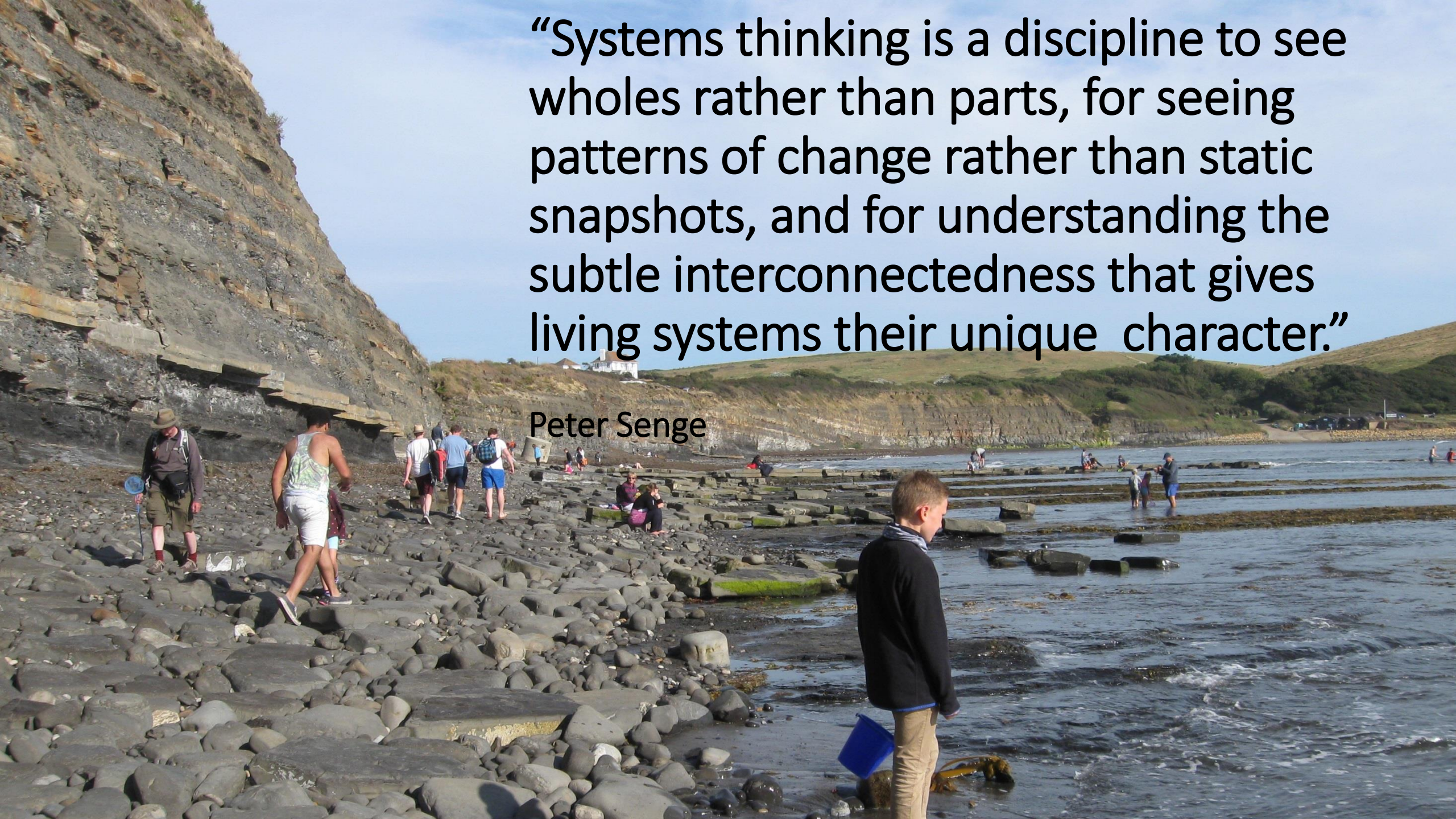
Decisions, values and systems

Ruth Waters

Natural England

Cowboy economy to Spaceman economy

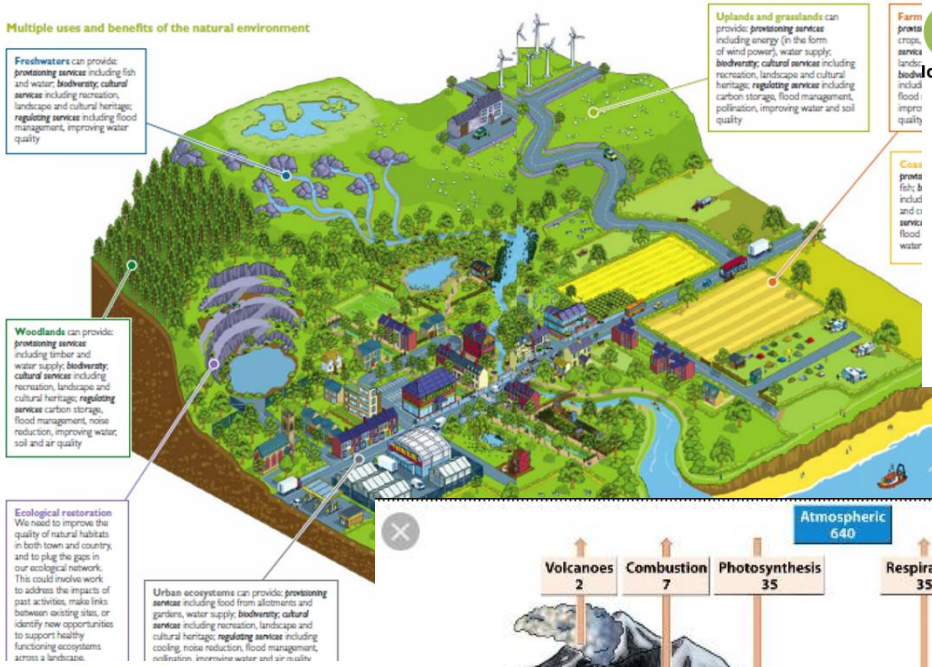
- Kenneth Boulding wrote about two extreme types of economy
- The Cowboy – who need not worry about waste or resources
- The Spaceman – who must manage everything
- We are moving towards a ‘Spaceman’ situation – but our economics are from the ‘Cowboy’ era
- Need a much more systems based approach

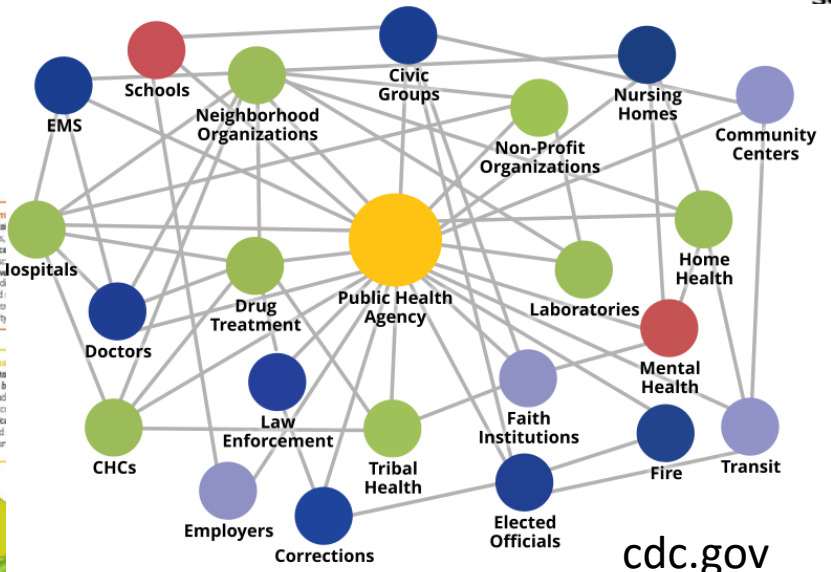


"Systems thinking is a discipline to see wholes rather than parts, for seeing patterns of change rather than static snapshots, and for understanding the subtle interconnectedness that gives living systems their unique character."

Peter Senge

Systems, systems, everywhere…





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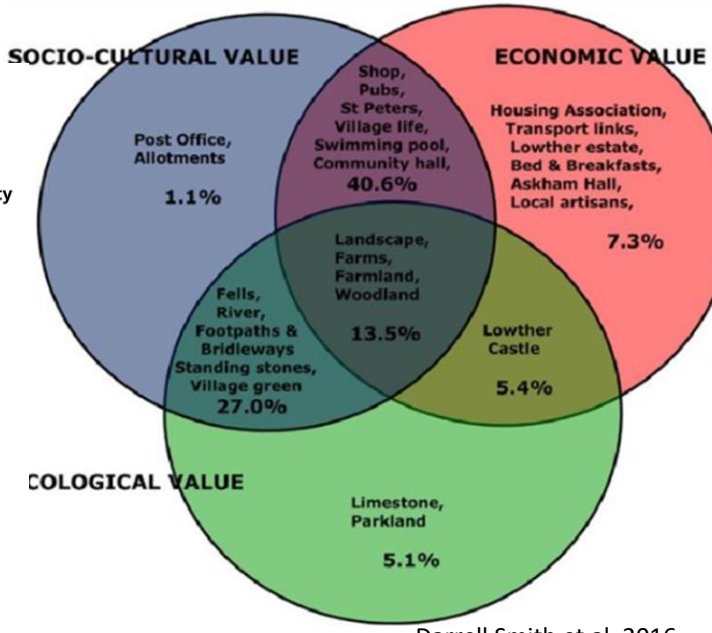
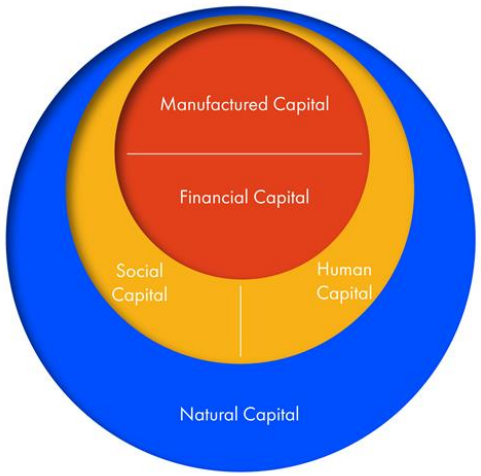
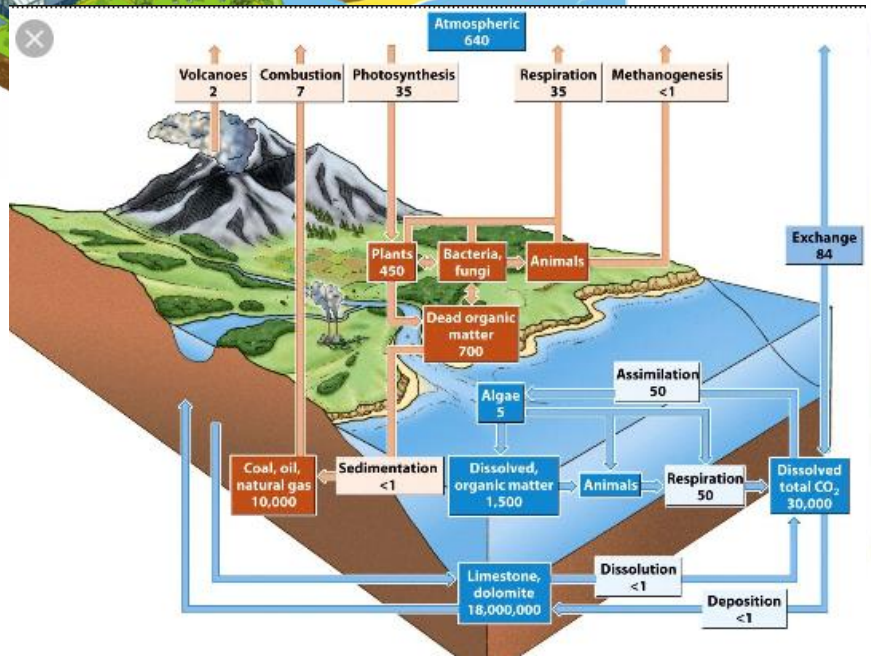
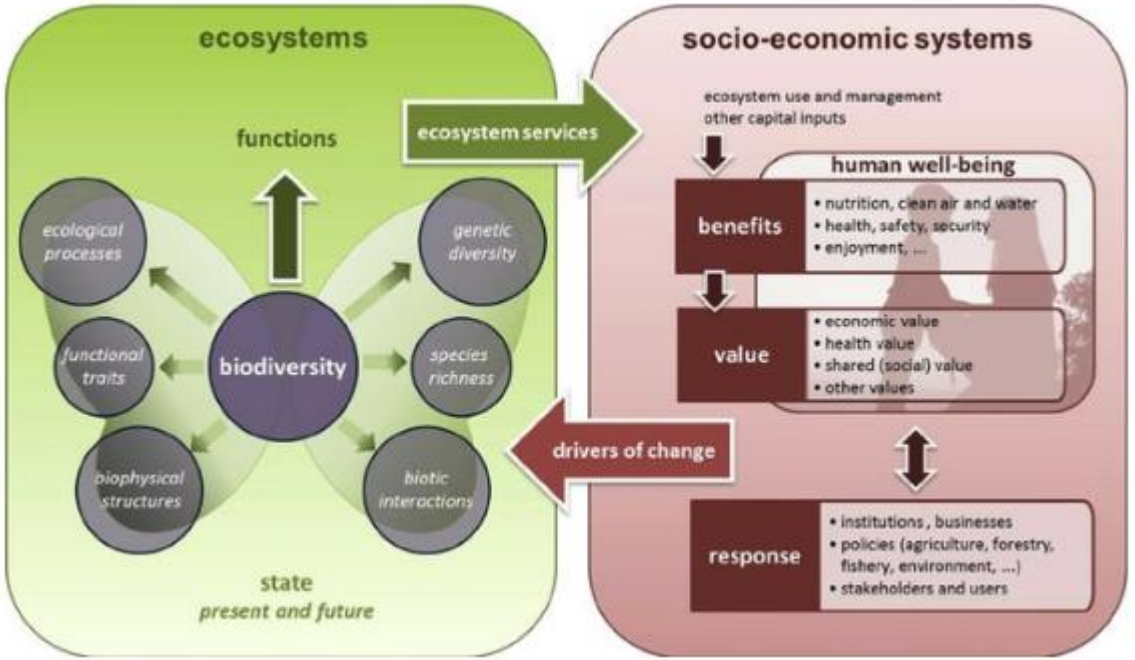
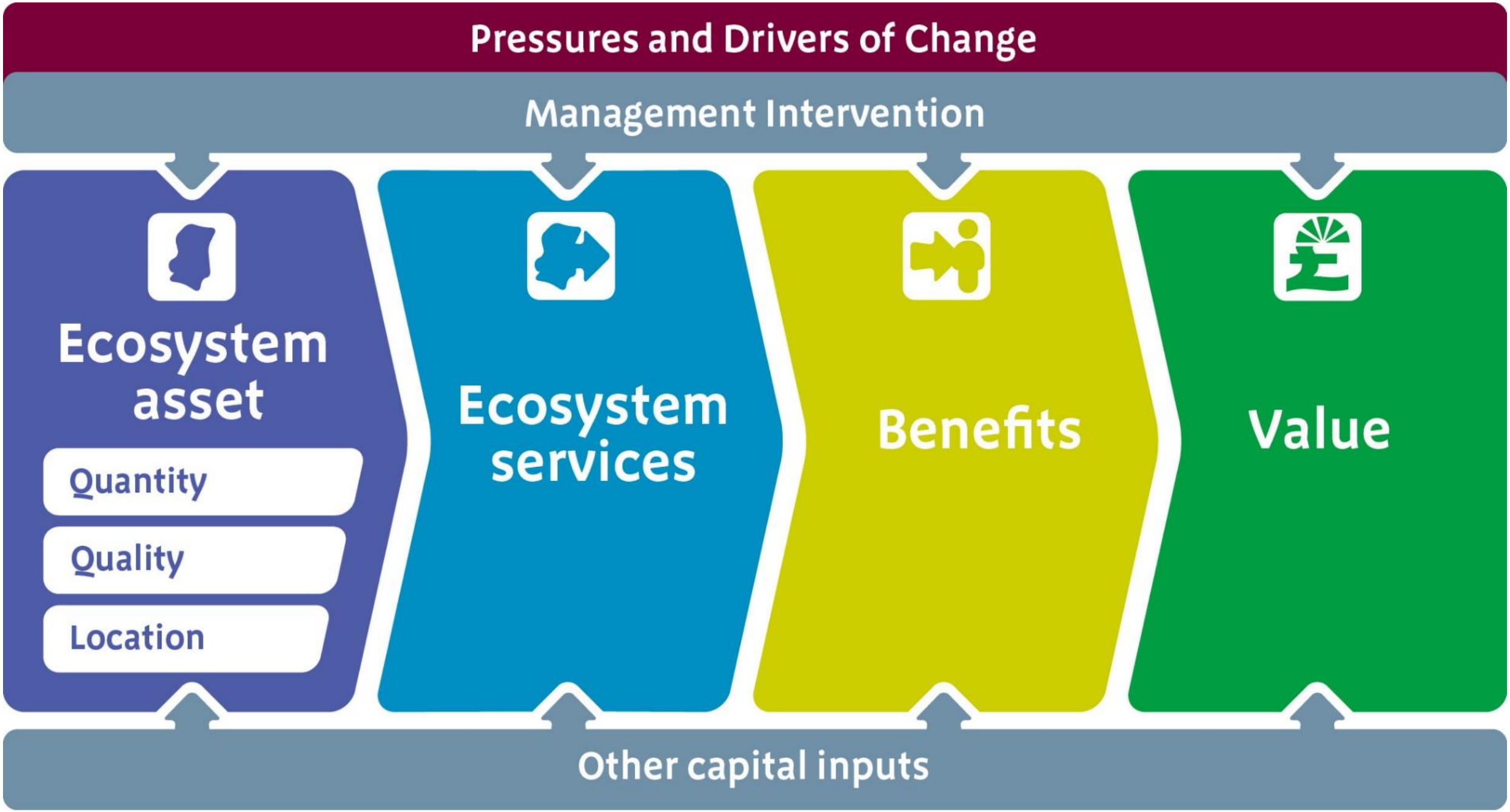


Darrell Smith et al. 2016








Pressures and Drivers of Change
Management Intervention
Ecosystem asset
Quantity
Quality
Location
Ecosystem services
Benefits
Value
Other capital inputs

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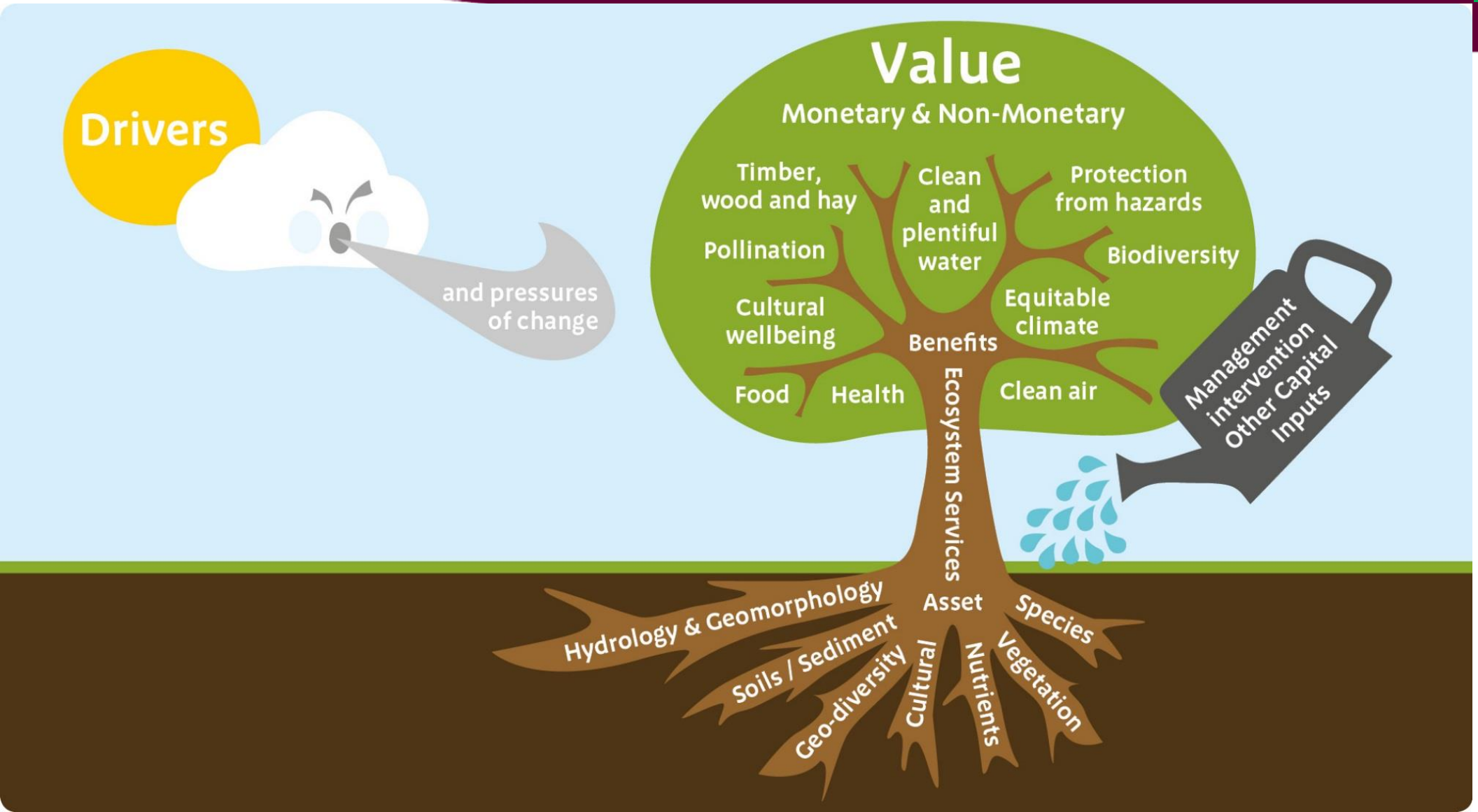
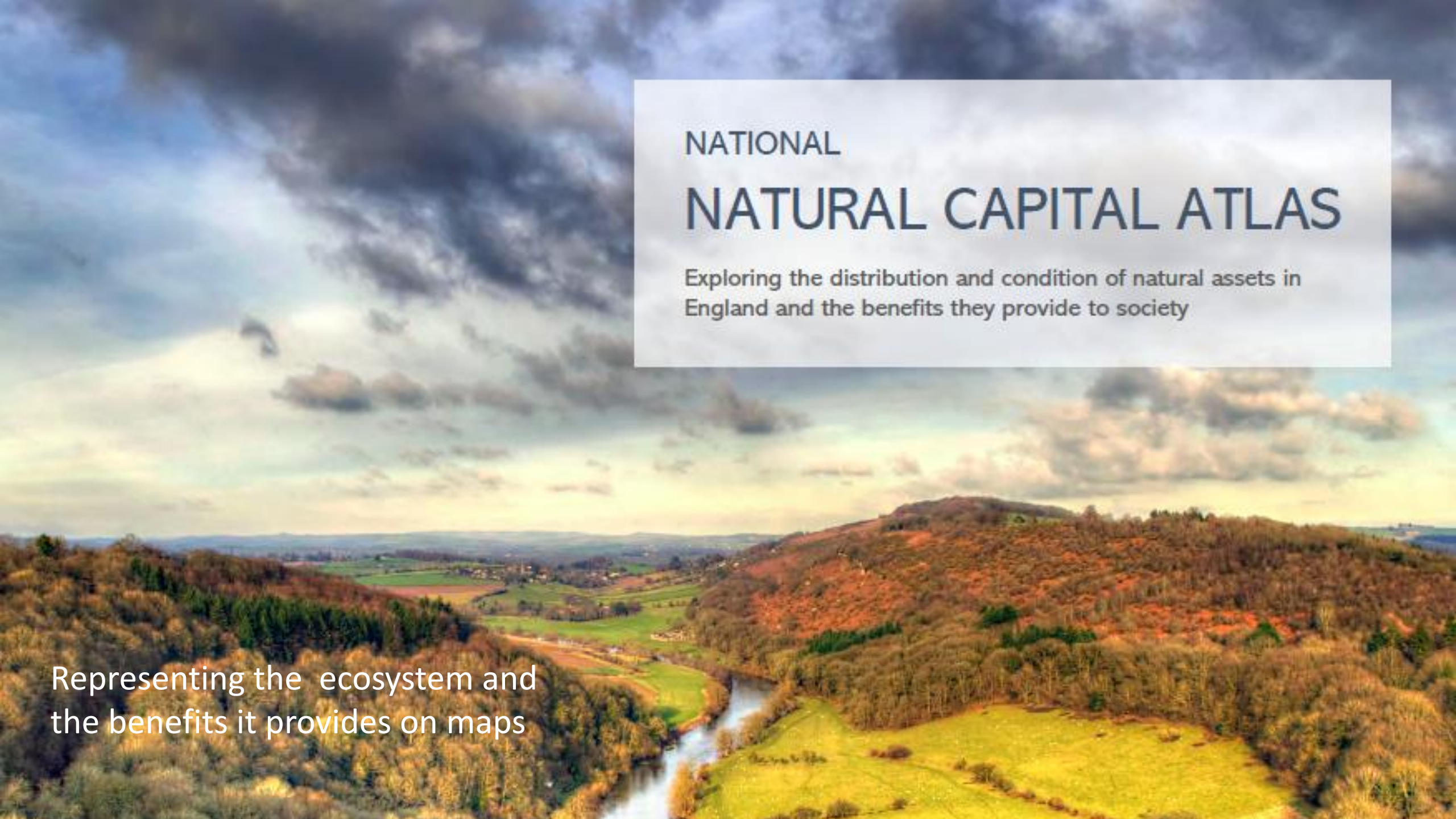
Key categories of indicators identified





Representing the ecosystem and the benefits it provides on maps

ASSET QUANTITY: MOUNTAINS, MOOR & HEATH

Mountains, moorlands and heaths cover 18% of the UK's land area (CEH LCM2015), ranging from highly fragmented lowland heaths to upland moors and heathland, representing some of the largest contiguous semi-natural habitats in the UK. Mountains, moorlands and heaths are the source of around 70% of the UK's drinking water, hold an estimated 40% of UK soil carbon (UK NEA, 2011) and host numerous rare plants and animals, such as the IUCN Red Listed ring ouzel.

Mountains, moor and heath provide a wide range of ecosystem services, including food provision (from livestock, crops and game), fibre provision (sheep wool) and the regulation of water quality and river flows, as well as a host of cultural, historical and recreational services. Such cultural services can be lucrative - the Lake District National Park attracted 19 million tourists in 2017, generating £1.4 billion (STEAM 2017: Cumbria Tourism).

Ecosystem Services

The following are key ecosystem services that can be assessed using the mountain, moor and heath quantity indicators (shown on the following page). Following the Natural Capital Indicators Project, the services are based on the Common International Classification of Ecosystem Services (CICES Version 4.3).

Water Supply

Water for drinking & non-drinking purposes

Water Quality

Maintenance of water quality - Mediation of wastes, toxins & other nuisances (by biota & ecosystems)/chemical condition of freshwaters/chemical condition of freshwaters

Flood Protection

Climate Regulation

Global, regional & local climate regulation

Reared Animals & their Outputs

Mass Stabilisation

Mass stabilisation and control of erosion rates

Maintenance of Nursery Populations & Habitats

Maintenance of nursery populations and habitats (and other stages of life cycles)

Cultural Services

Practices related to: experiential (e.g. wildlife watching) & physical use (e.g. walking); scientific/educational (subject matter of research, education, in-situ and ex-situ); aesthetic (e.g. art, poetry); spiritual and/or emblematic.

ASSET QUANTITY

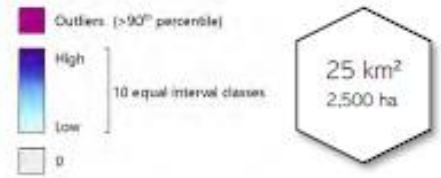
Indicators showing mountain, moor and heath habitat quantity in England

Duplication

Some of the moorland indicators duplicate habitats that are included in the freshwater indicators, e.g. blanket bog, lakes and rivers. If used for accounting purposes, the moorland components of the freshwater indicators would need to be excluded.

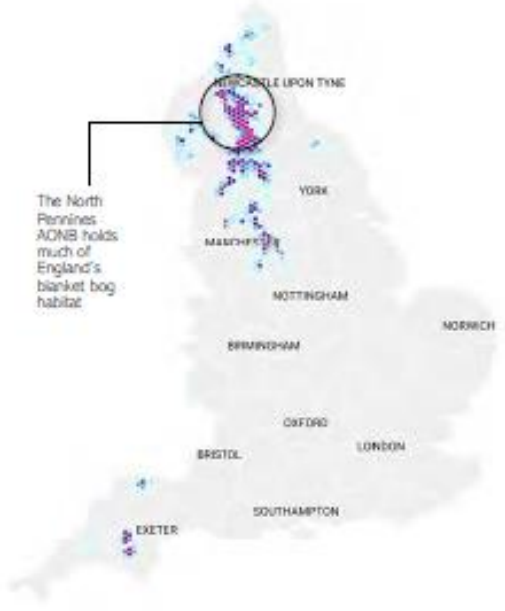
Map Key

Indicator value:



Blanket Bog

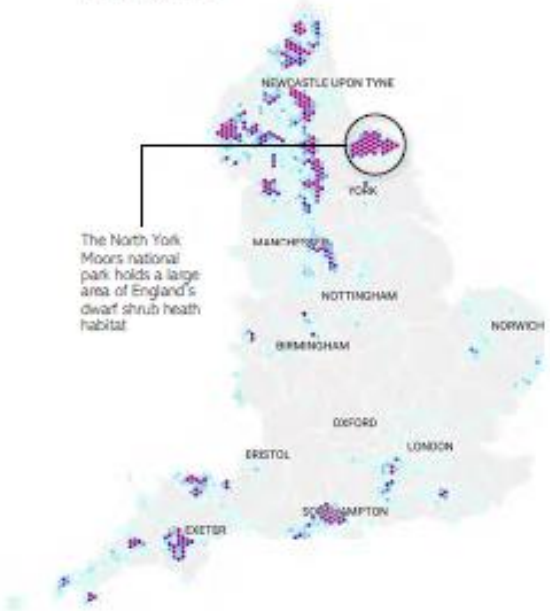
Area of blanket bog mapped using NE's Priority Habitat Inventory



Hexagon values: 0 – 15.7 km²; Outliers: 15.7 – 24.6 km²

Dwarf Shrub Heath

Area of dwarf shrub heath mapped using NE's Priority Habitat Inventory ('fragmented heath', 'lowland heathland' and 'upland heathland')



Hexagon values: 0 – 6.5 km²; Outliers: 6.5 – 22.5 km²

Inland Rock, Scree and Pavement (Above Moorland Line)

Area of inland rock and limestone pavement above the moorland line, mapped using CEH's LCM2015 ('inland rock'), NE's Priority Habitats Inventory ('limestone pavement') and RPA's Moorland Line dataset

Hexagon values: 0 – 0.60 km²; Outliers: 0.60 – 6.94 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Materials from plants, animals and algae
- Wild animals, plants, algae and outputs
- Plant-based energy
- Aquaculture
- Cultivated crops
- Water supply
- Reared animals and outputs

Regulating:

- Water quality
- Air quality
- Noise regulation
- Mass stabilisation
- Flood protection
- Pollination and seed dispersal
- Maintenance of nursery pops and habitats
- Pest and disease control
- Climate regulation

Cultural:

- Cultural services

Map Key

Indicator value:

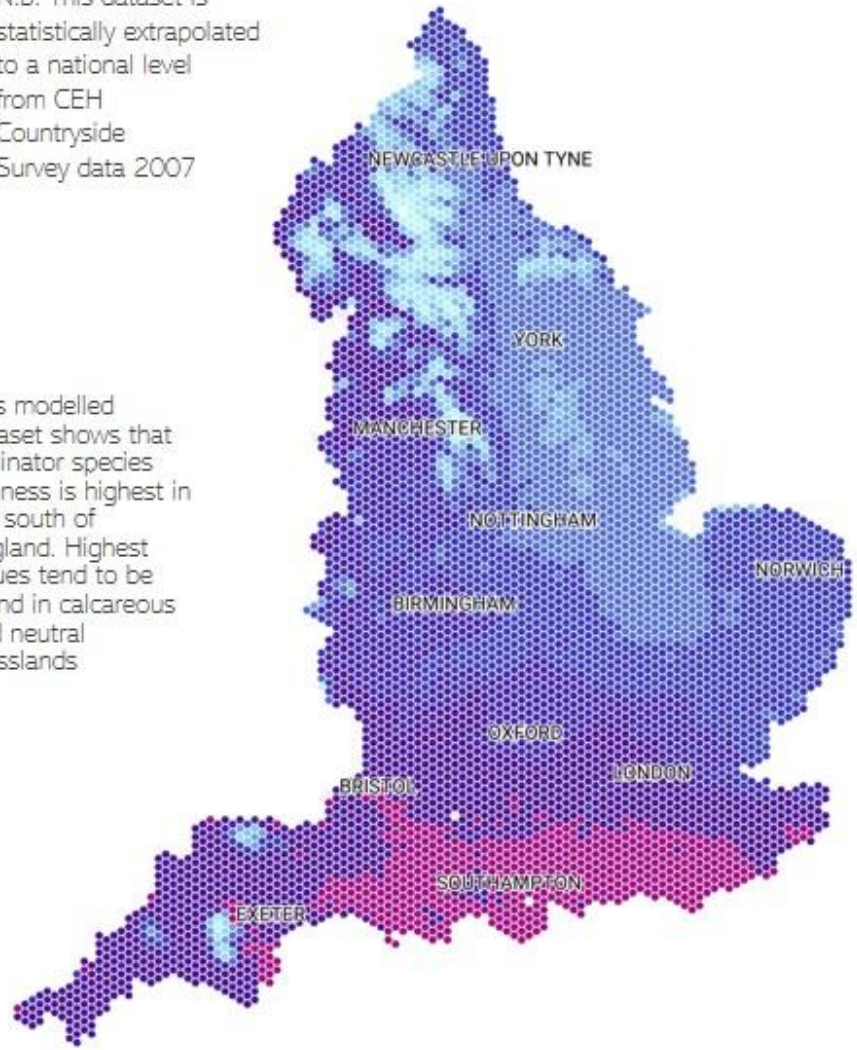
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

25 km²
2,500 ha

P Presence & Frequency of Pollinator Food Plants

Mean estimates of number of nectar plant species for bees per 2x2m plot, mapped using data produced from NE and CEH's 'Mapping Natural Capital' project (2016)

N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007

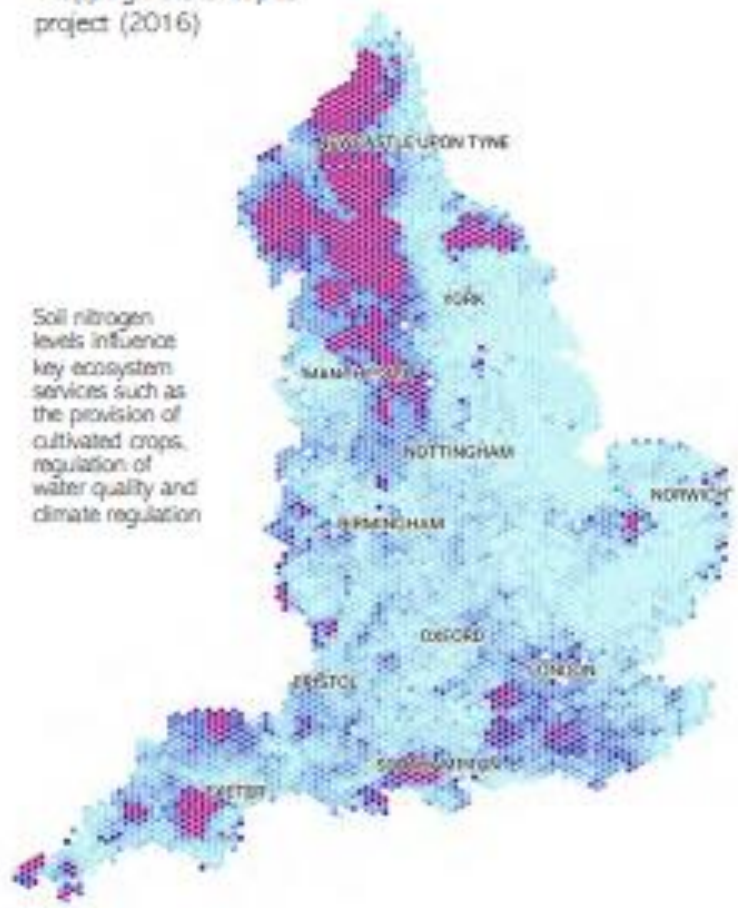


This modelled dataset shows that pollinator species richness is highest in the south of England. Highest values tend to be found in calcareous and neutral grasslands

Hexagon values: 0.78 – 6.75; Outliers: 6.75 – 9.81

A G N C Nutrient Status of Soil

Mean estimates of total nitrogen concentration in topsoil (0-15cm depth) - % dry weight of soil, mapped using data produced from NE and CEH's 'Mapping Natural Capital' project (2016)



Soil nitrogen levels influence key ecosystem services such as the provision of cultivated crops, regulation of water quality and climate regulation

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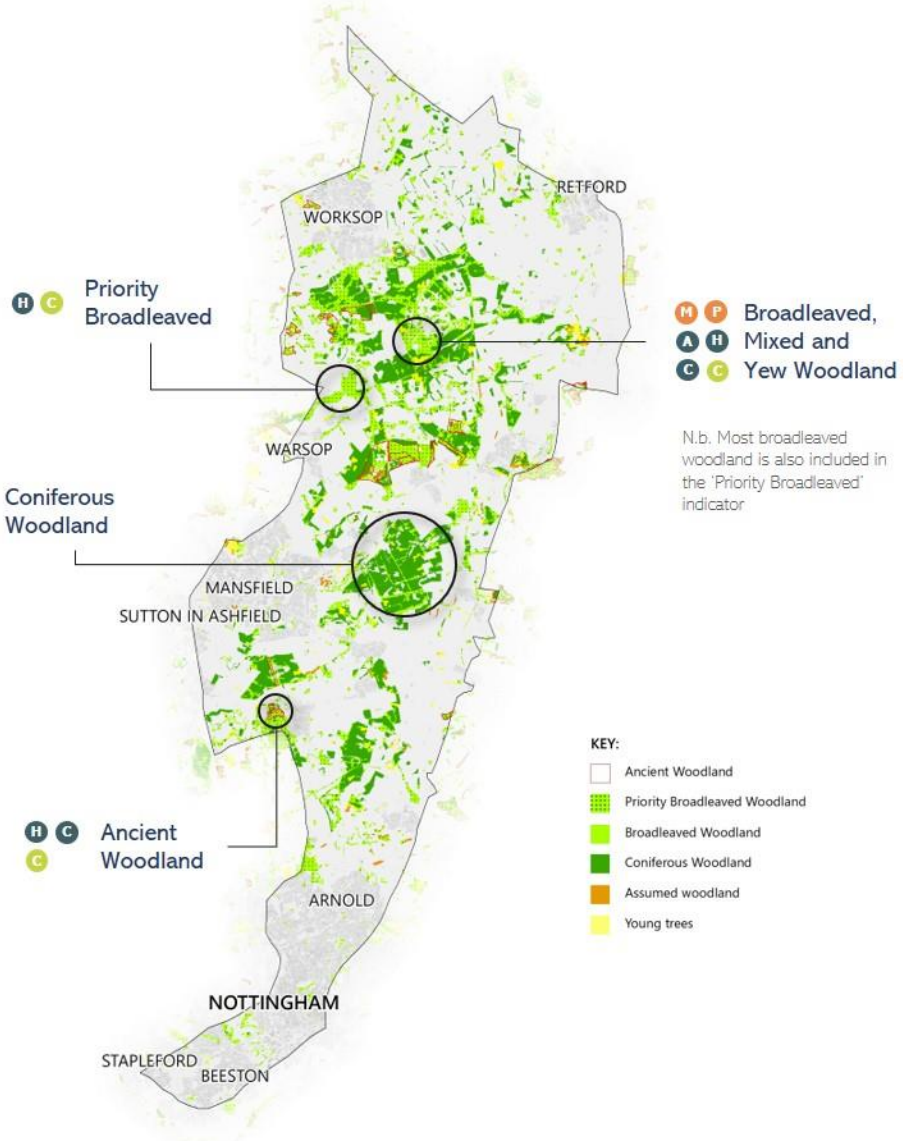


Priority Broadleaved

Broadleaved, Mixed and Yew Woodland

N.b. Most broadleaved woodland is also included in the 'Priority Broadleaved' indicator

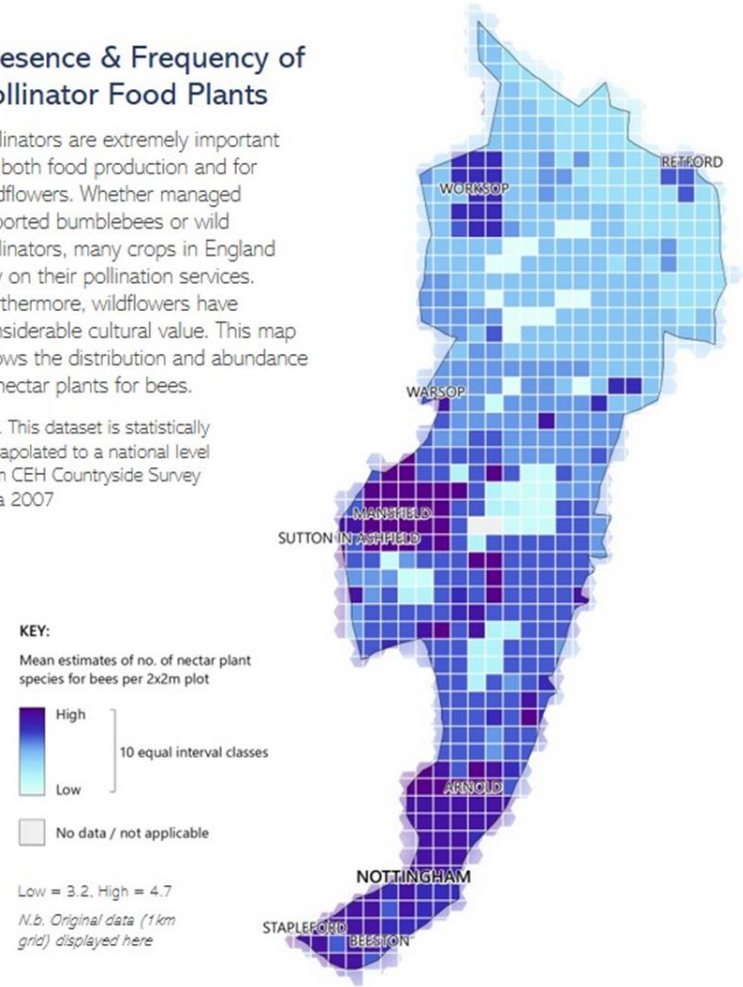
Coniferous Woodland

Ancient Woodland

Presence & Frequency of Pollinator Food Plants

Pollinators are extremely important for both food production and for wildflowers. Whether managed imported bumblebees or wild pollinators, many crops in England rely on their pollination services. Furthermore, wildflowers have considerable cultural value. This map shows the distribution and abundance of nectar plants for bees.

N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007



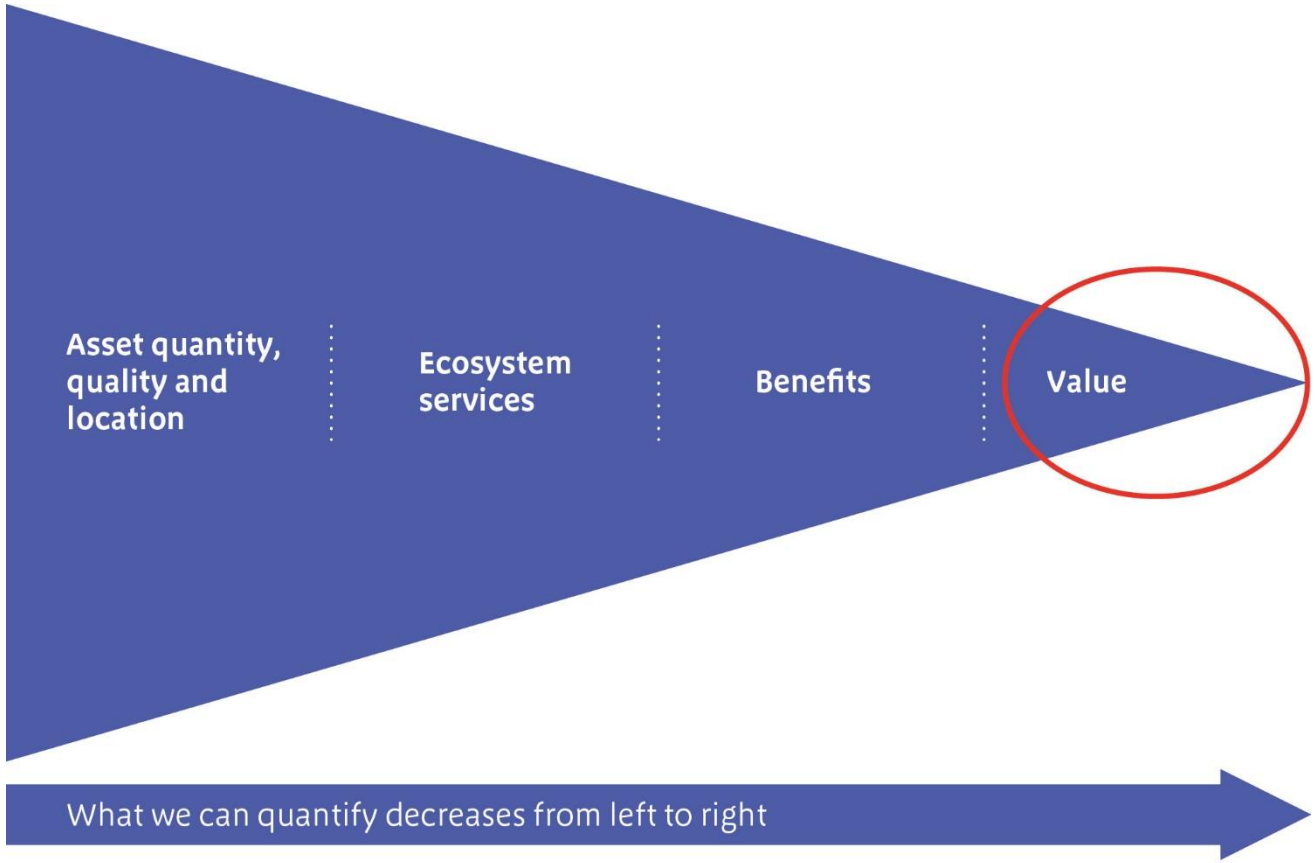
Indicator: Mean estimates of number of nectar plant species for bees

The map to the left shows the mean estimates of number of nectar plant species for bees per 2x2m plot for each spatial unit (hexagon).

Dataset: CEH & Natural England Mapping Natural Capita project (2016) – Bee nectar plant diversity of Great Britain


NATURAL
ENGLAND

Measured value is a small proportion of true value – how can we capture more information from the system?



Ecosystem asset

Natural capital asset baseline		
Asset Attribute	**Indicator**	
Extent	**Total area (ha)**	**66839.7**
Hydrology	Ground water status (% good) Water Framework Directive (WFD)	24.1
	Surface Water status (% good) WFD	18.6
Nutrient/ chemical status	Mean sulphur dioxide concentration (µg m-3)	0.32
	Mean nitrogen acid deposition (kg N ha-1 year-1)	12.3
Soil	Mean Estimates of Soil Organic Carbon in 30cm Topsoil (% of total) from NATMAP	9.13
Vegetation	% of NNR (ha) under a Site of Special Scientific Interest (SSSI) which is in favourable condition	51.3
Species composition	Nectar plant diversity – Mean Estimates of Number of Nectar Plant Species for Bees (per 2×2m plot)	5.05
	Soil Invertebrates Abundance – Mean Estimates of Total Abundance of Invertebrates in Topsoil (0–8cm depth soil core)	65.3
Cultural	Tranquillity (mean score)	13.8
	Scheduled monuments at risk (ha)	74.7

Ecosystem services

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		

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**		●

Bringing more of our socio-ecological-economic system into the picture

- Being clear about the problems we want to solve – are we focusing on the wrong problem? Take a systems perspective
- We need to ask what different things should this decision *really* accomplish?
- Asking what would I *really* like to know? Being open to different forms of evidence.
- Design the decision making process to bring different forms of evidence to the table
- What are the uncertainties and ambiguities? Making them clear.
- Keeping the bigger picture in mind

ELSEVIER

Organizational Dynamics

Volume 47, Issue 3, July–September 2018, Pages 135-146

Making evidence-based organizational decisions in an uncertain world ☆

Denise M. Rousseau

Ecosystem approach

All part of a bigger system

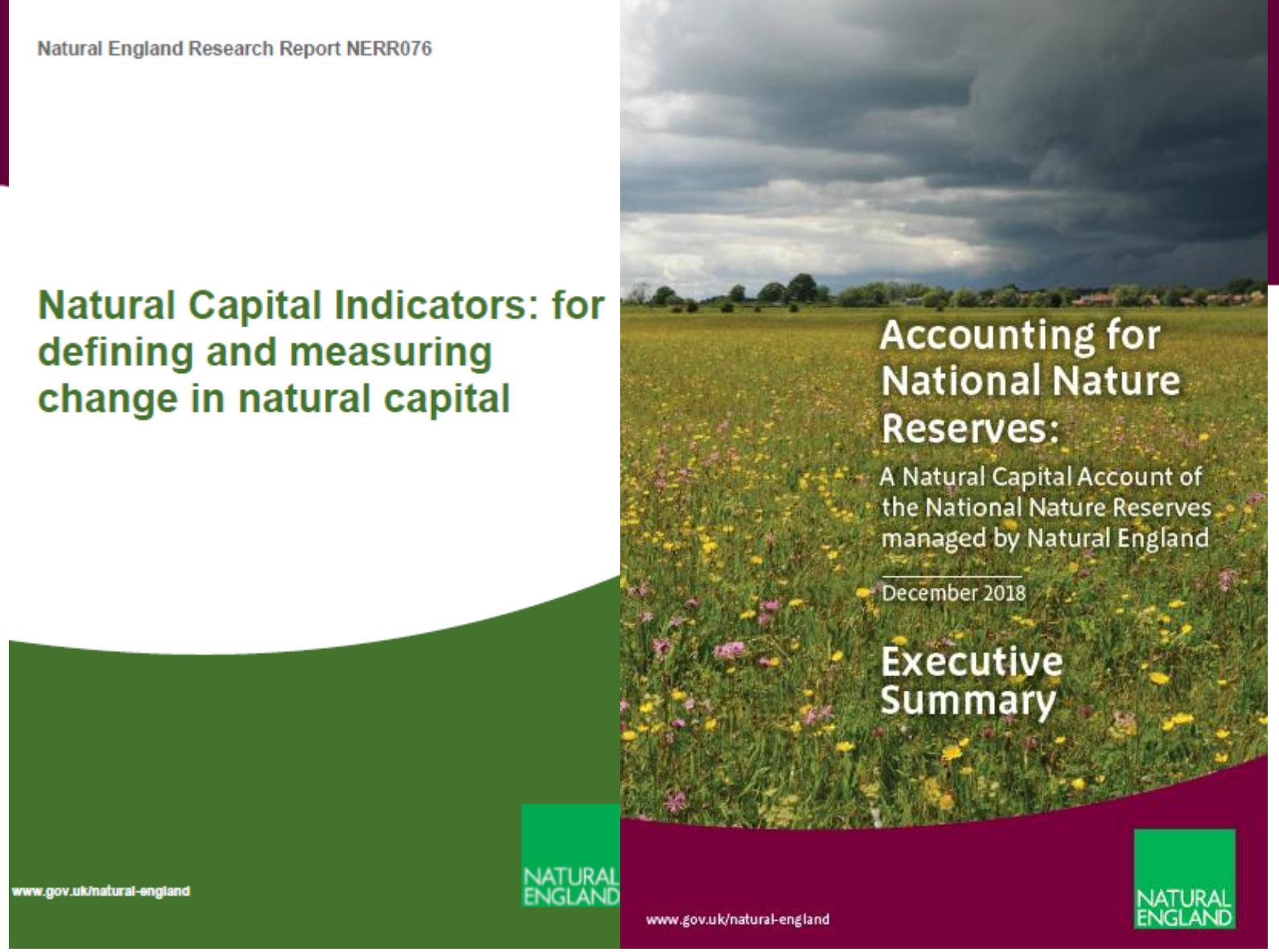
Human health, wellbeing and economy

Regulating services

Cultural services

Provisioning services

Natural Capital



It's been a big team effort: Jane Lusardi, Cat Hudson, Dan Marsh, Patricia Rice, Jenny Craven, Tim Sunderland and myself. Ruth.waters@naturalengland.org.uk