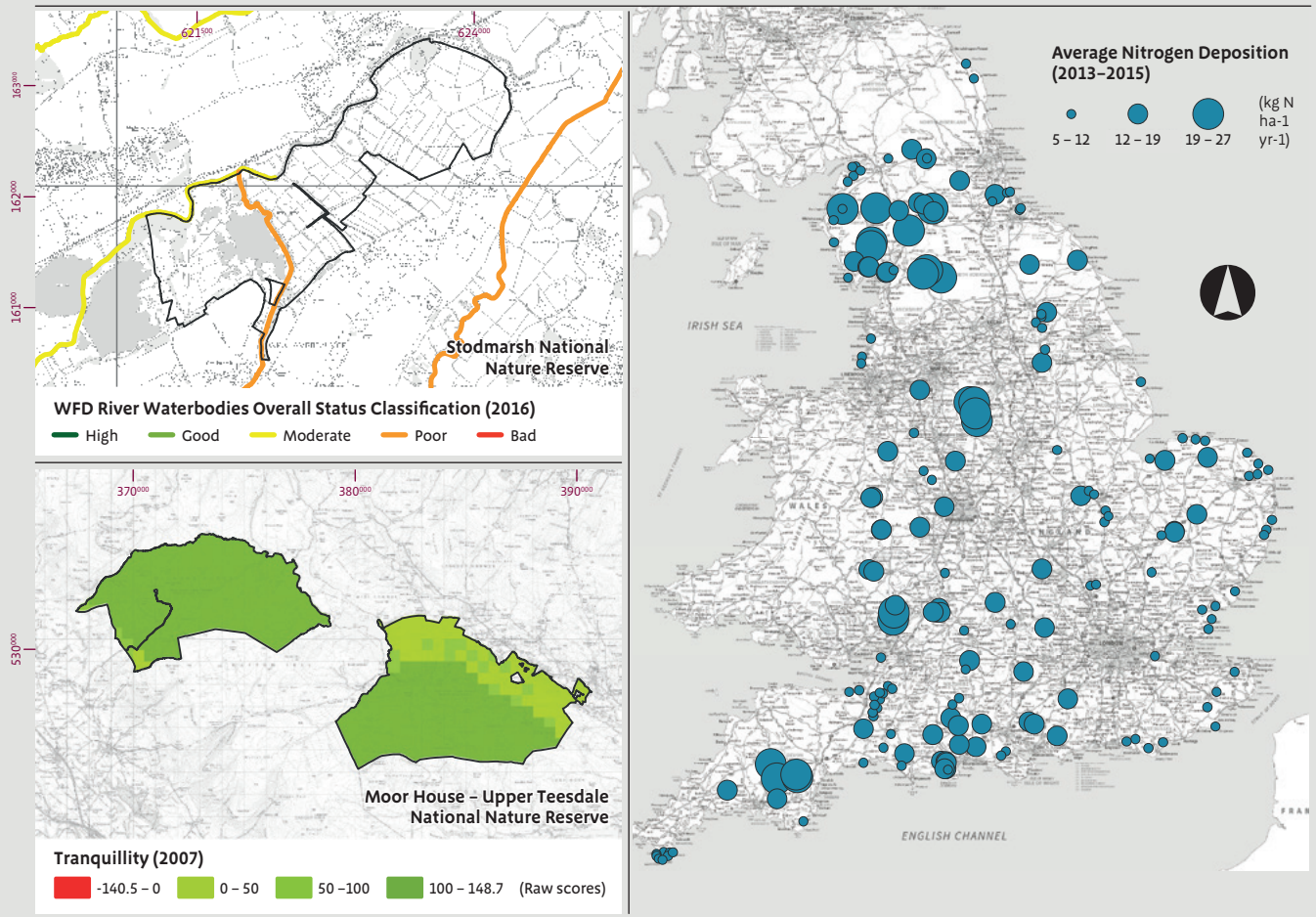
¹ Littoral Sediment

Figure 5: The Lizard NNR by broad habitat



The baseline assessment of natural capital assets uses 27 indicators to describe the extent and quality of the NNR assets. Using available data sources we were able to produce mapped estimates of many types of natural capital asset and benefits. 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. We have used open data as much as possible.

Figure 6: Map of quality attributes (A)



Map produced by Catherine Hudson
(M995797), Evidence Services
23/11/2018.
Map Ref: NE20180424-1006-000-HG-CUL-NC

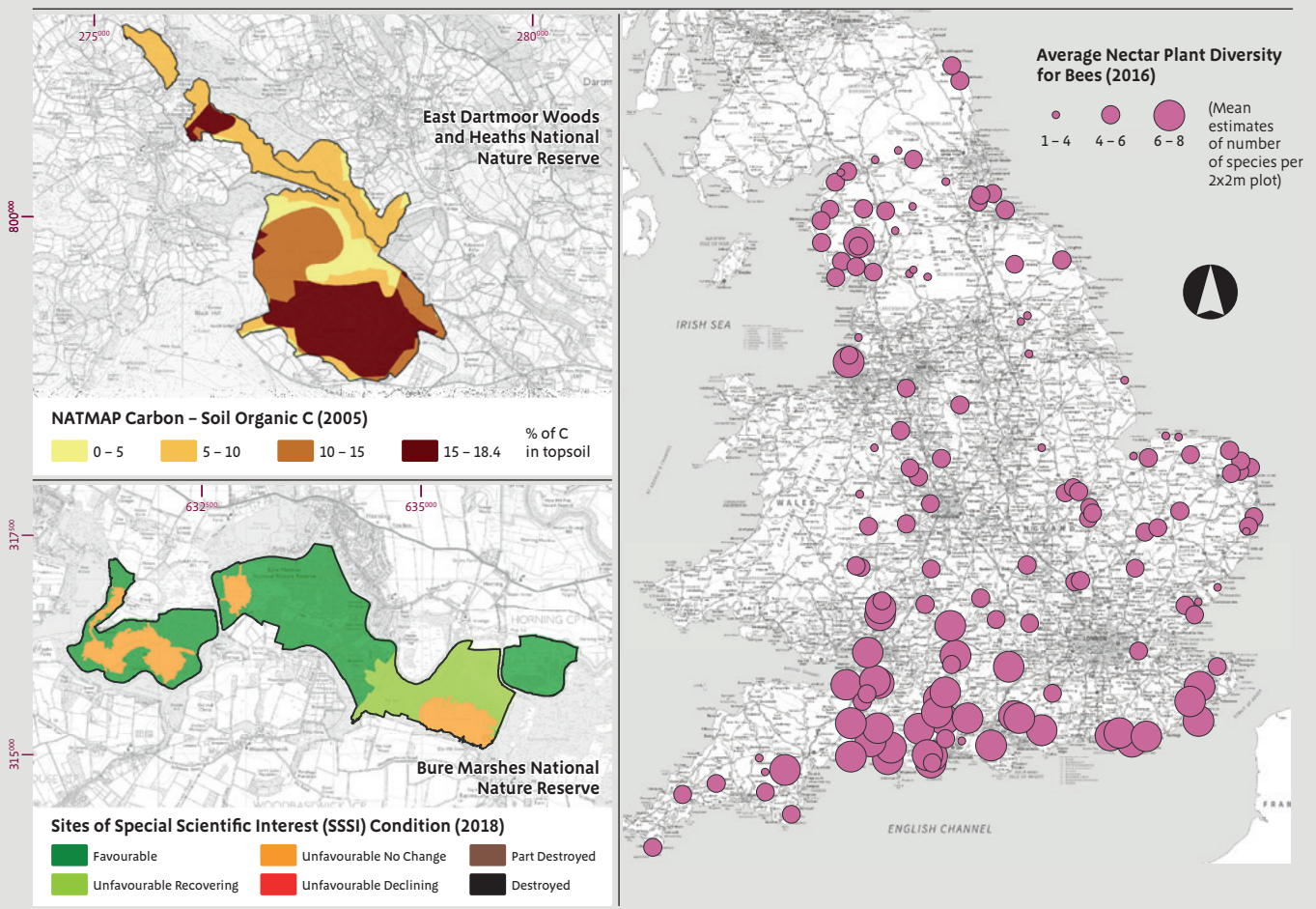
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These are abbreviated copyright statements; for the full dataset copyright statements see appendix 6.5 of the full report

We have been able to map a large number of natural capital indicators for the report. Figures 6 and 7, *above and overleaf*, provide examples from the key attributes — shown earlier as the roots of the tree.

See Figure 6, *above*. The top-left shows water-quality at Stodmarsh, the bottom-left Tranquillity mapping at Moor House – Upper Teesdale and the right-hand panel average nitrogen deposition across the estate.

Figure 7: Map of quality attributes (B)



Map produced by Catherine Hudson (M995797), Evidence Services 23/11/2018.
Map Ref: NE20180424-1006-000-SS-VEG-SC

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These are abbreviated copyright statements; for the full dataset copyright statements see appendix 6.5 of the full report

Figure 7, above, provides three more examples. The top-left shows soil organic carbon at East Dartmoor Wood and Heaths, the bottom-left Site of Special Scientific Interest (SSSI) condition at Bure Marshes and the right-hand panel shows average nectar plant diversity for bees across the estate.



NCA 57 Sefton Coast – Ainsdale Sand Dunes NNR © Natural England/ Rob Wolstenholme

Natural Capital Accounting is designed to be repeated on a regular basis in order to help managers keep track of their assets. Our assessment this time forms a baseline against which future accounts can be compared. Data sets that were applicable to this work are limited. They are of variable resolution, have varying intervals for repetition, and in some cases are proxies for a quality aspect we are interested in and not direct measures. Nevertheless, this provides a useful suite of information against which we can measure changes in quality and extent of the natural capital assets at a future date. We have not benchmarked the indicators of the quality of natural capital against other assets beyond NNRs but this could be a useful exercise to undertake at a later date.

Services

Thriving wildlife, recreation and scientific research are the NNRs core purposes, but they also deliver a wider range of ecosystem services. Table 4, *opposite*, shows our estimates of the significance of ecosystem services provided by the assets. These are based on expert opinion. The quantity, quality and location of the assets influence this ecosystem service delivery, as does management and external pressures. The relationships between the asset features and delivery of ecosystem services is too complex to capture on a simple diagram. This also applies to the other steps in the logic chain. Interested readers should refer to our Natural Capital Indicators report.

Kingfisher, *Alcedo atthis* © Natural England / Allan Drewitt



Table 4: Ecosystem Service Significance, Indicators and Quantities

Ecosystem service	Significance (1 small to 3 large)	Indicator	Quantity where available
Timber, hay and other materials	2	Sale of timber	3000t
Game and fish	1		
Water supply	1		
Livestock	1		
Water quality	1		
Air quality	1		
Erosion control	1		
Flood protection	1		
Pollination	1		
Thriving wildlife	3		
Pest and disease control	1		
Climate regulation	3	Carbon Sequestered – tonnes of CO ₂ equivalent	185,000
Recreation, tourism and volunteering	3	No. of recreational visits	5.5 million
		No. of volunteering hours	150,000
Scientific and educational	3	No. of educational visits	37,000
Cultural appreciation of nature	3		

We are able to quantify only a small proportion of these ecosystem services. Even where we are able to 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 point or range estimates provided by NNR staff. Similarly, there are a number of ecosystem services which are not insignificant but which we do not know enough about to quantify. To give one example, land maintained as a nature reserve will hold and slow down water, reducing flooding downstream of it, but the scale of this is not currently known for our NNRs. There is an opportunity to improve the collation and collection of suitable data for future accounts.

Value and Significance of Benefits

Society values NNRs for the enjoyment people gain from them and the benefits they provide. They are especially valued for their role in:

- nature conservation and protection of biodiversity
- conservation and enhancement of the landscape,
- access to the countryside/open spaces and open-air recreation
- access to facilities for the study, understanding and enjoyment of the natural environment.

These are all services which Natural England is responsible for providing and which are essential prerequisites for achieving the goals laid out in the Government's 25 year environment plan. All of these services are provided by natural capital which the Government is committed protecting and growing².

We have assessed the significance of these benefits and where possible have estimated their monetary value, these results are summarised in Table 5, *opposite*.



Cuckoo Flower, *Cardamine pratensis*
© Natural England / Allan Drewitt

² 25 Year environment Plan, page 9

Table 5: Significance of benefits, values and confidence ratings

Benefit	Significance (1 small to 3 large)	Indicator	Annual benefit	Asset value	Confidence in the values (Red is low, Amber is Medium & Green is High)
Timber, wood and hay	2	Sale of timber	£56,000 	£2 million 	●
Food	1	Income from grazing	£281,000 	£9 million 	●
		Sporting rights income	£28,000 	£1 million 	●
Clean and plentiful water	1				
Clean Air	1				
Protection from floods and other hazards	1				
Pollination and pest control	1				
Biodiversity	3				
Equable climate	3	Carbon sequestered	£12 million ▬	£1 billion ▬	●
Health	2				
Cultural wellbeing	3	No. of recreational visits	£22 million ▬	£710 million ▬	●
		No. of volunteer hours	£1.8 million ■	£60 million ■	●
		No. of educational visits	£123,000 	£4 million 	●
Total quantified monetary benefits			£36 million ▬	£1.8 billion ▬	●
Significance of unquantified benefits			Very large		
Total annual costs			£14 million		●



Family enjoying a brisk walk on Saltfleetby-Theddlethorpe Dunes NNR
© Natural England / Peter Roworth

The most significant benefits provided by NNRs are thriving wildlife, equable climate and cultural services wellbeing³.

Although we are able to put a monetary value on some cultural well-being benefits, there are many more that are difficult to separate out or quantify, such as tranquillity, inspiration and sense of belonging. These are often described using the language of landscape, but we have used cultural benefits for consistency with the ecosystem service framework we are using. They also include non-use values — the fact that people value the conservation of nature, landscapes, habitats and species whether or not they visit them. We assess the significance of these benefits as 'Very Large'.

We estimate the monetary benefits to society from recreational and educational visits and volunteer work as being of the order of £24 million per annum, with an asset value of around £774 million. We are not able to estimate the magnitude of other cultural benefits or thriving wildlife, except to note that they are very significant and very likely to exceed the benefits we have been able to quantify.

The largest benefits that we can quantify in monetary terms are from carbon sequestration — resulting in less damage from climate change in the future. We estimate that NE managed NNRs sequester around 185,000 tonnes of CO₂ equivalent per year. This provides annual benefits of around £12 million. The value of carbon sequestration is expected to rise sharply over the next 50 years such that annual benefits will reach £65 million in 2077.

The natural capital asset value for carbon sequestration over the next 100 years is expected to be around £1 billion⁴, assuming that NNRs are maintained in at least their current condition. If NNR condition is allowed to decline, or if some NNRs are converted to other land uses then substantial carbon emissions could result. For example emission of 5% of the carbon stored in NNRs would amount to 600,000 tonnes. This additional 600,000 tonnes of CO₂ equivalent would cause damage with a value around £3.5 billion over the next one hundred years⁵.

Overall we estimate the monetary value of quantifiable benefits from NNRs to be in excess of £36 million per year with a natural capital asset value in excess of £1.8 billion. We note the 'very large' significance of benefits that we have not been able to value in monetary terms and suggest that these are probably greater than the quantified values.

³ Cultural benefits include:- capabilities e.g. knowledge, health, dexterity, judgement. Experiences e.g. tranquillity, inspiration, escape, and discovery. Identities e.g. belonging, sense of place, rootedness, spirituality, sense of history. Non-use values: existence, bequest, altruistic, option

⁴ Official Carbon Price estimates are available until 2100. These assume that the carbon price slowly declines from 2077 onwards. The asset value has been calculated assuming that this price decline continues at a steady rate — from £304 in the 2100 to £217 in 2017.

⁵ Damage for each future years has been discounted and then added together to produce a single 'present value' figure using Treasury guidelines).

Costs

We have attempted to estimate the cost of managing NNRs to Natural England from the financial accounts. The results are in Table 6, below.

Table 6: Expenditure relating to NNRs for the 2017/18 Financial Year

Cost	£ millions	Confidence Rating
Staff costs for NNR and NNR related staff	4.5	● Green
NNR running and capital costs ('direct')	4.2	● Green
NNR running costs ('indirect')	3.1	● Amber
NNR related expenditure by partner organisations	0.37	● Green
Replacement cost of volunteers	1.8	● Amber
Total	13.97	● Amber

Note: NE net expenditure on NNRs was around £10 million after deducting £0.73 million of NNR income and £1 million from single farm payments.



Harvest Mouse, *Micromys minutus*
© Natural England/Allan Drewitt



Skipwith Common NNR © Natural England / Peter Roworth

Natural England spent around £11.8 million on NNRs in 2017/18, this includes staff costs of £4.5 million, direct running and capital costs of £4.2 million and indirect costs of £3.1 million. The indirect costs are based on an assumption of a percentage of NE overheads and general expenses being spent on these NNRs. Further work would be required to assess appropriate percentage, hence the amber confidence rating.

Partner organisations such as the Heritage Lottery Fund and the EU spent a further £370,000 on particular NNR related projects.

The estimated market cost of replacing the work carried out by volunteers on NNRs was £1.8 million. This is based on an average value per hour per volunteer, because we do not have data on the categories of work undertaken by volunteers. For this reason we have given this estimate an Amber rating.

This brings the total economic cost of managing these NNRs in 2017/18 to around £14 million.





Hare's-tail cottongrass *Eriophorum vaginatum*, Humberhead Peatlands NNR © Natural England / Peter Roworth

Discussion

The presentation of information on assets, services, benefits and values together seeks to avoid the 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 to asset owners who are concerned about the state of their 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 account is a baseline report against which future accounts can be compared. It doesn't comment on whether the assets are in good condition or otherwise, it just reports on the current state of the NNRs in natural capital terms. We have not benchmarked the results against other groups of assets.

We have used the best available open data where possible. Occasionally we have had to use contractor published data, where nothing else was available. 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 frequency of every four years seems more appropriate. The limited number of relevant datasets also suggests there are huge opportunities for further data collection going forward including data collected at our NNRs themselves, through to the potential repeats of surveys such as the Tranquillity Dataset.

Our estimate of total cost to society per year is approximately £14 million. This is based on expenditure of about £12 million and a replacement cost for volunteers worth about £2 million. We have been able to put a monetary value on only a small proportion of the benefits. This is due to data and knowledge limitations, rather than the approach to this study. These were recreation (£22 million per year), carbon sequestration (£12 million per year) and benefits to volunteers (£1.8 million year). We note that due to uncertainties, these numbers could be up to ten times larger or smaller. Even at the most conservative assessment they are still significantly larger than traditional accounting asset values based only on market goods. If we could calculate the full value of the NNRs, based on all the ecosystem services the figure would be much larger. It's not appropriate to compare the costs in one year to the benefits in one year. This is because the benefits in any single year are the result of investment over many years. Working out the investment required to deliver a particular set of benefits would require detailed investigation into the specific costs of NNR management. Nevertheless, our large partial benefit values suggest this investment in managing NNRs is good value for money.

We cannot tell from this study whether benefits levels will stay the same, increase or decrease. This will depend on a complex mixture of investment in the NNRs and external drivers and pressures. Because we have no evidence about future change to benefits, we have chosen to calculate asset values based on the assumption that they will stay the same. On this basis we produce an asset value of £1.8 billion.



Clitocybe spp. © Natural England / Paul Lacey

To ensure that the benefits continue, or increase, we need to understand, protect and invest in the ecology. We also need to understand how this delivers benefits. This is best done at site level. But it's also useful to understand it strategically. Our assessment in this report is a first pass at this. The data gaps and confidence levels mean that the approach taken in this study is not an appropriate management tool for NNRs. But it does provide a valuable additional perspective on them. It helps to highlight the broader benefits provided by the NNRs, beyond their core role of conservation, access and research. Further data collection on NNRs, and some changes to our accounting data would improve this assessment next time. Our approach also points towards further innovation in this area. For example, we could use participatory approaches to underpin the qualitative assessment. Or we could use approaches from complexity science to represent less than certain information about system relationships.





Ingleborough NNR © Natural England / Neil Pike

Conclusion

Natural England NNRs offer significant benefits to society. The most important benefits are in line with the NNRs core purposes of thriving wildlife, scientific research and recreation but there are many others. Benefits from climate regulation, provision of goods, health and broad cultural well-being are also significant. Beyond this there is a long list of ecosystem services where NNRs make a modest contribution. We were able to put an economic value on only a small proportion of the benefits, but even this partial valuation helps to illustrate the importance of NNRs to society.

This innovative approach to NCAs provides a baseline assessment of the quantity and quality of our natural capital assets, the services and benefits provided, and their value all reported alongside each other in an extended balance sheet. This provides comprehensive, accessible information that is available for better decision-making and avoids the problems of partial natural capital accounts. Leaving the environment in a better state for future generations will require meaningfully linking financial decisions with environmental assets and benefits. This study is a contribution to this long term task. We commend this approach to all organisations which are committed to managing their environmental assets to deliver public benefit over the long-term.

Hay meadows in flower on
Lower Derwent Valley NNR
© Natural England / Peter Roworth

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