Towards a Register of Exmoor's Natural Capital

Report prepared for the Exmoor Society
by Robert Deane and Anne Walker, Rural Focus Ltd
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The Exmoor Society
Conserving Exmoor for All

Contents

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Cover photograph © Nigel Stone, showing Dunkery from Croydon Hill.

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Foreword

'A Green Future: Our 25 Year Plan to Improve the Environment', the UK Government's long-term approach to protecting and enhancing the UK's natural landscapes and habitat, which sets natural capital at its heart, was published after this project was conceived. In his keynote address at the 2017 Spring Conference of the Exmoor Society and Exmoor National Park Authority, Professor Dieter Helm, Chairman of the Natural Capital Committee, had already challenged Exmoor to investigate how the concept could be used in the context of its designation and purposes as a National Park. The Exmoor Society was quick to respond, and the result is this report.

Coincidentally, Exmoor National Park Authority and Exmoor Hill Farming Network were working towards 'Exmoor's Ambition', proposals for adapting farm policy for Exmoor in the light of Brexit. The two projects were self-standing, yet complementary. Importantly, farming in a national park is about much more than conventional commodity production. In Exmoor, farmers also play a key role in creating, enhancing and maintaining its visual landscape so greatly enjoyed and valued by visitors and residents alike. In part, this landscape stems from extensive sheep and cattle livestock farming which uses the moorland, and partly from farmers in a role as stewards of the wider countryside. They also provide holiday and recreational facilities. Further, farmers and their families are the bedrock of a great deal of Exmoor's social life and traditions. In short, Exmoor provides a whole range of benefits for people that extend far beyond the purely physical aspects of its viewed moorland, farmed countryside, woods, valleys, waterways and coastline, important as these are. There are other human dimensions, too, including both the tangible artefacts of its history and archaeology and intangibles such as the stories people tell about Exmoor, whether real or, like Lorna Doone, fictional. Such cultural aspects are also part of what makes Exmoor a unique place of exceptional value.

The analysts therefore had to push the boundaries of the natural capital concept sufficient to accommodate cultural factors as a particular class of ecosystem services from which people also benefit. In that sense, Exmoor as an entity represents an aggregate of natural capital assets that provides a wide and diverse range of both tangible and intangible benefits to society. Collectively, these are described in the report as the attributes of Exmoor's natural capital that translate into the many ecosystem services people value.

Here, the exercise is confined to outlining and testing the conceptual framework. If it is to be of practical use, this has to be capable of underpinning monetary valuations as a basis for incentivising and rewarding Exmoor farmers (and indeed other relevant decision-makers) to provide society with the benefits it wants. Three pilot areas were selected from the 2007 Landscape Character Assessment of Exmoor as broadly representative of the national park's characteristics, and each investigated in detail as the foundation for a natural capital asset register. Given real world data limitations, achieving what is ideal in principle seldom is possible in practice. Lessons learned from the Exmoor project are likely to have implications for similar work conducted elsewhere. So, Exmoor Society is also pleased to publish this report, with our most sincere thanks to its authors Robert Deane and Anne Walker, as a contribution to that broader purpose.

Dr Keith Howe
Vice-Chairman, The Exmoor Society

Towards a Register of Exmoor's Natural Capital: **Executive Summary**

Context: The concept of natural capital lies at the heart of the Government's recently published 25 Year Environment Plan. Defined as "*the parts of the natural environment that produce value to people",* natural capital is set to play an increasingly influential role in how public policy develops, especially in special areas such as National Parks.

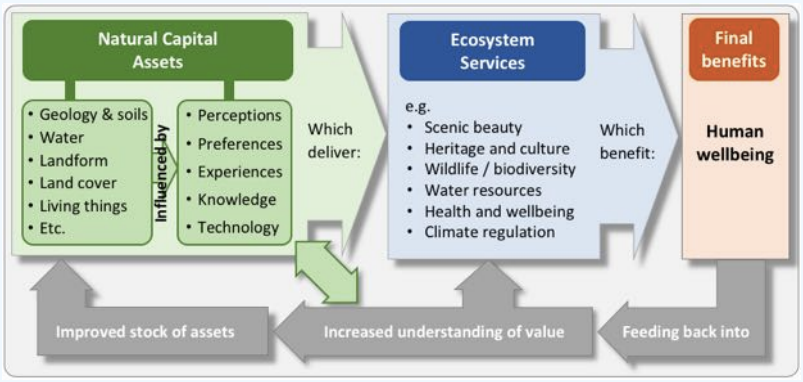
Purpose: This study has sought "to develop and pilot a practical toolkit for identifying and prioritising the natural capital assets that deliver the full range of benefits (ecosystem services) that can be provided by Exmoor". It has done this by developing and testing a register of natural capital in three pilot areas which, between them, cover almost all the landscape types present in the National Park.

Headline findings: This study breaks new ground in four ways.

1. **It proposes a unifying classification describing all elements of natural capital, overcoming the duplication and inconsistencies inherent in existing typologies.**
2. **It investigates and describes the relationship between natural capital and cultural considerations, a topic that is frequently neglected in other work.**
3. **It uses landscape character to ensure descriptions of natural capital are place-based, capturing the distinctiveness and special qualities of landform, land cover, management, experiences and perceptions.**
4. **It shows the importance of involving local knowledge and values to gain the commitment of the people who own, manage or use natural capital. This gives them a personal stake in the concept of natural capital.**

Definitions: Clarity and consistency, and a rigorous approach to terminology and definitions, are essential if the concepts of natural capital and ecosystem services are to gain currency amongst decision makers.

Natural capital assets consist of both physical resources and the valued attributes people bestow on them. The latter are particularly important for ecosystem services such as natural beauty and cultural heritage.



The pathway from assets to services to benefits

Requirements of an effective register: A register of natural capital assets needs to include information about their extent (covering their quantity and spatial configuration), condition and change. This information can then inform decisions about their protection and management and enables valuation of the services and benefits that they provide to society

There is already much data describing natural capital held nationally and locally. The register must provide a 'front end' for, and not seek to replace or duplicate, these primary sources. However, existing data is often messy (conflicting, gappy and dated) even in an area as well studied as Exmoor. The ownership and cost of existing data are a constraint and filling gaps in information by new surveys can be time-consuming.

More work needs to be done on the use of a geodatabase structure, building on existing models where possible, that is capable of receiving data from primary sources. Notwithstanding these limitations, this study has demonstrated that a register of natural capital can provide the information needed to assess the full value to society of an area like Exmoor.

Recommendations: The study makes eight suggestions for developing a natural capital register on Exmoor and testing its use in other areas. These cover the following topics:

- There is a need to improve understanding of natural capital and particularly the way that it supports cultural ecosystem services. Better knowledge is required on how the extent and condition of assets affect service delivery.
- Technical developments in geodatabase design (using existing models where suitable) and improving access to existing datasets will ensure a more useable register.
- The lack of information on some key assets such as hedges and high value grassland needs to be tackled by developing a robust and repeatable methodology so that these gaps in data can be filled efficiently.
- Finally, the register on Exmoor should be expanded so that it can be used to estimate the value of all the services provided by the National Park, demonstrating the full worth of the designation to the nation.

1. Introduction

1.1. This is the report of a study undertaken between October 2017 and May 2018 for the Exmoor Society by Rural Focus Ltd. This main report is accompanied by a Technical Appendix containing supporting information[1].

Purpose

1.2. The Exmoor Society commissioned this study to investigate whether the natural capital approach can be used to include all the natural/cultural elements that make up Exmoor's unique landscape character; prioritise those areas which need sustainable management by farmers/land managers and can be increased in extent and quality; and help retain a hill-farming community equipped with the knowledge, skills and other resources to provide the desired outcomes.

1.3. The overall objective of this project is: "**To develop and pilot a practical toolkit for identifying and prioritising the natural capital assets that deliver the full range of benefits (ecosystem services) that can be provided by Exmoor**".

Context

1.4. The origins of the study lie in the keynote addresses given to the Society's 2017 Spring Conference by Professor Dieter Helm, chair of the Natural Capital Committee. In response to a question about the use of natural capital in National Parks, he challenged Exmoor to investigate how the concept could be used in the context of the designation and its statutory purposes. The Trustees of the Exmoor Society subsequently responded to his challenge by commissioning this study.

1.5. There is a strong national context to this study. The Government's Industrial Strategy for the UK (published in November 2017) and 25 Year Environment Plan for England (January 2018) both emphasise the role of the natural capital concept at the heart of Government policy. The 25 Year Environment Plan, which uses the term 106 times in its 151 pages, states "*over coming years the UK intends to use a 'natural capital' approach as a tool to help us make key choices and long-term decisions*". This study is intended to demonstrate how this can be done in the context of the National Park designation.

1.6. There are also important local contexts to the study.

- Firstly, the study has taken place at the same time as Exmoor National Park Authority and the Exmoor Hill Farming Network are developing a proposal for post-Brexit farm and environmental support on Exmoor ('Exmoor's Ambition'). One of the design principles of this proposal is that future support should be based around a register of natural capital on each holding. Although not limited to this purpose, this study is intended to demonstrate how this aspect of Exmoor's Ambition could be taken forward in practice.
- Secondly, the Exmoor and Dartmoor National Park Authorities are working with the South West Partnership for Environmental and Economic Prosperity (SWEEP) at the Universities of Exeter and Plymouth to develop natural capital reporting and accounting in the two National Parks. This follows previous work on Exmoor, such as the Wimbleball Project that sought to define and map ecosystem service delivery in the catchment around the Wimbleball Reservoir[2]. It is hoped that this study can feed into the ongoing work with SWEEP.
- Finally, North Devon (to the west of the National Park) is the location for one of Defra's 25 Year Environment Plan Pioneer projects. Based in a rural landscape setting, the project is developing the natural capital approach and accounting framework with a view to preparing a shared natural capital investment plan. Again, it is hoped that this study can feed into that work.

1.7. The ways in which the natural capital approach can be used in national and local policy are developing. A number of large organisations such as the Forestry Commission and Duchy of Cornwall are using corporate

[1] The Technical Appendix can be downloaded from https://www.exmoorsociety.com/content/publications/reports-2.
[2] Reid C (2013)

natural capital accounting[3] to report annually on the way their activities impact on the natural environment and the services and benefits the environment provides. There is also a growing number of local area projects that have used the natural capital approach to help guide land management and investment[4].

1.8. However, at a local area scale, these natural capital projects have tended to cover only a limited number of assets and services (usually limited to those things for which monetary value is most easily calculated) and have not sought to take a more comprehensive approach, particularly where the cultural ecosystem services are concerned[5].

1.9. In commissioning this study, the Exmoor Society is aware that current uses of natural capital tend not to take account of the full richness and diversity of environmental assets within national parks which derive from their socially and culturally constructed values. Overall, there has been a lack of an holistic perspective that captures the spirit of these unique places because of a tendency to focus on the many worthy demands from competing single-interest groups. This study seeks to address these issues.

Methodology

1.10. The study was conducted in three stages, as follows

A. A desk study, with specialist consultations, to identify the potential uses of a register of natural capital on Exmoor and the existing information that can be used in it, and to identify three case study areas representative of the range of landscape types on Exmoor.

B. The gathering and mapping of information describing natural capital assets on the three case study areas, including field work and interviews with the farmers concerned, to fill major gaps in data.

C. Preparation of this report and illustrative material showing examples of the register and setting out conclusions and recommendations from the study.

Scope and limitations

1.11. This study aims to describe the range of natural capital assets from which Exmoor, as a National Park, provides benefits to the nation. It does this by developing and testing an approach in three pilot areas. It takes the innovative, but much needed, step of describing the natural capital assets from which the cultural ecosystem services such as natural beauty and cultural heritage are derived. These are assets which are often inadequately recognised in other studies.

1.12. The locus of an upland National Park gives the study a particular emphasis on its international landscape value (maintained primarily by sympathetic livestock farming) and the statutory purposes of the designation (covering both the conservation of natural beauty and its enjoyment by people – see para. 2.6). As a National Park, there is also a wealth of environmental data to draw on, giving a richer evidence base than is available in many other areas. Notwithstanding this geographical focus, the methodology developed by this study, and its findings, should be relevant to other areas of England, and indeed the UK.

1.13. Natural capital accounting is an important and developing area of research. This study does not attempt to monetise the value of the services provided by Exmoor natural capital – such a task is beyond the resources and expertise of the study. Drawing up a register is the first step in the natural capital approach, establishing the evidence base from which valuation can be undertaken, informing the important decisions about investment, protection and management. It is for others to use the register for these tasks.

[3] See for instance Forest Enterprise England (2017)

[4] The Natural Capital Assessment Gateway hosted by the Ecosystems Knowledge Network provides access to projects in the UK. https://ecosystemsknowledge.net/natural-capital-assessment-gateway

[5] An exception to the lack of research on natural capital and cultural ecosystem services is work recently commissioned by Historic England, including RPA and LUC (2018) and a suit of eight local studies (in progress), including one in the Peak District National Park examining the use of the natural capital concept in relation to stone walls of historic value.

2. Definitions

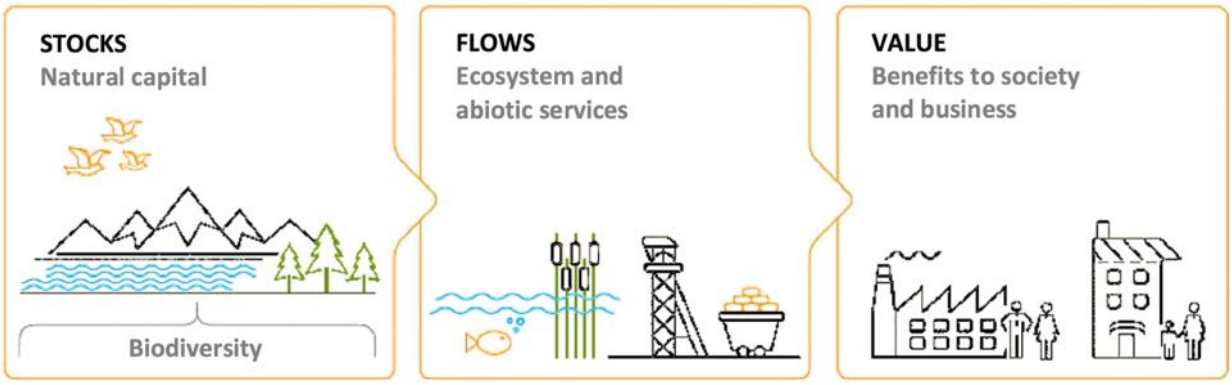
2.1. The first task is to explore and define some of the key concepts and issues surrounding the use of natural capital and the purpose of a register to record it. This section is structured around a series of questions:

1. What do we mean by natural capital?
2. What are the key services provided by natural capital on Exmoor?
3. What and who could a register of natural capital be used for?
4. What are the components of natural capital?
5. What framework is needed to classify Exmoor's natural capital assets?
6. How do Exmoor's assets relate to the services they give us?
7. What information does the Register need to record?

What do we mean by natural capital?

2.2. At its simplest, the UK's Natural Capital Committee defines natural capital as: "*The parts of the natural environment that produce value to people*". The World Forum on Natural Capital (an annual conference that brings together world leaders and experts) uses a more elaborate definition: "*The world's stocks of natural assets which include geology, soil, air, water and all living things. It is from this natural capital that humans derive a wide range of services, often called ecosystem services, which make human life possible*". This latter definition emphasises the position of natural capital at the start of a pathway, with stocks of natural capital producing flows of goods and services (termed ecosystem services), from which society receives benefits. This pathway is illustrated in **Figure 1**.

Figure 1. The stock of assets producing the flow of services that provide value to society



Source: Natural Capital Coalition https://naturalcapitalcoalition.org/natural-capital/

2.3. The essential point from Figure 1 is that individual natural capital assets are what provide the flow of goods and services from the environment that people value. Put another way, in order to identify natural capital, you first have to define the goods and services that nature gives us, which respond to society's needs and wants.

What are the key services provided by natural capital on Exmoor?

2.4. As noted above, the rationale for a register of natural capital on Exmoor must start with an understanding of the goods and services that we value and are obtained from its natural environment. The concept of ecosystem services has been used in policy circles for over a decade and the typology set out in the UN's Millennium Ecosystem Assessment[6] (MEA) is commonly referred to. This distinguishes between provisioning, regulating and cultural services. The list of services used in this study, to underpin the register, is shown in Figure 2. This is based on the MEA and uses definitions that are drawn from, or are compatible with, other similar studies[7].

[6] Millennium Ecosystem Assessment (2005)
[7] See for instance Dwyer J et al (2015)

Figure 2. The services and benefits used to define the register of natural capital on Exmoor

Cultural services	***Enriching people's lives***
Natural beauty	*Presence of distinctive characteristics and features*
Wildlife	*Appreciation of wild species and habitats*
Cultural heritage	*Understanding of archaeology, buildings and landscape history*
Recreation and wellbeing	*Physical, mental and spiritual access to landscape and nature*
Arts and culture	*Fostering of cultural traditions, literature and art*
Education and knowledge	*Understanding of the natural environment (popular & specialist)*
Regulating services	***Support for life-giving processes***
Clean water	*Preserving water quality for drinking and healthy ecosystems*
Healthy soils	*For food production and healthy ecosystems*
Climate regulation	*Storage of carbon and cutting emissions of greenhouse gases*
Flood risk mitigation	*Reducing the risk of flooding*
Pollination	*Sustaining populations of insect pollinators*
Provisioning services	***Products of the environment***
Primary production	*Food, materials (e.g. wool and timber) and renewable energy*
Water supply	*Maintaining water in rivers and aquifers*
Genetic diversity	*Conserving diversity in both farmed and native species*

2.5. The order in which the three types of services are shown has been reversed from that which is normally used. This is deliberate and is intended to draw attention to the way in which these services relate to the statutory purposes of the National Park designation. In summary, these two purposes are: (1) to conserve and enhance natural beauty, wildlife and cultural heritage and (2) to promote opportunities for public understanding and enjoyment of Exmoor's special qualities. These are supported by a duty to foster the economic and social well-being of local communities in the context of the purposes.

2.6. The two purposes are best expressed by the cultural services shown in the table (e.g. natural beauty, wildlife, the historic environment, recreation and enjoyment, etc.) and so these services are listed first. The regulating services relate closely to the special qualities of the National Park and a broader definition of natural beauty, so are listed second. Finally, the provisioning services tend to be those for which there is a (partly) monetised market demand (particularly primary production of food and materials, and water supply) which relates to the duty to foster the economic well-being of local communities.

What and who could a register of natural capital be used for?

2.7. Asset registers are a tool commonly used by organisations to keep track of what they own or manage. Preparing a register of natural capital assets is recognised as the first stage in preparing natural capital accounts that value the benefits they provide[8]. A register of natural capital can therefore be defined as a "*way of making natural assets and their benefits explicit. This is a catalogue of the significant assets owned by the organisation, which includes data on the asset extent, condition, services and benefits delivered*"[9].

2.8. Although a register of natural capital has a specific role in the process of natural capital accounting, it may also fulfil other purposes in its own right without requiring the further steps of monetising the value of benefits produced. These are summarised in Figure 3, which shows that a register could have a wide variety of audiences and uses. This includes helping to improve public and professional awareness of how, in a given area, the natural environment benefits society; guiding investment and activity by the public, private and voluntary sectors; and providing a framework for tracking and reporting on change.

[8] Provins et al (2015)
[9] Landscape Institute (2015)

Figure 3. Potential purposes of a register of natural capital

Purpose	Audiences	Uses	Requirements
1. To inform and engage	Broad non-specialist	Deliberative, inclusive	Simple framework to facilitate debate. Clear links from assets to human benefits.
2. To understand delivery of services	Planners and managers	Scientific, technical	Use data to better understand functional pathways (cause/effect/risk) between assets and services
3. To prioritise public investment	Policy makers	Policy development	Use monetary valuation of benefits provided by assets. Broad estimates of extent may be sufficient.
4. To guide land management	Planners and managers	Policy delivery	Involves knowledge of potential outcomes (may involve valuation), extent, condition and change
5. To stimulate activity by others	Communities, businesses	Landscape management	Development of shared language and clear framework that emphasises opportunities
6. To monitor change	Planners and managers	Scientific, technical	Use data on relative change in extent and condition with ref. to a baseline and quantified objectives

2.9. Figure 3 also summarises what is required from a register of natural capital to fulfil the purposes. From this, we can conclude that:

- A register will need to accommodate data at a range of scales and of different types, including aspects of the environment that can be difficult to measure such as perceptual and experiential qualities.
- In many cases it will need to be represented spatially (i.e. as a series of maps), but it will also need to be interrogated as a database, with links to show the services that assets provide.
- To be effective, it must be capable of being presented as a consistent and uncluttered framework using language which is familiar to non-specialists.
- But it will also need to provide ways of holding and revealing more complicated data for technical uses, particularly to enable monetary valuation of the services provided by assets.
- Finally, it should connect strongly with communities and businesses, particularly those who own, manage or use the natural capital assets, giving them a stake in their protection and conservation.

What are the components of natural capital?

2.10. This might seem like an obvious question. After all, the definitions above talk about "*The world's stocks of natural assets which include geology, soil, air, water and all living things*". The Natural Capital Committee states that natural capital includes ecological communities, species, soils, land, freshwaters, minerals, sub-soil resources, oceans, the atmosphere, and the natural processes that underpin their functioning[10].

2.11. Much of the literature and guidance tends to conflate natural resources with natural capital. However, there is a significant distinction in economics between a natural resource and a capital asset. Whereas *natural resources* such as land, water and forests can exist in nature independent of human presence, *capital assets* are resources created and used by people in production of the final goods and services necessary to satisfy their needs and wants. In other words, when people take what nature provides and apply their ingenuity to transform natural resources into a more useful forms, they convert them into capital. This enhanced usefulness is what gives natural capital its value, and explains the label 'asset', showing that it is a source of benefits to people. Exmoor is natural capital because its natural resource basis has been transformed by human activity over a long period[11].

2.12. Clearly, a register that records only basic natural resources will not adequately describe the ecosystem services that are provided by a place like Exmoor. This is particularly the case for the cultural services and some of the provisioning services. It should be no surprise that this is the case since, for example, cultural

[10] Natural Capital Committee (2013)

[11] Dr Keith Howe, *pers. comm.* See also Dr Howe's paper on Economic Foundations in the Technical Appendix to this report.

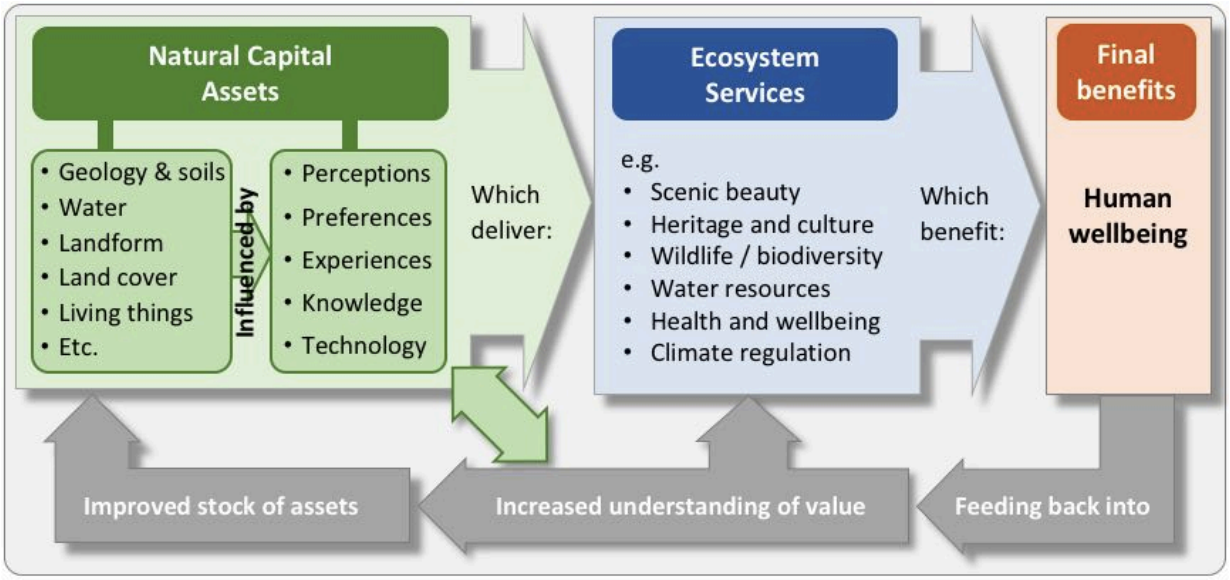
services have been defined as "*ecosystems' contribution to the non-material benefits that arise from human-ecosystem relationships*"[12]. Thus, Exmoor's natural beauty, which is core to its designation as a National Park and is the main attraction for its visitors[13], is derived from landform, land cover, wildlife and other physical features as well as the ways in which people perceive these through their preferences, imagination, knowledge and experiences. Similarly, Exmoor's cultural heritage (another special quality highly valued by visitors) is derived both from physical artefacts such as buildings, man-made landforms and other archaeology as well as people's understanding of their place in the landscape and their role in human history.

2.13. Natural capital partly reflects societal preferences for uses of the physical landscape expressed as statutory designations, rights of use and access, and definitions of character, as well as the outcomes of more personal perceptions. The difficulty of describing and quantifying these more personal and non-material aspects of the environment (such as natural beauty, tranquillity and sense of history) means that their benefits are often excluded from the natural capital approach[14]. However, just because they may be difficult to capture does not mean that we should ignore them. On the contrary, they are as much contributors to people's sense of well-being as, say, the cattle and sheep produced by Exmoor farms to feed us.

2.14. This study has reviewed other work that examines the role of human activity in shaping natural capital[15]. It has concluded that envisaging the two as entirely distinct elements, i.e. as separate streams of natural and human capital which combine to deliver ecosystem services, is not helpful. Instead, natural capital assets must be thought of as a combination of physical resources and human influences, placing people at the heart of how we understand and describe natural capital.

2.15. This study therefore defines **natural capital assets** as **natural resources influenced by societal and personal attributes**. This is illustrated in Figure 4 which shows that there is a powerful feedback mechanism in which people's wellbeing affects the value they place on natural capital assets. For example, enhancing attributes by adding to knowledge of the environment or aesthetic appreciation of natural beauty leads to a desire for improved protection and management of those assets.

Figure 4. The relationship between natural capital assets, ecosystem services and benefits to society



Adapted by this study from ONS (2017). Principles of Natural Capital Accounting

[12] Chan *et al.* (2011). Underlining added in this report.
[13] 'Landscape and scenery' was given as the primary attraction of Exmoor by people completing the 2016 visitor's survey.
[14] For examples of research that have addressed this issue see Natural England (2009) and RPA and LUC (2018).
[15] For instance, Jones *et al*. (2016) and Chan *et al.* (2011).

What framework is needed to classify Exmoor's natural capital assets?

2.16. The answers to the previous questions should enable us to define a list of the different types of natural capital assets that provide the services that Exmoor gives to society. To do this we need a way of categorising the many different assets involved, using a classification that is logical and recognises commonly used concepts.

2.17. The various disciplines involved in understanding the natural environment, such as ecology, hydrology, soil science, landscape architecture and archaeology, all categorise the assets according to their specific purposes. For instance, ecologists refer to habitats and species while landscape architects refer to character areas and features, and hydrologists to catchments and water bodies. There is duplication between these different typologies and, if the register of natural capital is going to be of value in sharing information from all these disciplines, a unifying classification is needed.

2.18. As we have seen, there are essentially two types of information that need to be recorded to describe natural capital assets. These are the physical resources - the things you can see and touch - and the qualities humans bestow on places and things, here called attributes. Both of these are shown in Figure 4. At the highest level of the classification there are therefore just two main categories: resources and attributes. Natural capital assets are the entities that are described by both resources and attributes, as illustrated in Figure 5.

2.19. Each of these two main components of natural capital assets can be split into separate 'domains'. In the case of resources, there are two domains of land cover and physical features and elements. In the case of attributes, there are three domains: defined areas; access and recreation; and perceptual and aesthetic qualities. Each of these domains can then be further divided into classes which in turn can be sub-divided into categories and sub-categories, until all the commonly encountered types of natural capital are covered. It is the category level of the classification that is likely to be the most frequently referred to. Figure 5 illustrates this structure diagrammatically and Figure 6 shows a fuller breakdown of the classification to category level. The technical appendix that accompanies this report contains the full classification structure, to sub-category level.

Figure 5. Diagrammatic representation of the classification of the natural capital register

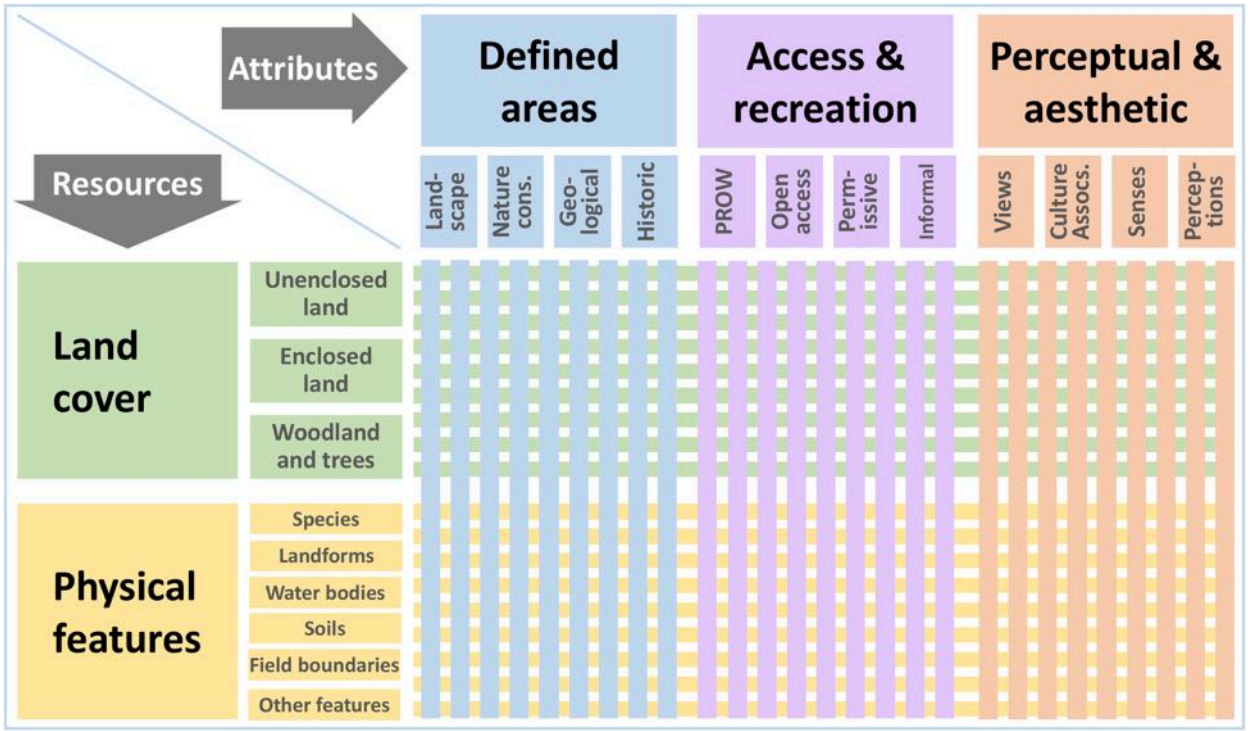


Figure 6. The classification of natural capital assets on Exmoor, to category level

Natural Resources		
Domain	Class	Category
Land cover	Unenclosed land	Heather moorland
		Grass moorland
		Mire
		Coastal habitats
	Enclosed land	Permanent pasture (5yrs+)
		Ley grassland (<5yrs)
		Enclosed rough grazing
		Arable crops
		Other enclosed land cover
	Woodland & Trees	Broadleaved woodland
		Conifer woodland
		Mixed woodland
		Orchards
		Scrub
		Specimen trees
Physical features and elements	Species	Plants
		Animals
	Landforms	Geology / geomorphology
		Human-created landforms
	Water bodies	Still water (lakes, ponds etc)
		Running water
		Springs and boreholes
	Soils	Carbon-rich soils
		Other significant soils
	Field boundaries	Hedgerow
		Hedgebanks and walls
		Other boundary feature
	Other features	Buildings
		Roads, tracks and paths
		Other significant features

Attributes we apply to the Resources		
Domain	Class	Category
Defined areas	Landscape	Protected landscapes
		Landscape character types
	Nature and geology	Statutory designations
		Non-statutory designations
	Historic environment	Statutory designations
		Non-statutory designations
	Hydrology	Statutory designations
		Non-statutory designations
	Common land	Common grazing rights
		Other common rights
Access & recreation	Statutory access	Public Rights of Way
		Open access land
		Public car parks & facilities
	Permissive access	Permissive routes
		Permissive open access
		Permissive car park
		Recreation attraction / event
	Other access	Informal routes and sites
Perceptual and aesthetic qualities	Views and vistas	Public (formal) viewpoints
		Informal vistas
	Culture and knowledge	Cultural associations
		Memory & knowledge
		Antiquity
	Sensory elements	Visual
		Soundscape
		Scents and smells
	Perceptions	Openness
		Wildness
		Tranquillity
		Challenge / risk

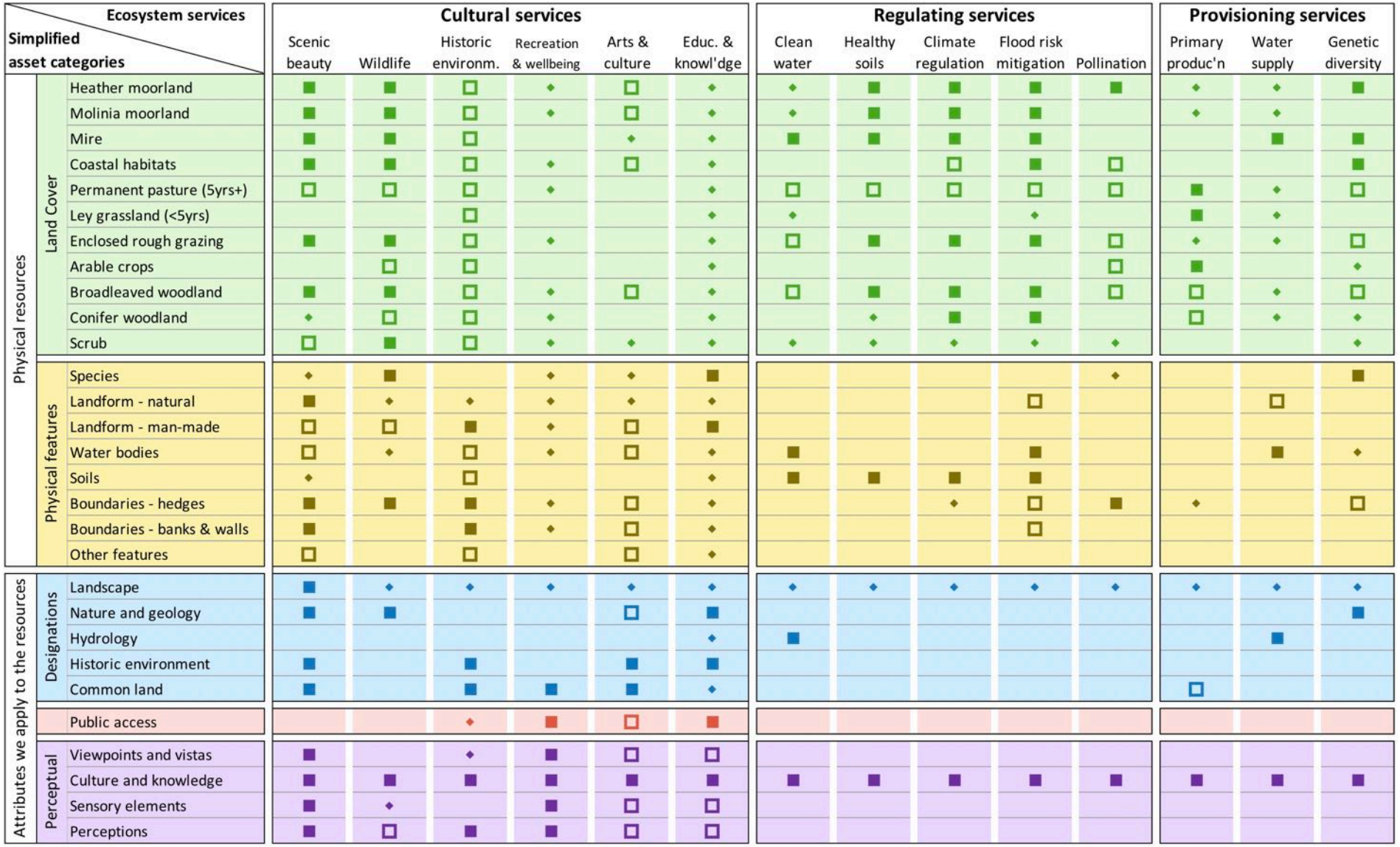
How do Exmoor's assets relate to the services they give us?

2.20. Having created a structure for defining different assets, it is possible to show how each of these assets has the potential to deliver Exmoor's ecosystem services. These relationships are indicated in the matrix in Figure 8 on the following page. In this matrix, the categories of assets are shown in the rows (some categories have been combined for simplicity) and the different services are shown in columns. Three types of symbol show the nature and strength of the way that assets contribute to services.

2.21. This matrix can only provide a summary of a complex situation and Figure 8 should be regarded as an initial way of showing the pattern of different relationships. A complete understanding of how different assets contribute to service delivery requires a detailed technical understanding of the natural processes involved and/or how the attributes we give to places contribute to the value we place on them[16].

[16] Natural England's Natural Capital Indicators Project (ongoing) is investigating the nature of these relationships through a series of 40 asset-to-service 'logic chains'. These are based on the UK National Ecosystems Assessment supplemented by expert opinion from Natural England and Environment Agency specialists.

Figure 8. The matrix linking Exmoor's capital assets to the services provided by the National Park



Key: ■: Asset likely to have a significant role in delivering the service; □: Asset may have a significant role, depending on condition and location; ◆: Asset has a more minor role

What information does the register need to hold?

2.22. In order to fulfil the range of purposes summarised earlier in Figure 5, a range of descriptors need to be recorded about each asset. The way in which the register does this must satisfy three criteria:

1. **Sufficient to support natural capital accounting.** The natural capital accounting process for identifying and valuing natural capital has an established methodology which requires that the 'stock' of individual natural capital assets is known[17]. Stock needs to be recorded in a number of different ways. These 'fields' of data are shown in Figure 9.
2. **Simple and consistent**. As well as recording the necessary information, the register must be simple to use and should present information in a common format, allowing the user to prioritise what is most important and compare between assets and areas.
3. **Compatible with existing sources**. A great deal of information is already available, held by Government agencies, Biological Records Centres, local authority Historic Environment Records, conservation bodies and landowners. Their data must be easily represented in the register. It should be noted that the register is not intended to replace or take precedence over these 'primary' sources, but rather to provide an integrated 'front end' for the data they hold.

Figure 9. Data fields used in the register to describe each individual natural capital asset

Field		Information recorded	Type of information
Type of assets		What is it?	Categories: Domain, class, category, sub-category etc. (See Fig 5)
Stock of assets	Extent and spatial configuration	How much and where?	GIS data (polygon, line or point) or text description
	Condition	What state is it in?	Categories e.g. good, fair, poor, bad
	Change over time	Is it improving or declining?	Categories e.g. same, more or less,

Extent and spatial configuration

2.23. What is the current extent of the assets occurring in each area? This question needs to be answered in two ways: first by stating how much there is (for most resources this can be measured quantitatively, but for attributes, a text description may be more appropriate) and secondly by stating where it is (again this may be done more precisely for physical resources than for attributes).

2.24. The spatial configuration (or location) of an asset is important because this often determines how it provides services. For instance, a public right of way will be more effective at providing recreational opportunities if it is well-connected to other accessible areas. For physical resources and for the attributes of defined areas and access/recreation, their spatial extent is best recorded on a Geographical Information System (GIS), either as a bounded area, a line or a point.

2.25. For the perceptual and aesthetic attributes, spatial extent may be either difficult to quantify or not relevant. These include views, cultural associations and knowledge (such as hefting of livestock or keeping of traditional breeds) and perceptions (such as the wildness of landscapes or the feelings of challenge and risk they give some people). Landscape character areas (as defined for Exmoor in the 2017 assessment[18]), provide a way of marking changes in these attributes. But in a register, a text description may also be helpful to describe their extent and location.

[17] For a description of the methodology see Provins A *et al.* (2015).
[18] Fiona Fyfe Associates (2017).

Condition

2.26. What is the current condition of assets? By condition, we mean their ability to deliver the goods and services that society needs and wants. For instance, an area of woodland that is being ravaged by pests or disease will not be as good at providing services such as genetic diversity or primary production as a semi-natural woodland in good health. Similarly, an archaeological site that is being eroded and forgotten will not provide cultural heritage or education as well as a site that is well looked after and recorded.

2.27. There are often complex technical ways of describing condition for different types of assets (reviewed in the following section – see para. 3.14). However, for the register, a simple four-level scale of 'excellent, good, fair and poor' should be sufficient to enable comparison between assets. It is also worth noting that assets may have different conditions for different services. For instance, grazed pasture that is in good condition for primary production (e.g. rearing livestock) and storing carbon and flood water may not be in good condition for wildlife, pollination or natural beauty. There will be a compromise in the register between simple utility (a single measure of condition) and comprehensive detail (a separate measure for each service, or for similar groups of services).

Change over time

2.28. What has been the change in extent and condition of these assets? Answering this question may not be strictly necessary for natural capital accounting, but it helps to identify whether the flows of goods and services provided in each area have been improving or deteriorating, leading to decisions about where policy intervention is most needed in the future. As with condition, tracking historical change can be a complex topic; not least in defining the period over which change can be measured. This study uses a simple assessment of whether the extent of assets has increased, reduced or stayed the same over the last few decades (depending on what time series data are available).

Other information about assets

2.29. Other types of information are often recorded about environmental assets. These include the risks and opportunities for protecting and enhancing them, and the critical thresholds at which their ability to deliver services changes significantly. This information is used to define the management objectives that will be taken forward by policy programmes and projects. Extending the register to cover these topics for all assets is not appropriate since, where the information is not already available, it would require lengthy discussions with the appropriate bodies. However, where such information has already been prepared, it could be included within the register.

Conclusions from this section

- Natural capital is defined, mostly simply, as "the parts of the natural environment that produce value to people".
- In order to describe natural capital assets, we first have to identify the goods and services that they provide to society.
- A register of natural capital assets has the potential to be used in many different ways, from formal monetary valuations to engaging with the public about how we all benefit from nature.
- To understand how natural capital assets provide services, we must take account of both their physical aspects as resources (things we can see and touch) and their attributes (the qualities we give them).
- Existing classifications of environmental assets use different terms and duplicate each other. This study proposes a new unifying classification of assets, split between resources and attributes.
- In order to measure the stocks of natural capital assets, we need to measure or describe their extent and spatial configuration, their condition and the way they are changing.

3. Lessons from the pilot areas

3.1. This study has tested the definitions of natural capital set out in the previous section on three areas of Exmoor. This section describes this piloting work using the following headings.

1. The selection and location of the pilot areas
2. Existing ways of recording information about environmental assets
3. Sources of data for the register
4. Outputs from the register to highlight natural capital assets
5. Using the register to show service delivery
6. How well the register fulfils its potential purposes

The selection and location of the pilot areas

3.2. The three pilot areas were selected to be broadly representative of the range of characteristics in the National Park. The 2007 Landscape Character Assessment of Exmoor[19], which describes the National Park's nine distinctive landscape types, was used to create areas of search.

3.3. The pilot areas were defined as individual farm holdings for the practical reasons that permissions and information can be easily gained from the landowner and farmer and also because of the potential use of the register as part of future farm and environmental support. Personal contact by members of the Steering Group was used to identify three landowners (and in two cases their tenants) who were willing to take part in the study.

3.4. Figure 9 shows the location of the three pilot areas and the distribution of the Exmoor's nine landscape character types.

- The first pilot area, Wydon Farm, is in the north eastern area of the National Park on the coast. It is split into two areas (Wydon Farm itself as well as Bossington and Selworthy Hills) and covers five of the nine character types.
- The second area, Lyshwell, is on the southern edge of the National Park. It consists of a single block of land covering two of the character types.
- The third area, Aclands, is in the central and western part of the National Park. It is in two parts, split between the main holding and separate grazing land at Chapman Barrows. It covers two of the character types.

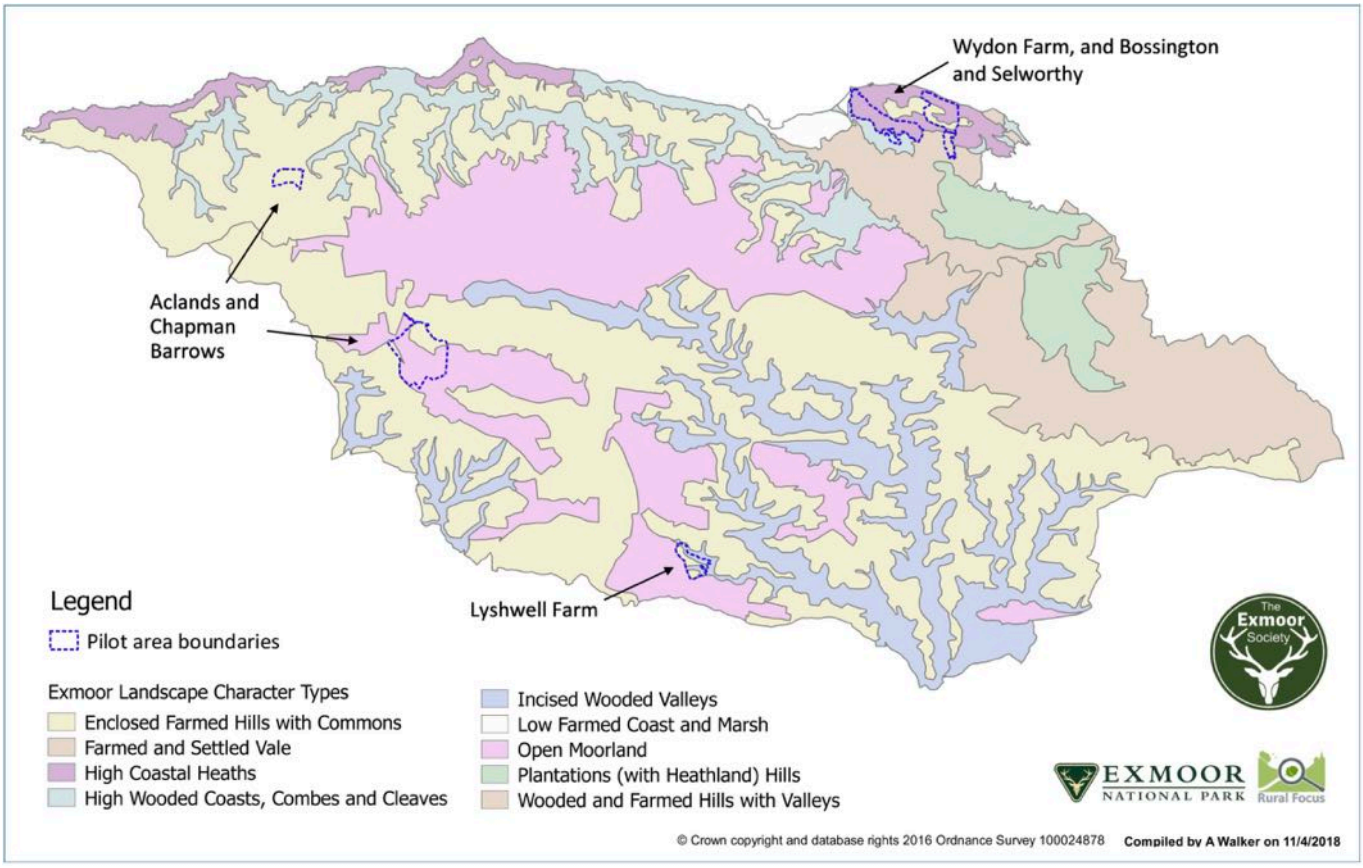
3.5. Two of Exmoor's nine landscape character types are not included in the pilot areas. These are the 'plantation (with heathland) hills' and the 'wooded and farmed hills with valleys' that occur in the Brendon Hills in the east of the National Park.

3.6. For each of the pilot areas, data on natural capital assets were recorded within the farm boundary itself and also in a buffer zone 250m wide around the farm to ensure that the context and connectivity of natural capital around the farm were properly recorded.

3.7. In addition, a wider buffer (not defined) was taken into account when considering large scale elements such as landform and some of the aesthetic and perceptual qualities such as views.

[19] Preece E (2007)

Figure 9. Location of the pilot areas within the framework of Exmoor's Landscape Character Areas



Existing ways of recording information about environmental assets

3.8. Although the concept of natural capital may be relatively new, information about environmental and cultural assets (such as habitats, species, historical sites and landscape features) has been recorded and used for many decades. Before creating a new way of portraying data on natural capital, we should ask whether tried-and-tested formats can be used.

3.9. Examples of existing formats include management plans (such as those prepared by the Farming and Wildlife Advisory Group and Forestry Commission), Farm Environment Plans (for applications to Environmental Stewardship) and online GIS databases such as MAGIC[20] and SHINE[21]. Although management plans often take a rigorous approach to assessing assets as part of identifying opportunities and actions, there is no standard model that can be applied to all rural land. Formats such as Farm Environment Plans and the MAGIC portal are used to portray existing data but do not take a systematic (and natural capital / ecosystem service focussed) approach and do not record perceptual and aesthetic qualities.

3.10. This study encountered two recently developed software formats that have the capability to acts as effective and flexible natural capital asset registers. These are the GIS database being created by FWAG South West (www.fwagsw.org.uk) for its work for the Duchy of Cornwall and the Land App (www.thelandapp.com) which is being tested in the South Downs National Park (amongst other areas). Both of these deserve further consideration.

Sources of data for the register

3.11. This study approached the issue of how to populate the register by looking for the information needed to adequately describe the stock of natural capital, rather than by haphazardly capturing the large amounts of environmental data that already exist.

[20] http://www.natureonthemap.naturalengland.org.uk/About_MAGIC.htm

[21] SHINE stands for Selected Heritage Inventory for Natural England and is used to collect information on the historic environment for Countryside Stewardship applications. See: https://www.myshinedata.org.uk

3.12. Nevertheless, the register must be able to accommodate the large amount of spatial and other data that are already available (noting that the register is not intended to replace existing databases, but to provide a unifying way of portraying their data). Exmoor National Park Authority holds a large amount of environmental data covering the National Park, much of it provided to the Authority under licence by other bodies. Where these licences allowed it to do so, the Authority made the data available to this study.

Data describing the extent of assets

3.13. The first and most important information needed to define the stock of natural capital assets is their extent and spatial configuration. As noted in Section 2, this is usually in the format of GIS data (for natural resources, defined areas and access & recreation), but may be descriptive text for some of the perceptual and aesthetic qualities. Analysis of the data available for the pilot areas reveals that there are GIS datasets which provide high quality data on the extent of many assets on Exmoor (full details for each category of assets are provided in the Technical Appendix). Figure 10 shows that many of these provide national coverage while some apply only to the National Park (although the LCA and HER are available in equivalent formats, but not necessarily the same detail, in other areas of England).

Figure 10. Key sources of GIS data on the extent of assets

Datasets with national coverage	Data sets specific to Exmoor
• Ordnance Survey Mastermap provides the base map of land parcels, often also identifying land cover in many of these parcels. • Natural England's Priority Habitat Inventory (PHI) records the extent of many broad habitat types of nature conservation interest • The Forestry Commission's National Forestry Inventory maps and classifies different types of woodland cover with areas above 0.5 ha. • Boundaries of statutory designations (e.g. SSSIs, NVZs and Scheduled Monuments) are held by national agencies.	• The Exmoor Landscape Character Assessment (LCA) distinguishes the patterns of landscape character and describes the key features and qualities in each area. • The National Park Authority's Section 3 map shows the extent of mountain, moor, heath, woodland, down, cliff and foreshore. • The National Park Authority's Historic Environment Record (HER) includes a large amount of data but requires interpretation. • The definitive maps of Public Rights of Way are maintained by the County Councils.

3.14. There were important GIS datasets that were not available to this study because of licencing restrictions or cost. These include the Rural Land Register held by the Rural Payments Agency, Land Cover Map 2015 (produced by the Centre for Ecology and Hydrology), species data held by the Biological / Environmental Records Centres and Soilscapes data from the National Soils Resource Institute at Cranfield.

3.15. Notwithstanding the large number of existing datasets, there are four important limitations to the use of these data to describe the extent of natural capital assets.

- Firstly, there is **inconsistent duplication**, where the same asset is covered in two or more datasets, but each shows different extents. An example of this is moorland (a key habitat on Exmoor) which is mapped differently by the OS Mastermap, Section 3 map, PHI and Defra's moorland line.
- Secondly there are **old data** which may have been produced decades ago but have not been checked or updated since (an example of this is some of the PHI data).
- Thirdly, the study encountered **gaps** in existing spatial data on the extent of important assets. Examples of this are grassland (with the exception of grassland of high nature conservation value) and hedges. Some of the gaps could be filled by purchasing data, such as from Land Cover Map 2015 and the Soilscapes database, but these carry a significant cost.
- Finally, for several of the perceptual and aesthetic qualities, existing information was **spatially imprecise** (i.e. not available at a fine-enough resolution)

3.16. An important conclusion is that much of the existing data describing the extent of natural capital assets are either partial and inconsistent, or costly. For some of the assets, their extent could only be described by

obtaining new information, either from aerial photography (accepting that agricultural land cover may change from year to year) or from a visit to the area, either for field survey or, more importantly, to interview the farmer. Analysis in the Technical Appendix shows that the most significant gaps in data for physical resources are for grassland (particularly identifying permanent and low input grassland) and field boundary types (particularly the beech hedgebanks that are characteristic of much of Exmoor). Although the perceptual and aesthetic attributes are described at a high spatial level in the Exmoor Landscape Character Assessment, site visits enabled much better understanding of how these apply at smaller scales and enabled the knowledge and experience of the farmer to be taken into account.

Data describing the condition of assets

3.17. As noted earlier (para. 2.25), condition is defined in relation to how well assets are able to deliver services. For some assets, this may already be measured in a pre-determined way. Examples include the Environment Agency's Water Framework Directive assessment of the ecological condition of water bodies (five condition classes), Natural England's SSSI favourable condition assessment (four classes), Historic England's Heritage at Risk Register (four classes) and the National Park Authority's surveys of Public Rights of Way (three classes).

3.18. However, for many assets on Exmoor, their condition is not currently recorded. This is the case for many of the assets that are commonplace and deliver many ecosystem services (e.g. grassland, hedges and woodland). Suitable assessment methodologies already exist and can be applied. Natural England's Farm Environment Plans[22] contained a condition assessment for many habitats and features, producing three classes (A, B & C) to guide management[23]. The Forestry Commission's English Woodland Grant Scheme included a Woodland Condition, Opportunities and Threats Assessment. These can be adopted to assess condition of assets through field survey. Although the methodologies are relatively simple, adding this condition survey requirement to the preparation of the register adds significantly to the time taken.

Data describing the change over time of assets

3.19. Tracking trends in the extent and condition of assets on Exmoor requires suitable time series data to compare. This study did not attempt to track changes in condition since most existing data are recent but did explore changes in extent from historic maps. Most old maps do not record land use in any detail (with the exception of woodland and waterbodies). Maps which do, to a greater or lesser extent, include the first edition Ordnance Survey County Series maps (Somerset 1882-1888 and Devon 1855-1889), the First Land Utilisation Map prepared by Dudley Stamp (1932-34), the Second Land Utilisation Map prepared by Alice Coleman with additional surveys of Exmoor's land use commissioned by the Exmoor Society from Geoffrey Sinclair (1965), and the more recent Land Cover maps prepared by the Centre for Ecology and Hydrology (1990, 2007 and 2015). This study used Geoffrey Sinclair's 1965 map, a digital copy of which is held in the Exmoor Society Archive.

Outputs from the register to highlight natural capital assets

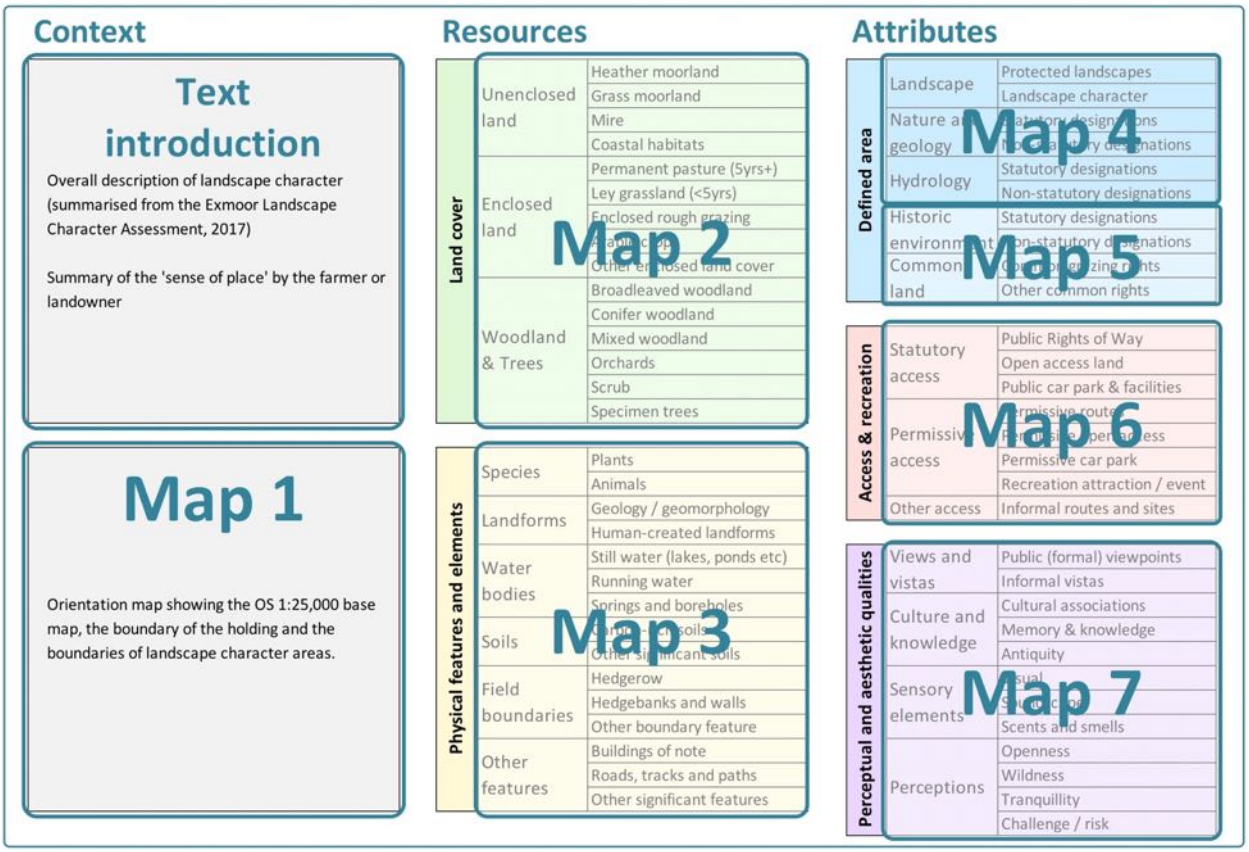
3.20. A suitable geodatabase, containing spatial data and associated numerical and textual fields, can be constructed to record the information described above, wherever possible making use of existing 'primary' sources (see the Technical Appendix for the proposed structure). However, creating a database is of no value if the information cannot be displayed in ways that are useful. Inevitably, a compromise is needed between providing comprehensive detail and highlighting the key points in ways that aid communication and decision making, particularly when it comes to guiding the conservation and management of assets.

Showing the extent of assets

3.21. This study came to the conclusions that a total of eight pages can be used to show the extent of all natural capital assets in ways that are easy to assimilate. These consist of an introductory page of textual description followed by seven annotated maps. As shown in Figure 11, each of the maps shows a different set of assets. Map 1 shows the overall spatial context, maps 2 and 3 cover the natural resources and maps 4, 5 and 6 cover the human attributes.

[22] Farm Environment Plans were part of the application process to the Higher Tier of Environmental Stewardship. That scheme's replacement, the higher and middle tiers of Countryside Stewardship now requires the completion of a simpler Farm Environment Map.
[23] Natural England (2010)

Figure 11. Display of information describing the extent of natural capital assets



3.22. There is only room in this main report to show a few examples of these outputs of the register. Copies of all the outputs for the three pilot areas are provided in the Technical Appendix. Maps 2, 3 and 7 are perhaps the more innovative maps developed by this study (Maps 1, 4, 5 and 6 being similar in content to maps that already exist), so Figure 12 shows an example of Map 2 (Land cover), Figure 13 shows Map 3 (Physical features and elements) and Figure 14 shows Map 7 (perceptual and aesthetic qualities).

Figure 12. Map 2 (Land Cover) for Lyshwell

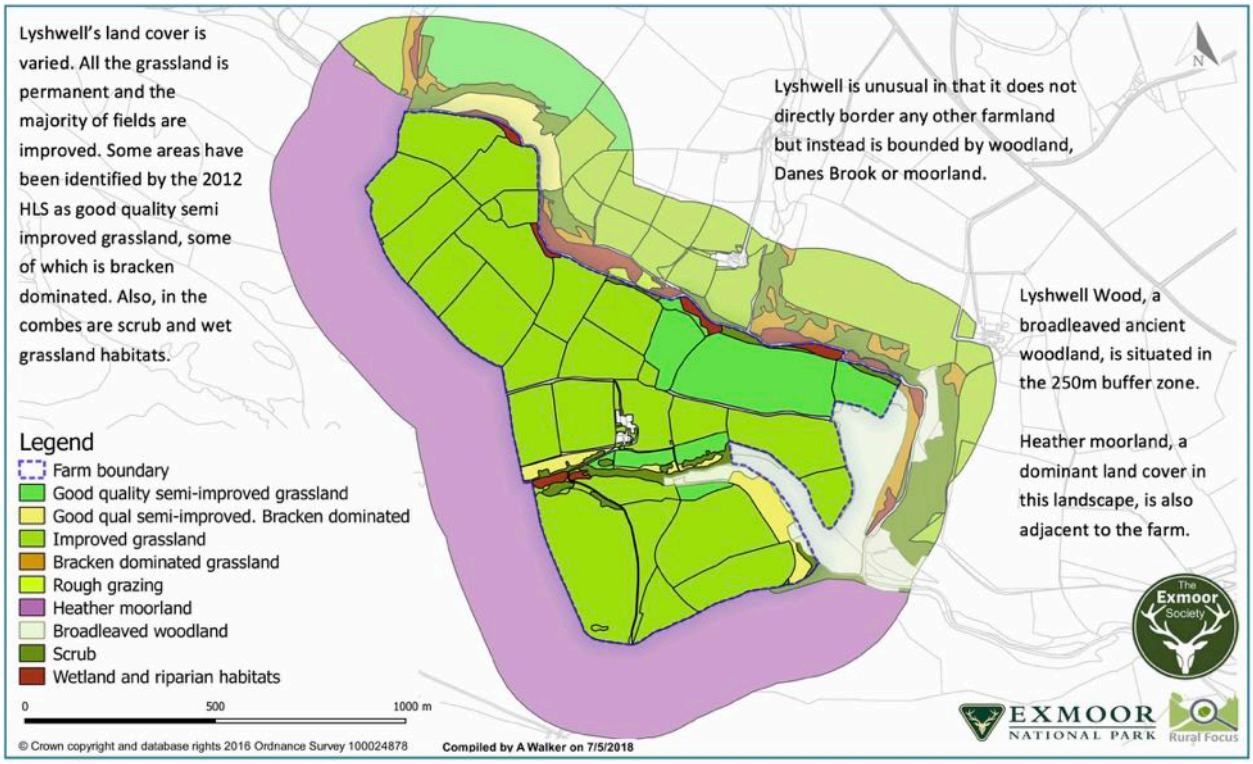


Figure 13. Map 3 (Physical features and elements) for Wydon

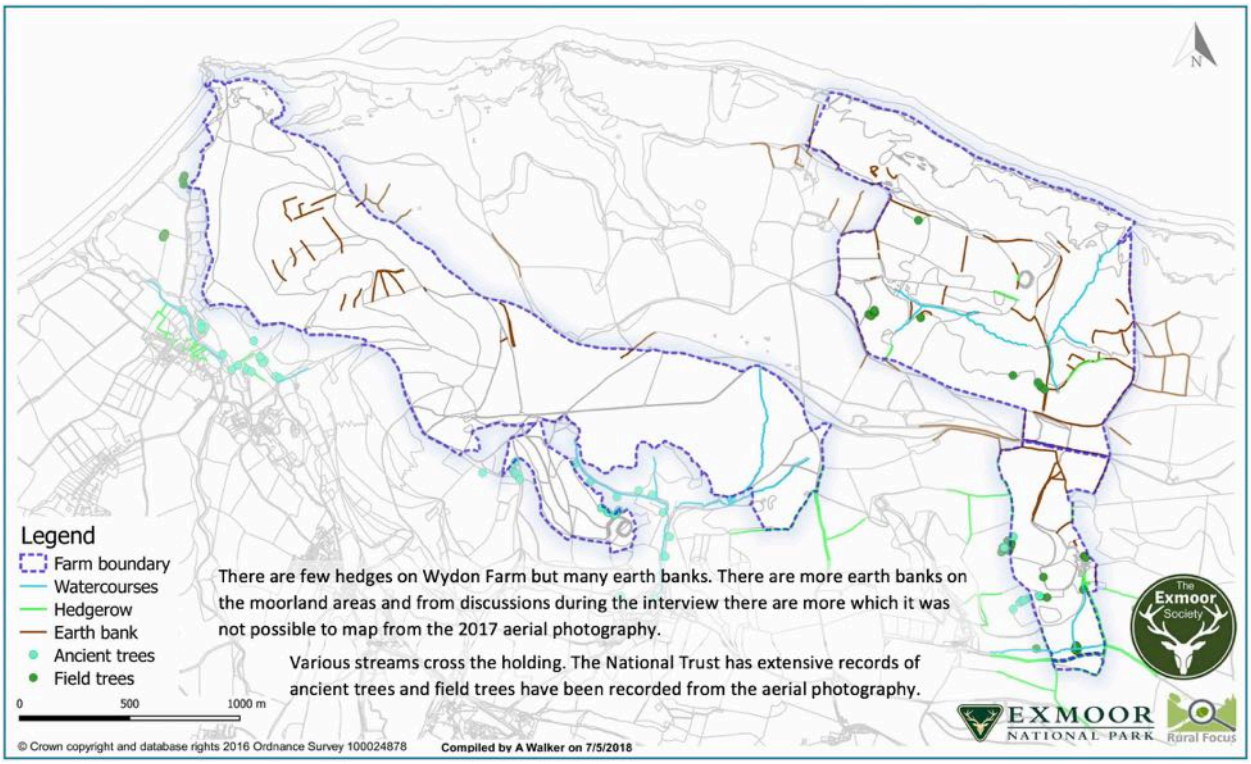
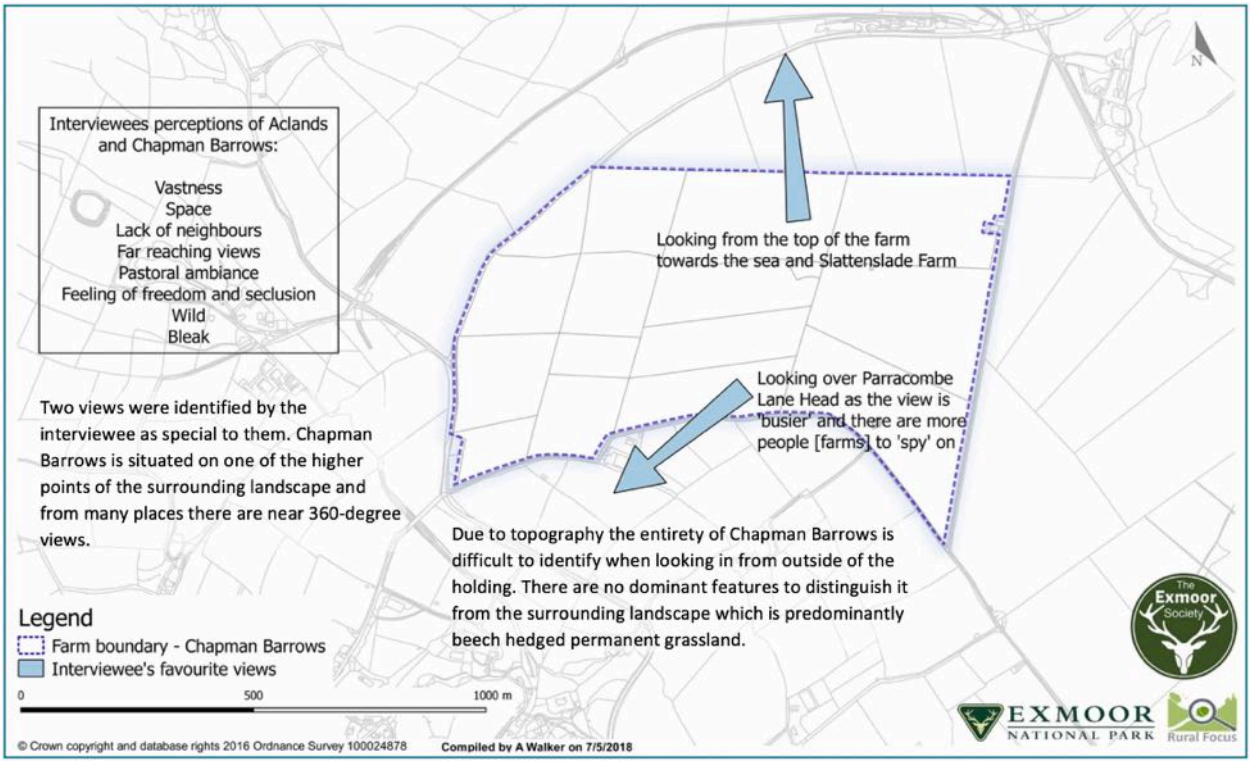


Figure 14. Map 7 (Perceptual and aesthetic qualities) for Chapman Barrows, part of Aclands



Showing the condition and change of assets

3.23. This study has not explored simple ways of presenting the condition of assets, primarily because there was insufficient existing information for many of the assets in the pilot areas. However, it is suggested that a 'traffic light' symbology could be used to do this.

3.24. As noted earlier (para. 3.16), trends in the extent of land cover were assessed by comparing the Land Utilisation Map prepared for Exmoor in 1965 by Geoffrey Sinclair[24] with current land cover. In order to do this, the digital copy of the 1965 map held by the Exmoor Society was imported into GIS, allowing the areas of land cover in 1965 to be mapped and quantified, and compared with current land cover. Figures 15 and 16 show the breakdown of land cover for Wydon at the two dates, showing a loss of moorland converted to improved grassland and colonised by woodland, as well as a decline in arable cropping (the use of root crops as livestock winter fodder in 1965 having been replaced by bought-in feeds and silage). The Technical Appendix provides equivalent analysis for all the pilot areas.

Figure 15. Charts showing changes in land cover 1965 to present on Wydon Farm

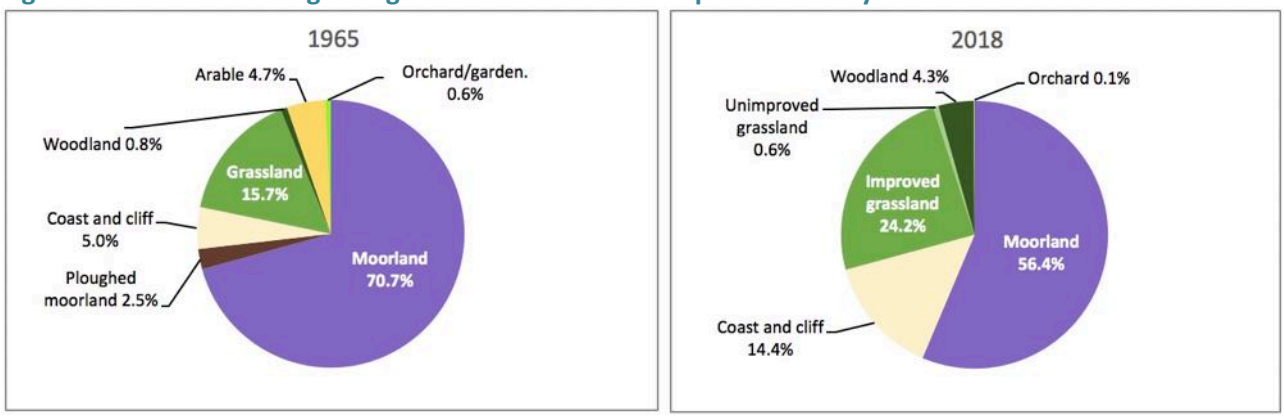
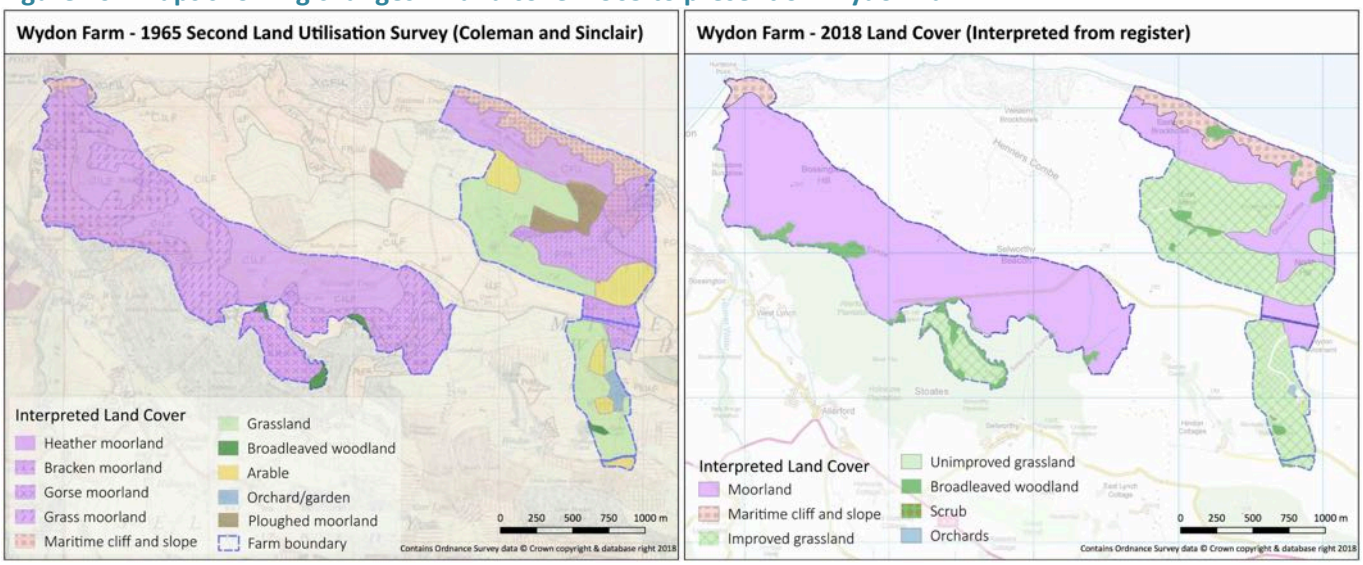


Figure 16. Maps showing changes in land cover 1965 to present on Wydon Farm



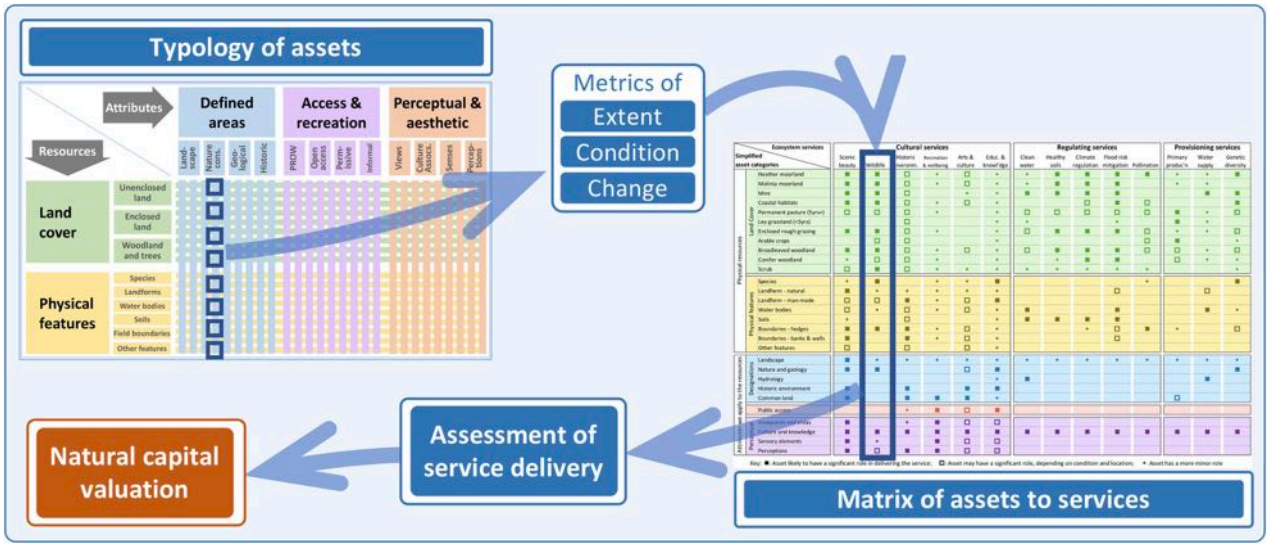
Using the register to show service delivery

3.25. As well as showing the stock of natural capital assets, the register should also be used to identify the assets which are most influential in providing different ecosystem services. As noted earlier (para 2.4 and Figure 4), the primary rationale for describing natural capital assets is to understand the goods and services they provide to society. It is from the data that are contained in the register on the stock of assets, and the links to the services they deliver, that the value of natural capital can be estimated.

3.26. Figure 8 made an initial assessment of the relationships between assets and services on Exmoor. Figure 17 shows that this can be combined with the data in the register to understand how natural capital is delivering services from each area. This process can then be taken to the next stage which involves natural capital valuation, where the monetary value of the services can be estimated (not covered by this study).

[24] This 1965 map was commissioned from Geoffrey Sinclair by the Exmoor Society. It incorporates the cartography from Alice Coleman's Second Land Utilisation Map, also dated 1965, which covered most of the UK, albeit with limited areas published.

Figure 17. Schematic diagram showing how service delivery can be assessed, leading to valuation



3.27. In practice, the limitations of existing data and the resources needed to fill gaps are constraints on producing a comprehensive and highly accurate assessment of service delivery. It is important to accept that we live in a world of incomplete and imperfect information, and so appropriate means are needed to use available data to best effect. Other research, being led by the Environmental Change Institute at the University of Oxford[25], is seeking to develop a robust and broadly applicable methodology that quantifies service delivery from natural capital, using measures of extent and condition to score outputs of service. In this study, a necessarily simplistic approach has been taken based on the quantity (area, length or number) of assets and a simple classification of condition in relation to the service under consideration. An example of these assessments is shown in Figure 18.

Figure 18. The natural capital providing the service of Genetic Diversity at Lyshwell

Assets on the farm	Extent	Condition	Notes
Wet grassland	1.2 ha	1	Some designated as Local Wildlife Site.
Good quality semi-improved grassland	12.2 ha	2	Some designated as County Wildlife Site (CWS). Likely to have a higher number of plant species present.
Good quality semi-improved grassland. Bracken dominated	2.5 ha	3	Likely to have a higher number of plant species present but probably less than non bracken dominated grassland of the same type. Useful if fritillaries present. Some designated as CWS
Scrub	2.3 ha	1	Mix of gorse & shrubby trees. Some designated as CWS.
Broadleaved woodland	1.2 ha	1	Native tree species of mixed age. Ground flora.
Hedgerows	8.0 km	1	Mixed ages & heights. Dense. Some recently laid. Predom. beech.
Waterbodies	2.7 km	1	Good water quality.
Breeding birds	N/A	N/A	Data not available
Exmoor Horn sheep	N/A	N/A	Closed, breeding flock. Win local Society prizes.
Assets to consider outside of the farm boundary			
Heather moorland	67.0 ha		Special Area of Conservation, Site of Special Scientific Interest
Broadleaved woodland	10.1 ha		Ancient woodland. CWS.

Condition scoring: 1 = good, 2 = fair, 3 = poor and 4 = bad.

[25] The Eco-metric Approach. See https://ecosystemsknowledge.net/sites/default/files/wp-content/uploads/2017/events/Tatton-workshop/AlisonTatton_ToolOverview_NaturalCapitalRuralEstate_Oct17.pdf

How well the register fulfils its potential purposes

3.28. A range of potential uses of a register of natural capital assets were described in Figure 3 on page 5 of this report. Having shown how the concept of the register has been developed and applied to the pilot areas, it is helpful to consider how well it meets those requirements. These requirements, summarised in paragraph 2.9, include accommodating existing and new data of different types and scales; representing these data in a clear and consistent way; recognising the ways that assets provide cultural services; connecting strongly with local communities and businesses (particularly those with responsibility for managing them); and finally enabling the monetary value of services provided by assets to be estimated.

A unified classification for what nature gives us

3.29. At the outset of this study, it was not anticipated that a new way of classifying natural capital would be needed, but the duplication and mismatch between current definitions used by different environmental disciplines required a new approach. A key distinction is between the physical resources (things you can see and touch) and the human attributes (qualities we apply to the resources) that together create the capital assets that have value to society. Although the suggested typology has been designed around the natural capital found on Exmoor, it should need relatively little amendment to suit other areas.

The importance of cultural services and the assets that support them

3.30. The brief for this study recognised that most of the existing work on natural capital has paid little attention to the cultural services, despite these services being high on the public's lists of wants, especially in a National Park. Compared to the assets that provide regulating services such as clean water or carbon storage, the assets that produce natural beauty, a sense of antiquity or wildness are difficult to pin down (and particularly to quantify). The process of landscape character assessment, and the descriptions it produces, provide a good baseline that can be developed in discussion with people who know an area well. Such discussions were limited in this study to the farmers and in future this should be expanded to wider communities.

Coping with imperfect information

3.31. It is important not to be daunted by old or incomplete information on the stock of natural capital and to recognise that data will never be comprehensive. Tools such as the register that help us make good decisions need to make best use of data that are available or can be obtained easily. It should draw on existing primary datasets and not seek to replicate or replace them. To this end, further technical work is needed to create a suitable geo-database structure that can incorporate data from different sources. The suitability of existing models, such as that developed by FWAG SW and the Land App (para. 3.8), should be investigated. Some valuable data was not available to this study because of cost or licensing issues and this also needs to be addressed.

Engaging the people who own, manage and use natural capital

3.32. A key purpose of the register on Exmoor will be to influence the actions of farmers and others who look after and use its natural capital. A salutary comment from one of the pilot area farmers was that they felt their own skills and knowledge had not been taken into account when previously preparing a Farm Environment Plan, but that they felt a stronger sense of ownership of the register, because it captured a sense of their own feelings and experience of the land. Developing this buy-in and appreciation of the value of natural capital from everyone who influences its management must be an important output of the process of preparing the register.

Providing the baseline for valuation of natural capital

3.33. Natural capital accounting is likely to be an increasingly important tool for public authorities, charitable bodies and large companies. Although outside the scope of this study, Exmoor National Park Authority is working with the South Partnership for Environmental and Economic Prosperity (SWEEP) at the University of Exeter to investigate how the process can be used on Exmoor. To date, natural capital accounting has focussed on the services and assets that are easiest to quantify and value. Estimating the monetary value of cultural services such as natural beauty will remain a challenge, but the methodology developed in this study has come a step closer to objectively describing the assets that provide these services.

4. Conclusions and recommendations

4.1. The following findings emerge from this study.

Summary conclusions

1. This study breaks new ground: It proposes a simple classification; it seeks to describe the way natural capital delivers cultural services; it uses landscape character assessment to ensure descriptions of natural capital are place-based; and it shows the importance of involving local knowledge and values.
2. Clarity and consistency, and a rigorous approach to terminology and definitions, will be essential if the concepts of natural capital and ecosystem services are to gain currency amongst decision makers.
3. Existing data are messy – conflicting, gappy and dated – even in an area as well studied as Exmoor. Data ownership and costs are a constraint. Drawing on existing data has been the most time-consuming task in this study. This can be reduced with economies of scale but filling significant gaps would still require major resources if a register were to be produced over larger areas.
4. A register of natural capital assets should provide a 'front end' for, and not seek to replace, other primary sources of data. However, it will be helpful if consistent approaches to recording aspects of natural capital such as condition (for instance four-point scales) and change can be developed. More work needs to be done on the use of a geodatabase structure (building on existing models where possible) that is capable of receiving data from primary sources.
5. The cultural ecosystem services are often overlooked in natural capital accounting. Rather than separating cultural and natural capital, this study includes cultural attributes as intrinsic to natural capital. The tools of Landscape Character Assessment offer an objective way of describing these attributes.
6. Engagement with those who own, manage and use natural capital is essential and the process of preparing a register must take account of their knowledge and skills. The requirement to capture information about the perceptual qualities and management practices of natural capital provides a way of achieving this.
7. The scope of this study has been limited. It has not sought to apply a monetary value to the benefits provided by natural capital or look for patterns of natural capital at a large scale across landscapes. Both of these requirements need to be developed if the full value of a register is to be realised.
12. Notwithstanding these limitations, this study has demonstrated that a register of natural capital can provide a way of assessing the full value of the National Park designation (as set out in its statutory purposes) to society.

Recommendations

4.2. It is clear from this study that there is great potential to further develop the use of a register of natural capital on Exmoor, and that more work can be done to test its applicability in other areas. The following eight recommendations are intended to guide future activity. For each recommendation, the organisations that may be best placed to take the lead are suggested in italics.

4.3. **Improving understanding of natural capital**: The Government and a growing number of organisations are committed to using the concept of natural capital to guide policy development and delivery. The concept is still relatively new and is not yet familiar to many of the people who own or manage Exmoor's natural environment.

> **1.** Further dialogue should take place on Exmoor between environmental organisations, landowners and managers to embed and develop the concept of natural capital and the services it provides. A proper understanding of cultural elements will be essential if this is to take place. *ENPA and Exmoor Society.*

4.4. **Natural capital and the cultural services**: This study is one of relatively few that have sought to identify, in a practical setting, how natural capital assets deliver cultural services. It has taken a somewhat different

approach to other studies[26] and there will be merit in further reviews in order to generate a broad consensus on the way forward.

2. Further consideration should be given to the role and definition of the natural capital assets that support cultural ecosystem services, ensuring that data on these assets is recorded in a systematic way so that it can support natural capital accounting. Nationally: *Natural Capital Committee, Natural England and Historic England.* Locally: *The Exmoor Society.*

4.5. **The functional links between assets and services**: The value of natural capital can only be properly assessed in relation to the services it provides to society. This requires technical knowledge of how the extent and condition of assets affect the flow of services they provide. Ongoing research is needed to improve this knowledge, especially for services such as climate regulation and flood risk mitigation.

3. The pathways connecting the stock of natural capital with the flow of services and benefits should be better understood, applying the results of international and national research to the patterns of natural capital and service delivery found in areas like Exmoor. *Defra research and national agencies.*

4.6. **Geodatabase development**: This study did not have the expertise or resources to design and build the IT framework (for instance using QGIS and PostgreSQL) to receive spatial and other data from primary sources, making the necessary links to create a fully functioning register. This work would need to be done, working with suitable providers, before a register could be developed covering larger areas of Exmoor.

4. Technical development of GIS and associated database structures should take place, making use of existing models where available, to create a fully functioning 'front end' register to receive data from primary sources. *Exmoor National Park Authority.*

4.7. **Access to data**: There are valuable sources of spatial data that map the location of assets which were not available to this study. These include the Rural Payment's Agency's Rural Land Registry, The Centre for Ecology and Hydrology's (CEH) Land Cover Map 2015, The National Soils Resource Institute Soilscapes data and species data held by the Biological/Environmental Records Centres.

5. An assessment of the costs and benefits of acquiring additional data sources should be undertaken so that the best available information can be incorporated into a natural capital asset register for Exmoor. *Exmoor National Park Authority, working with partners (Natural England, SWEEP, etc).*

4.8. **Filling important gaps in the register**: This study has found that some important natural capital assets on Exmoor, such as permanent grassland and hedgerows, are not adequately captured by existing datasets. This is likely to be the case in other areas. New ways of gathering data which are cost-effective and can be applied objectively (potentially involving use of aerial photographs or field visits) need to be developed, drawing where possible on established metrics and classifications (for instance types of hedges).

6. A robust and repeatable methodology for filling gaps in data on natural capital assets should be developed and tested in another area. *North Devon Landscape Pioneer (Natural England).*

4.9. **Using the register to value the services that natural capital provides**: Natural capital accounting should be one of the main uses of a register. A register that seeks to identify the full range of assets for all the main services on Exmoor will enable a more complete valuation of natural capital than has been possible before.

7. Research on the monetary valuation of services provided by the full range of natural capital assets should be tested on Exmoor, advancing the use of natural capital valuation. *University of Exeter (SWEEP).*

4.10. **Sharing the findings of this research more widely**: It is hoped that the conclusions from this study will be of interest to people working on natural capital in other areas of the UK and more widely. The Natural Capital Assessment Gateway (an online portal maintained by the Ecosystems Knowledge Network[27]) should provide a means of doing this.

8. The results of this study should be shared with others to help shape policy development and delivery. *Ecosystems Knowledge Network.*

[26] For instance, Jones *et al* (2016)

[27] https://ecosystemsknowledge.net/natural-capital-assessment-gateway

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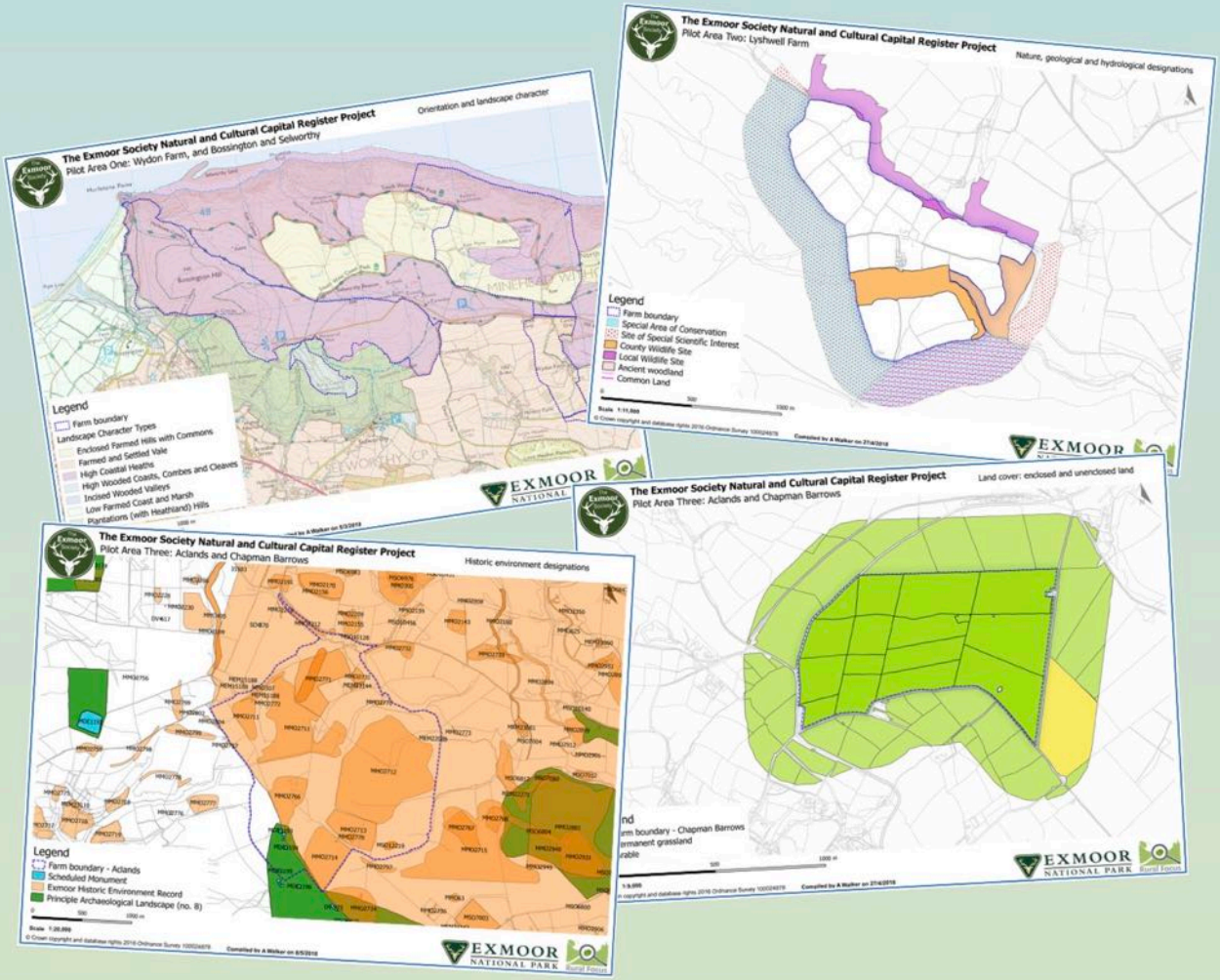
Towards a Register of Exmoor's Natural Capital

Main report prepared for The Exmoor Society by Rural Focus Ltd, June 2018

A Technical Appendix containing further analysis and copies of the outputs of the register, such as those shown below, can be downloaded from: https://www.exmoorsociety.com/content/publications/reports-2



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