

UK National Ecosystem Assessment

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Analysis and Experimentation on Ecosystems

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Building on the MA



Ecosystem Services

The benefits people obtain from ecosystems

Provisioning	Regulating	Cultural
Goods produced or provided by ecosystems <ul style="list-style-type: none">• food• fresh water• fuel wood• genetic resources	Benefits obtained from regulation of ecosystem processes <ul style="list-style-type: none">• climate regulation• disease regulation• flood regulation	Non-material benefits from ecosystems <ul style="list-style-type: none">• spiritual• recreational• aesthetic• inspirational• educational
Supporting Services necessary for production of other ecosystem services <ul style="list-style-type: none">• Soil formation• Nutrient cycling• Primary production		

In particular:

- Post MA reviews (e.g. Carpenter et al *PNAS* 2009)
- Balmford et al (2008) *Scoping the science...* TEEB
- Fisher et al (2008) *Ecological Applications*.
- EASAC report (2009) Ecosystem services and biodiversity in Europe

MA Constituents of Human Well-being



CONSTITUENTS OF WELL-BEING



Source: Millennium Ecosystem Assessment

ARROW'S COLOR
Potential for mediation by socioeconomic factors

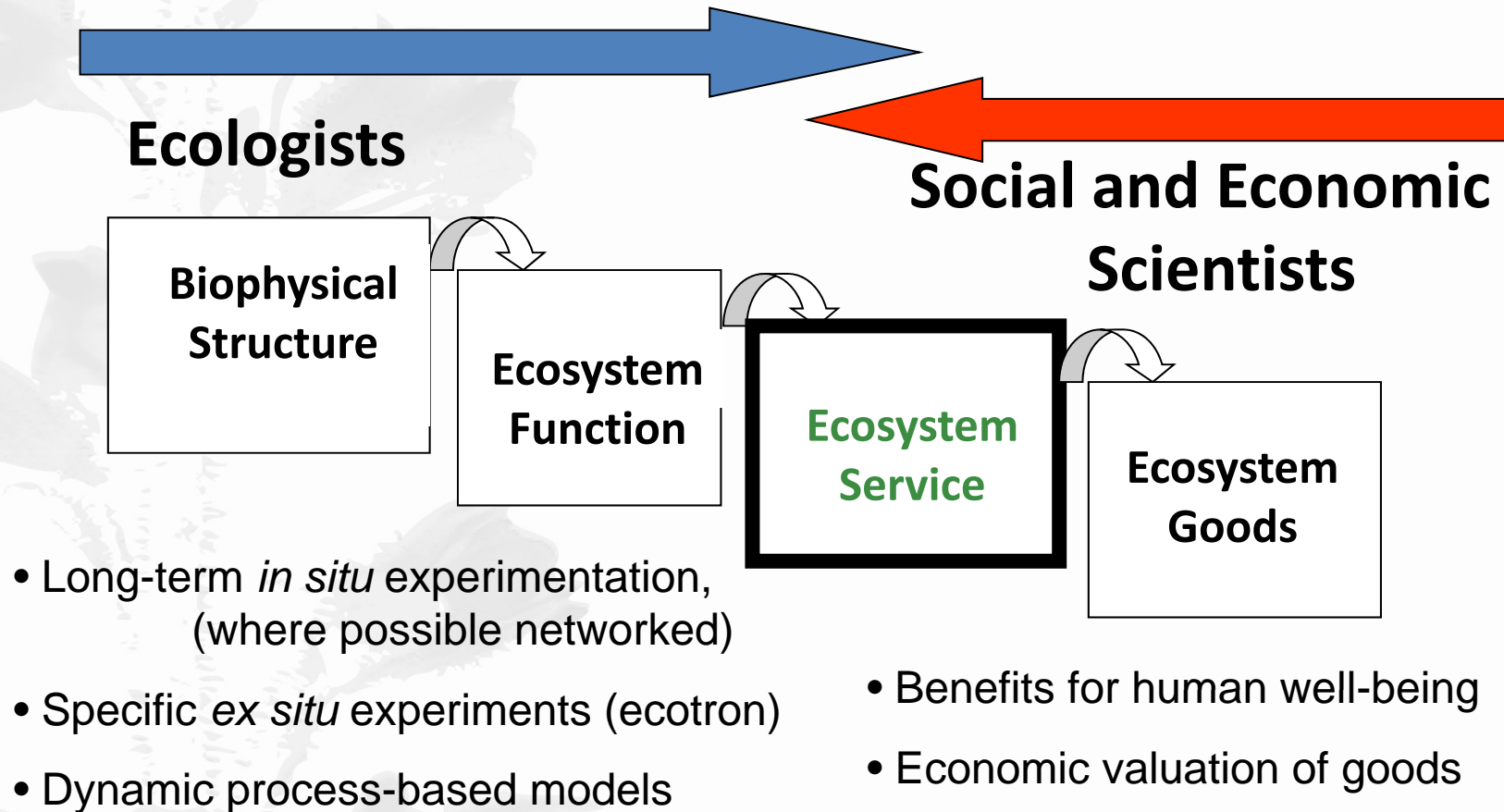
- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

Conceptual Approach – socio-ecological system

Plausible Scenarios



Adapted from Haines-Young

NEA Background and Scope

- House of Commons Environmental Audit Committee recommended that, **‘ultimately the Government should conduct a full MA-type assessment for the UK to enable the identification & development of effective policy responses to ecosystem service degradation’.**
- Covers terrestrial, freshwater marine ecosystems across the UK.
- Primary aims are to:
 1. Provide a high level picture of the **current state and trends** since WWII in ecosystems (habitats) and ecosystem services
 2. Look to the future (2050) to evaluate change under **plausible scenarios** and consider a range of **policy options**
- Advised by ‘Expert’ Panel to integrate environmental, economic and social science and co-construct scenarios with stakeholders to enhance policy relevance.

Ecosystem Services & Goods

Supporting services

- soil formation
- nutrient cycling
- water cycling
- primary production

Regulating services

- climate
- hazard control (flood/erosion)
- pests & disease
- pollination
- pollution (noise/toxic)
- air/soil/water quality



Provisioning services

- food
- fibre
- fuel
- bio-materials
- water

Cultural services

- aesthetic
- cultural heritage/sense of place
- education
- health
- recreation
- spiritual/religious
- tourism

Ecosystems (Broad Habitats)

Mountains/Moors/Heaths



Semi-natural grasslands



Woodlands



Rivers/Lakes/Wetlands/Flood plains



Enclosed farmland



Coastal margins and Marine



Urban (settlement)

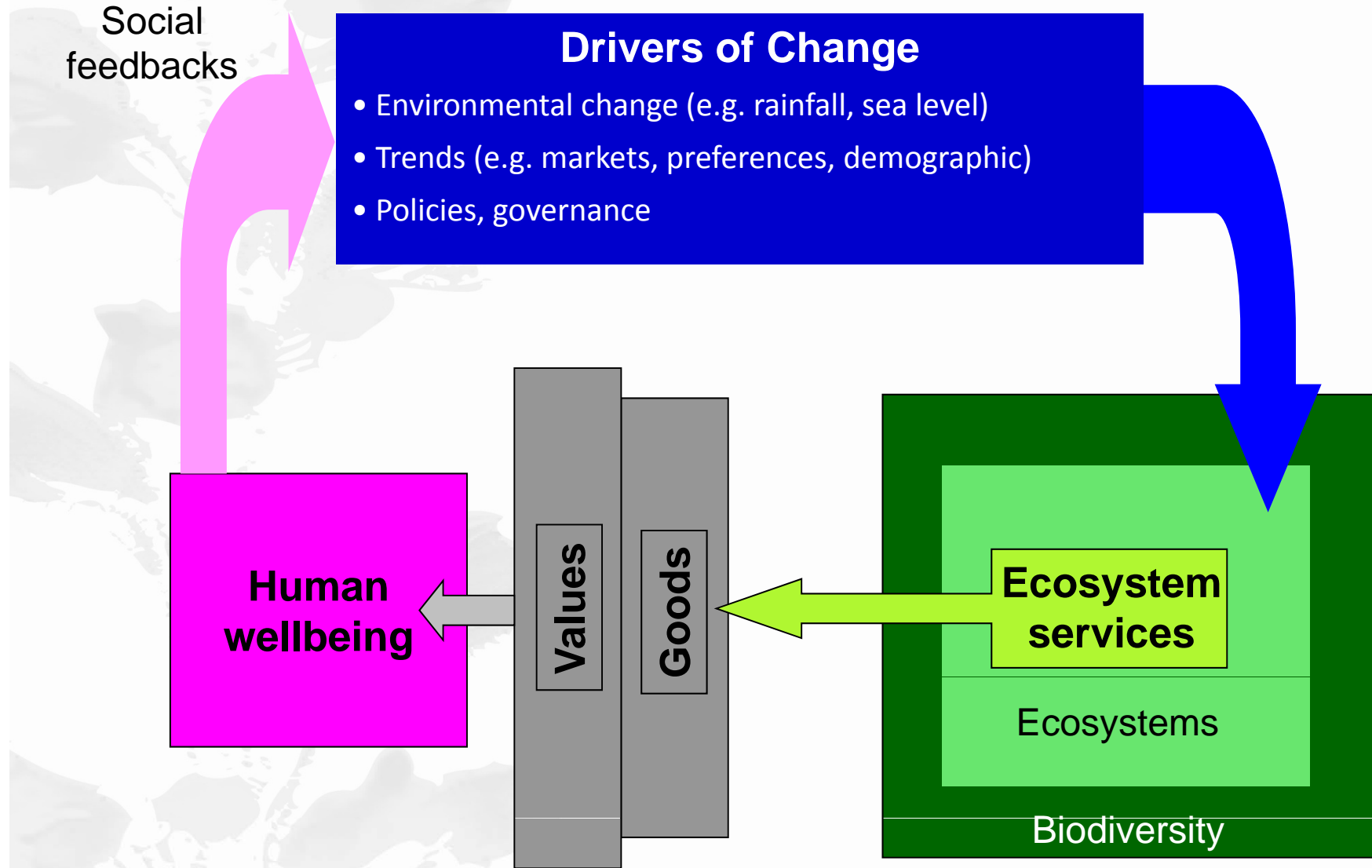


Evolution of MA approach to UK NEA

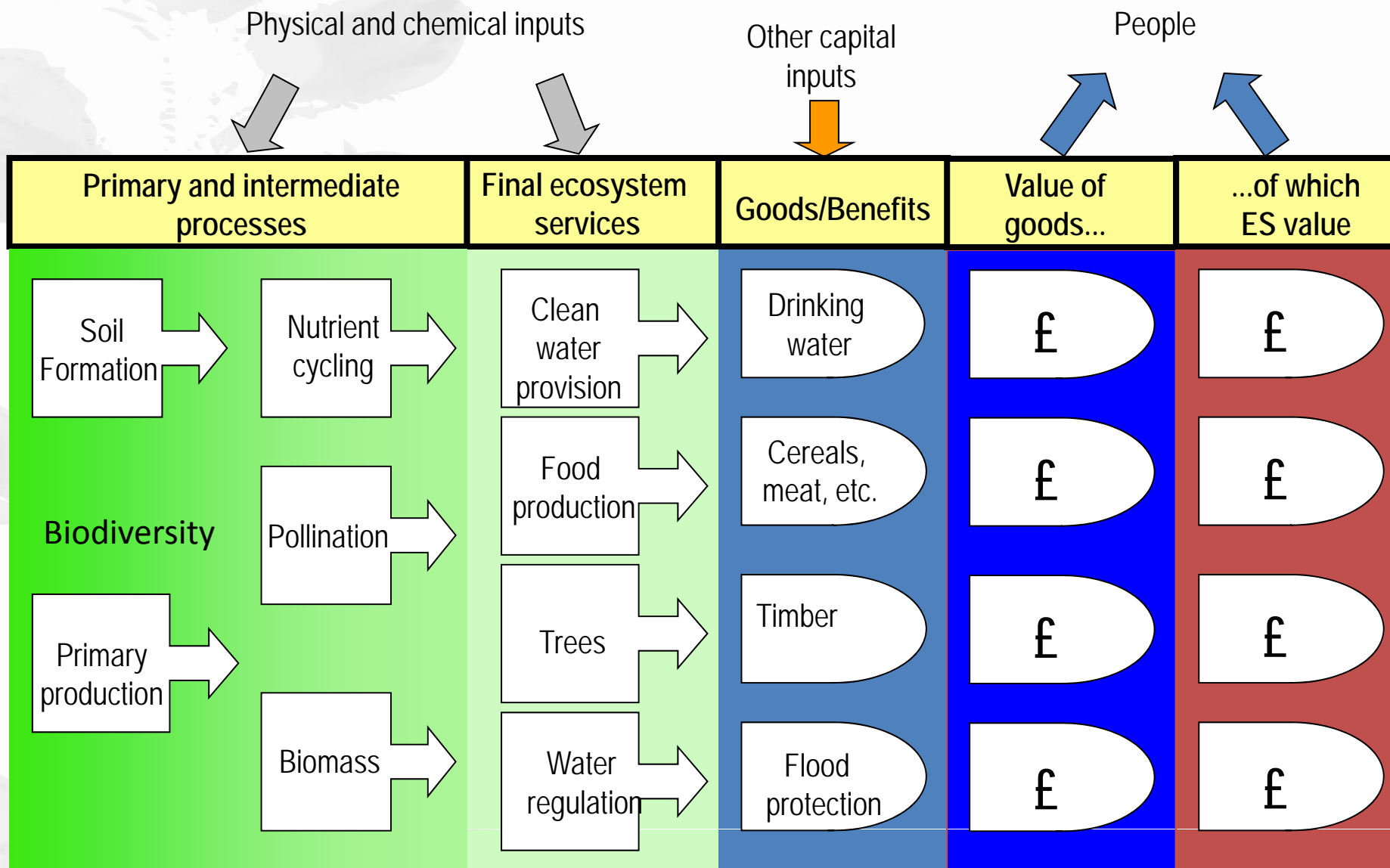
- 1. Address the particular context of the UK**, classification of ecosystems (broad habitat types), ecosystem services, change processes and goods/benefits.
- 2. Consider policy relevant changes** using scenarios regarding feasible and decision pertinent changes in the environment, markets and policy.
- 3. Incorporate economic valuation** explicitly using marginal changes (not total values) of final services to avoid double counting. Also assess the ecosystem contributions to goods/benefits.
- 4. Incorporate measures of wellbeing** for non-economic values
- 5. Biodiversity** is incorporated in 3 ways:
 - In the ecosystem processes that underpin intermediate ecosystem services.
 - As a final service in diversity at the level of genes and species that directly contribute to some goods, e.g. wild medicines and bio-prospecting
 - As a good/benefit where components of biodiversity are valued by people, e.g. the appreciation of wildlife and of scenic places, spiritual, educational, religious and recreational values.

National Ecosystem Assessment (NEA)

Overall Conceptual Framework



Ecosystems and the production of services



Adapted from Fisher *et al* 2008

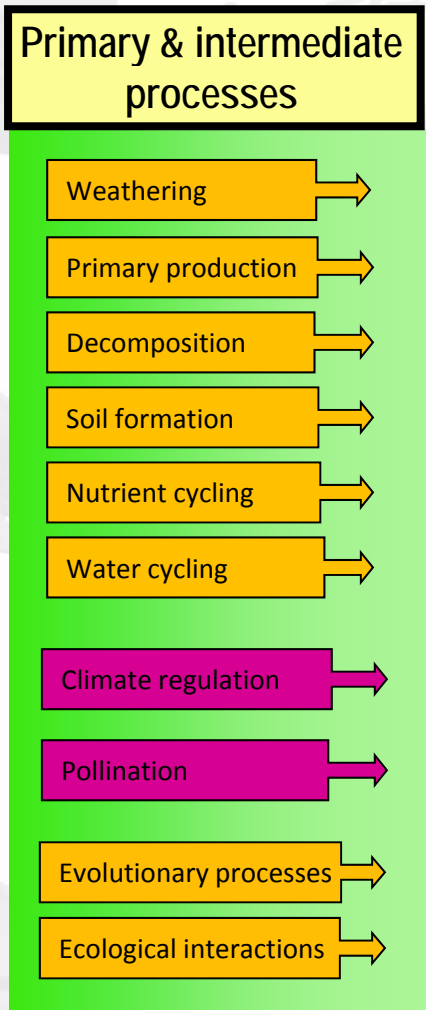
UK National Ecosystem Assessment

Ecosystem type, services and goods/benefits

Ecosystem service type	Primary & Intermediate ecosystem services and processes	Final ecosystem services (<i>example of goods</i>)
Provisioning		<p>Crops, plants, livestock, fisheries, etc (food, fibre, fertiliser, energy, CB list – Physical and mental health, ecological knowledge)</p> <p>Trees, standing vegetation, peat (carbon sequestration, energy, fertiliser, CB list)</p> <p>Water quantity (domestic and industrial water- incl. energy, CB list. See also flood protection as good under Hazard regulation)</p> <p>Purified water (potable water, CB list)</p> <p>Wild species diversity. incl. microbes (genetic resources, wild food, bio-prospecting, natural medicines. See also disease and pest control as good arising from natural enemies under Hazard regulation)</p>
Cultural		<p>Local places (CB list)</p> <p>Socially valued landscapes and waterscapes (CB List)</p> <p>Wildlife (CB list)</p>
Regulating	<p>Climate regulation</p> <p>Pollination</p>	<p>Local climate amelioration (avoidance of climate stress)</p> <p>Hazard regulation - incl stabilising vegetation and other habitat properties (erosion control, flood protection, noise abatement), and Natural enemies (disease & pest control)</p> <p>Waste breakdown, detoxification and purification (waste removal and degradation, clean air, clean water, clean soils)</p>
Supporting	<p>Primary production</p> <p>Nutrient cycling</p> <p>Soil formation (incl. weathering & decomposition)</p> <p>Water cycling</p> <p>Ecological interactions</p> <p>Evolutionary processes</p>	

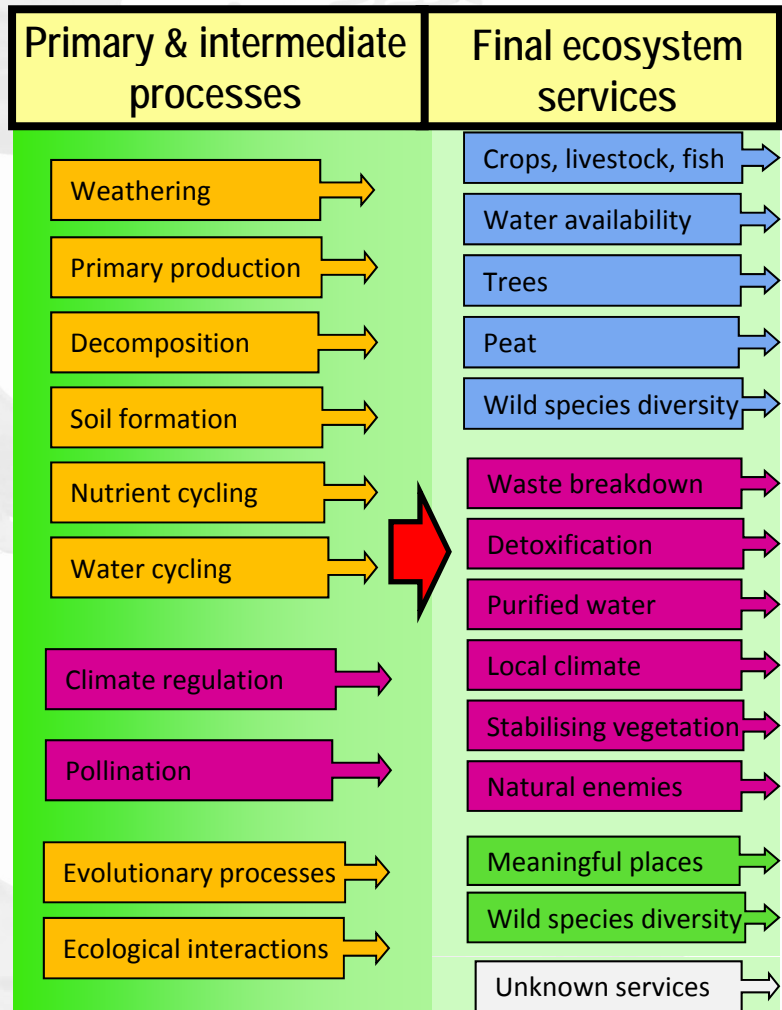
Primary & Intermediate Ecosystem Processes

Physical, chemical inputs



Final Ecosystem Services

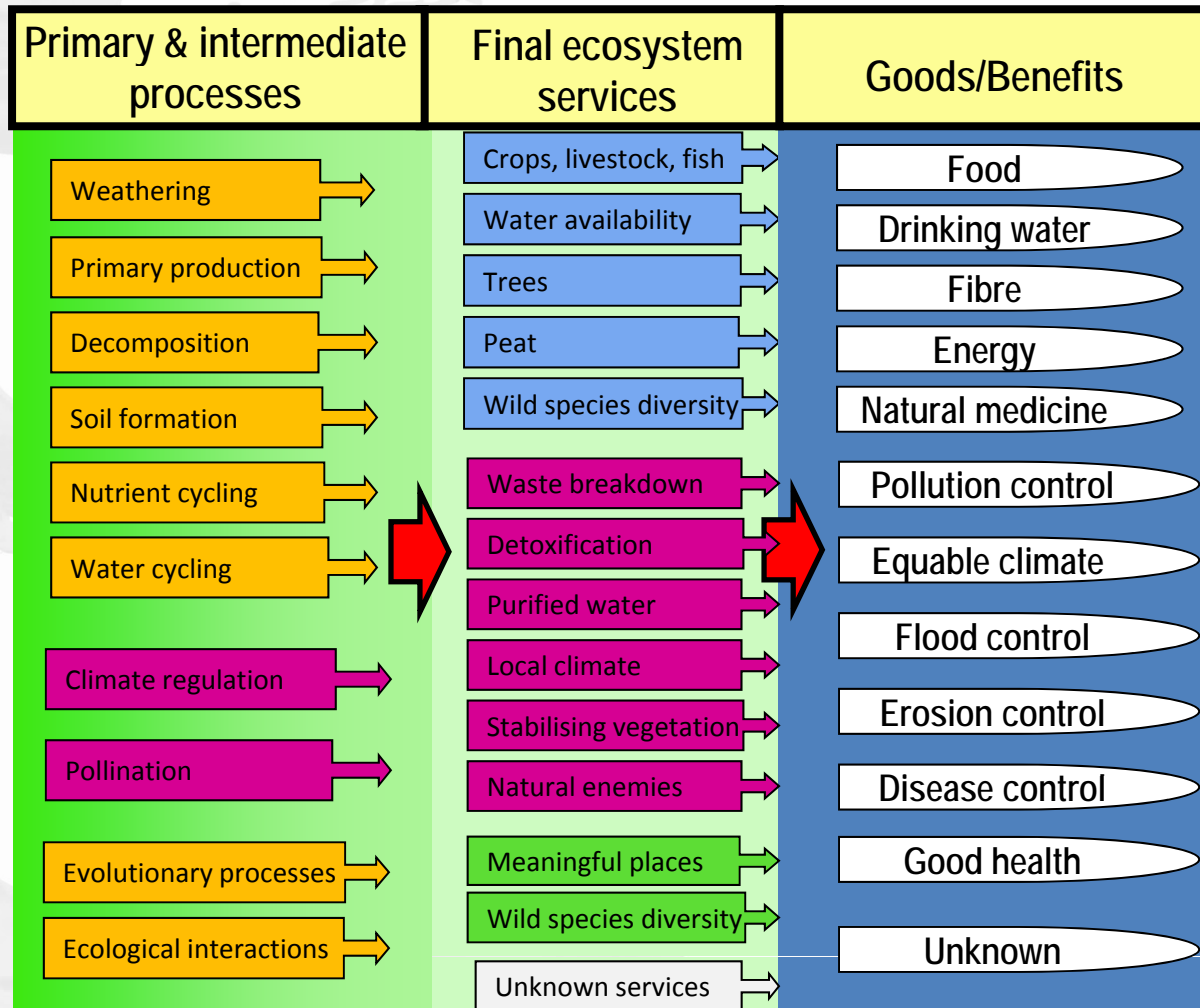
Physical, chemical inputs



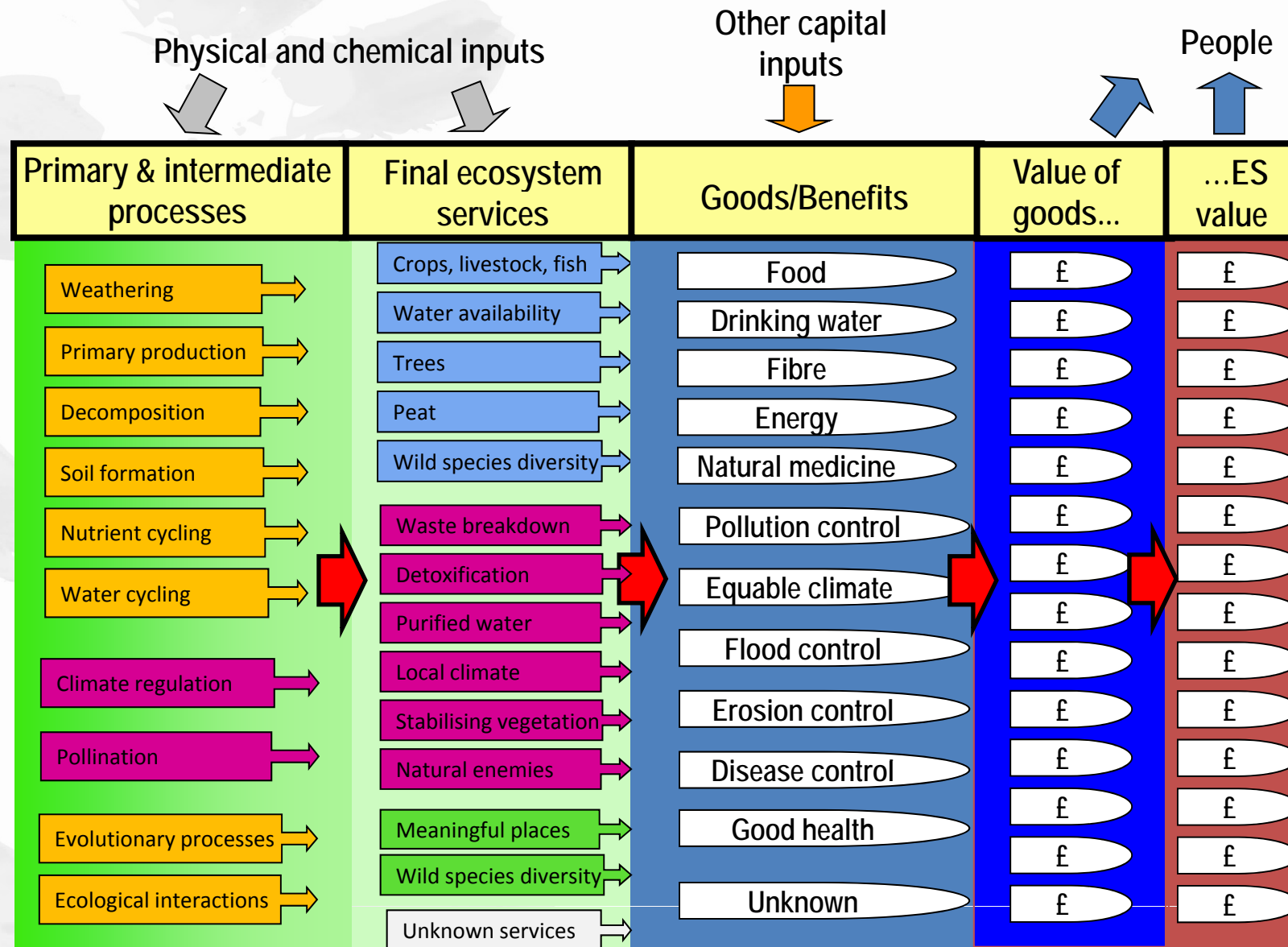
Final Ecosystem Services and Goods derived

Physical and chemical inputs

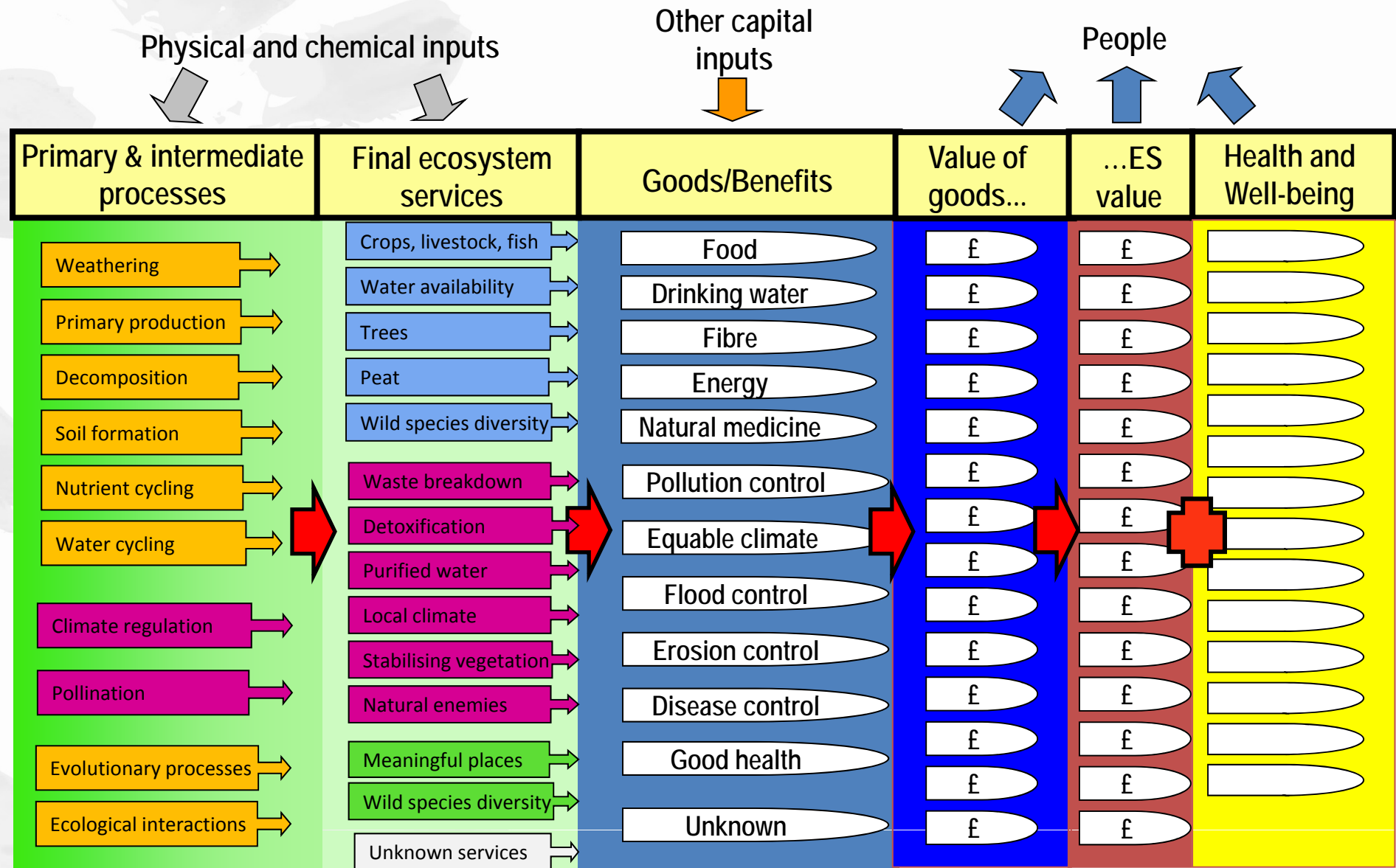
Other capital inputs



Final Ecosystem Services, Goods and their Valuation



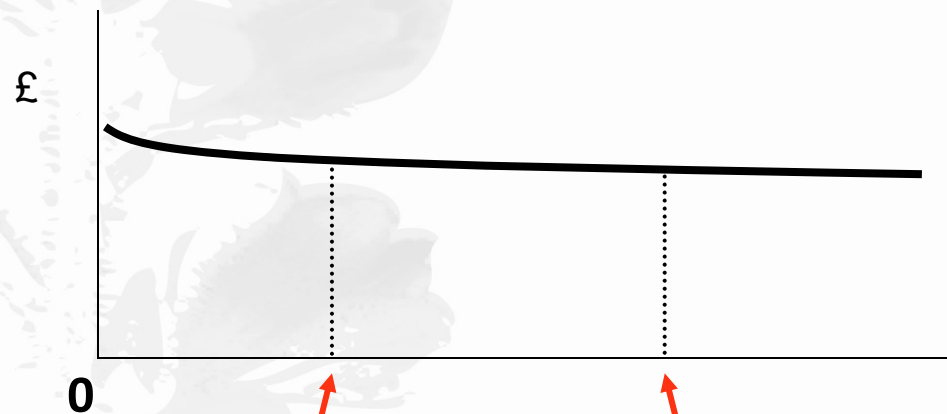
Ecosystem processes, Services, Valuation & Human Well-being



Approach to Economic Valuation

- The total value of all ecosystem services (ES) is not a useful input to decision making (effectively of infinite value - and anyway we are typically not looking at total losses of ES)
- Therefore the NEA looks at non-total changes in ES occurring under various policy relevant scenarios
- Therefore natural science groups need to provide the economists with the level of final ecosystem services generated under the baseline and alternative scenarios.

Examples of valuation: carbon



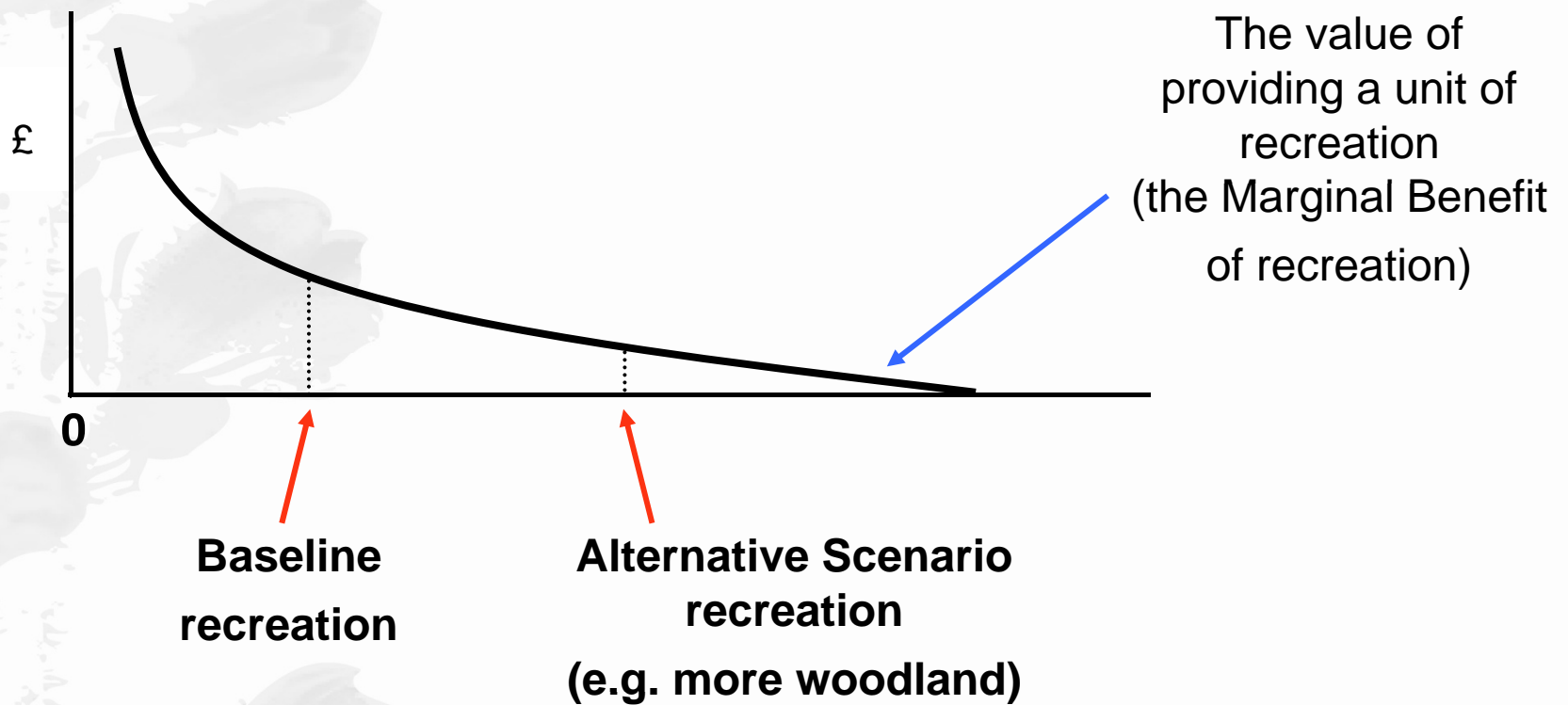
The value of sequestering a unit of carbon (the Marginal Benefit of carbon storage)

**Baseline
carbon storage**

**Alternative Scenario
carbon storage
(e.g. more woodland)**

- Flat (roughly) curve: the Marginal Benefit of carbon storage is approximately constant across this range
- This makes aggregation of values relatively simple. We just need the number of tonnes stored under the baseline and alternative scenario and then just multiply the difference by the (approximately) constant value per tonne stored.

Example of valuation: recreation



- Declining curve: the Marginal Benefit of recreation is diminishing across this range
- Aggregation is now more complex as we have to know both the number of units generated and how marginal benefits alter with that provision change.

Phase 1 - Habitat by Ecosystem Service matrix

Conceptual Framework – Mace

Biodiversity Synthesis – Norris

Broad Habitats	Mountains/ Moors/ Heathlands	Semi-natural grasslands	Enclosed Farmland (arable+ improve grass)	Woodlands	Rivers/Lakes Wetlands/ Flood Plains	Urban	Coastal margins/ Marine
Ecosystem services	R v der Wal	J Bullock	L Firbank	C Quine	Maltby/ Ormerod	Linda Davies	Mel Austen
Regulating Services Pete Smith							
Supporting Services R Bardgett							
Provisioning Services G Edward-Jones							
Cultural Services Church/Burgess							

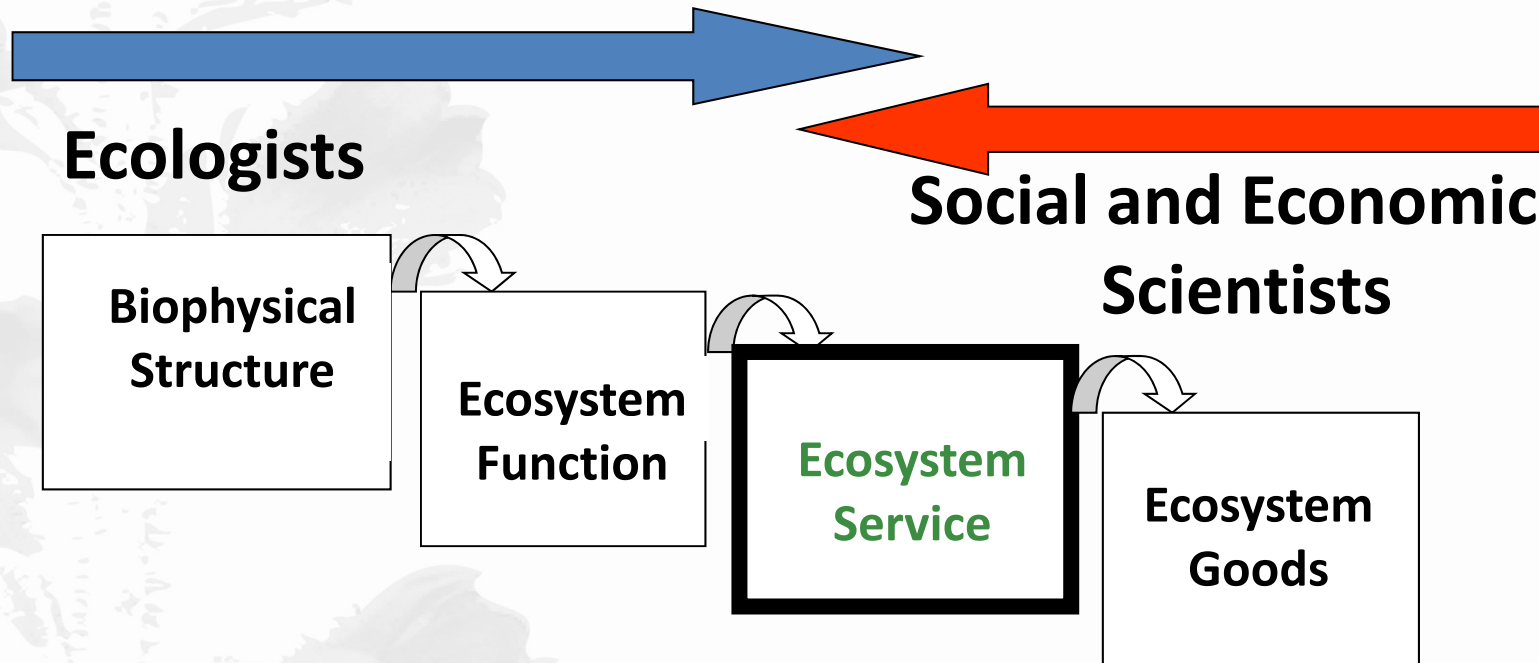
UK , National and Regional Syntheses – Hopkins (E), Aspinall (S), Russell (W)

Issues to tackle jointly by ecologists & social scientists

- Identify final ecosystem services, their level, and their role in generating goods and values since WWII
- Realistically “valuing” ecosystem services that generate benefits with no obvious market price (e.g. species’ “existence values”)
- Assess both temporal and spatial differences in ecosystem services
- Identify and prioritise gaps in knowledge for future research
- Ensure that emphasis on ecosystem service provision does not allow further erosion of biodiversity among scarcer species with small functional contribution.
- Assess plausible scenarios
- Develop holistic socio-ecological models of possible outcomes

Specific challenges for ecologists

Socio-ecological system



- Assess how changes in ecosystem function influence ecosystem services
- Assess irreversibilities (“Tipping points”)
- Increase collaboration of empiricists, modellers & theoreticians
- Seek development of designed networks

Adapted from Haines-Young

NEA – challenges for ecologists

- Case studies scarce.
- Quantitative link between service provision and ecosystem structure or function poorly understood.
- Appropriateness of indicators.
- Issues of spatial scale – different interactions and trade-offs, and recognition of sense of place and community
- Connectedness between habitats and therefore ecosystem services

UK National Ecosystem Assessment

Primary questions Phase 1 – Status & Trends

- What are the status and trends of the UK's ecosystems/Broad Habitats and the final ecosystem services they provide to society?
- What are the drivers causing changes in ecosystems/Broad Habitats in the UK and the services they provide to society?
- What are the uncertainties, and knowledge/data gaps for understanding, monitoring and managing , including restoration, of ecosystem services in ecosystems/Broad Habitats the UK?
- How have changes to ecosystems/Broad Habitats affected human well-being in the UK?
- Who and where are the beneficiaries of current ecosystem services in the UK?
- How does the location of beneficiaries of ecosystem services affect how the ecosystem services are valued and managed?

Final Ecosystem Services and examples of goods/benefits

Final ecosystem service	Goods and benefits
(P) Crops, plants, livestock, fish, etc. (wild and domesticated)	Food, fibre, avoidance of climate stress, energy, genetic resources, industrial inputs, fertiliser, Cultural benefits (CB) list
(P) Trees, standing vegetation & peat	Timber, avoidance of climate stress, energy, noise regulation, CB List
(R) Climate regulation	avoidance of climate stress,
(P, R) Water quantity	Potable water, Industrial use of water, flood protection, energy, CB List
(R) Hazard regulation –vegetation & other habitats	Coastal protection, erosion protection, flood protection, avoidance of climate stress, CB List
(R) Waste breakdown & purification detoxification	Waste removal, waste degradation, clean air, clean water, clean soils, CB List
(P,R,C) Wild species diversity including microbes	Natural medicine, disease and pest control, genetic resources, wild food, bioprospecting, CB List
(C) Local places	CB list
(C) Socially valued landscapes and waterscapes	CB list

List of Cultural Services goods/benefits

- Physical and psychological health
- Education/ecological knowledge
- Recreation and tourism
- Cultural Heritage & mediated natures
- Aesthetic/inspirational
- Spiritual/religious
- Security and freedom
- Meaningful places and community development
- Enfranchisement / social & environmental citizenship

Primary questions Phase 2 – Scenarios & Policy options

- How might ecosystems and their services in the UK change in the future under plausible scenarios?
- What are the future possible effects of changes in ecosystems on human well-being and who might be most affected?
- What is the current knowledge and understanding of ecosystem services in the public sphere?
- What are the policy options to secure and improve the continued delivery of UK ecosystem services under plausible future scenarios?
- What are the key ecosystem services upon which the UK depends that are not provided by UK ecosystems and what ecosystem services does the UK supply to other countries?
- What are the policy implications of UK-dependence on non-UK ecosystems?