Living With Environmental Change

UK National Ecosystem Assessment

Key Findings and Future Research Directions

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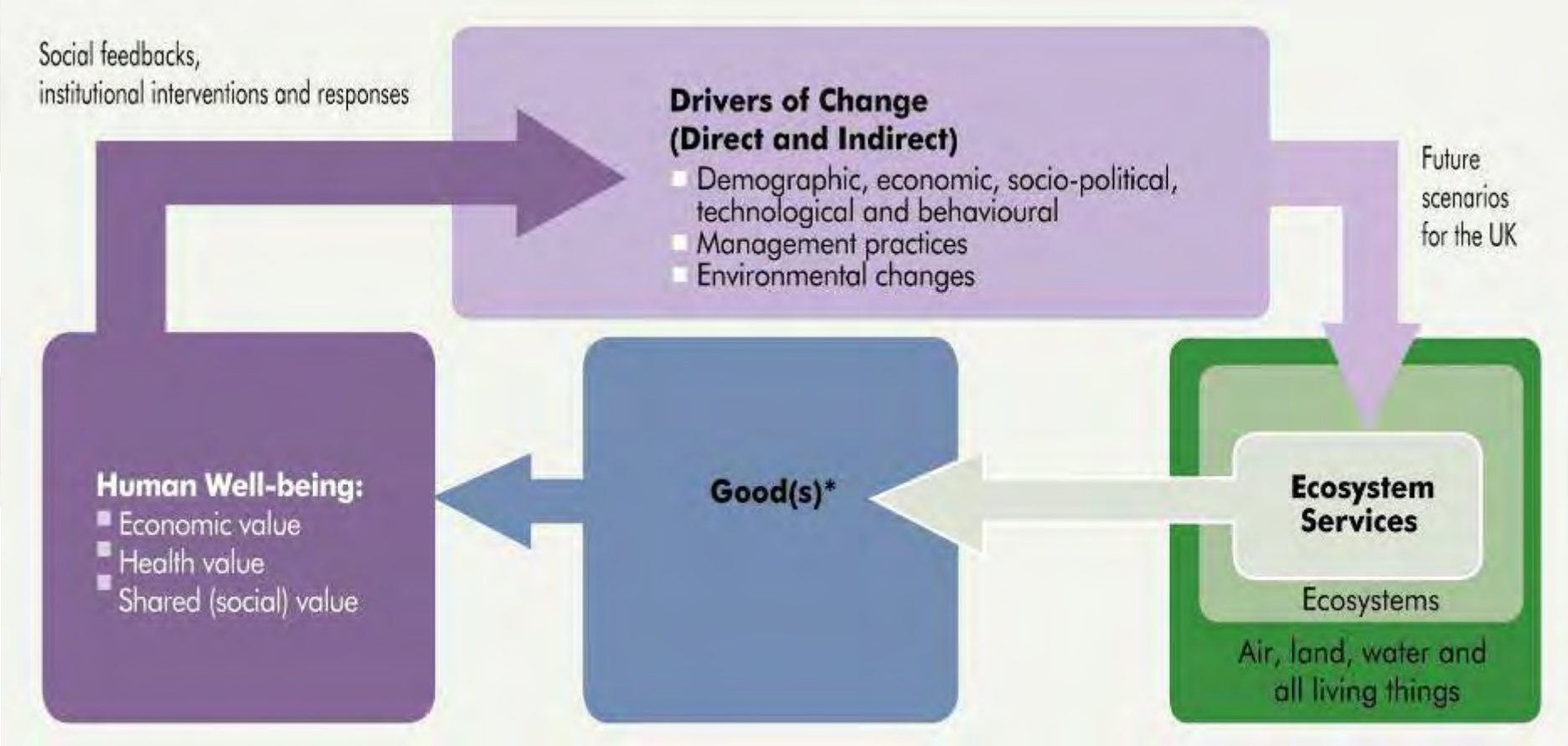
NATURAL ENVIRONMENT RESEARCH COUNCIL
NIEA Northern Ireland Environment Agency
The Scottish Government
Llywodraeth Cynulliad Cymru Welsh Assembly Government
UNEP WCMC

Press coverage at NEA Synthesis launch - 2 June

Conceptual Framework – evolution from the MA



Conceptual Framework – focus on well-being

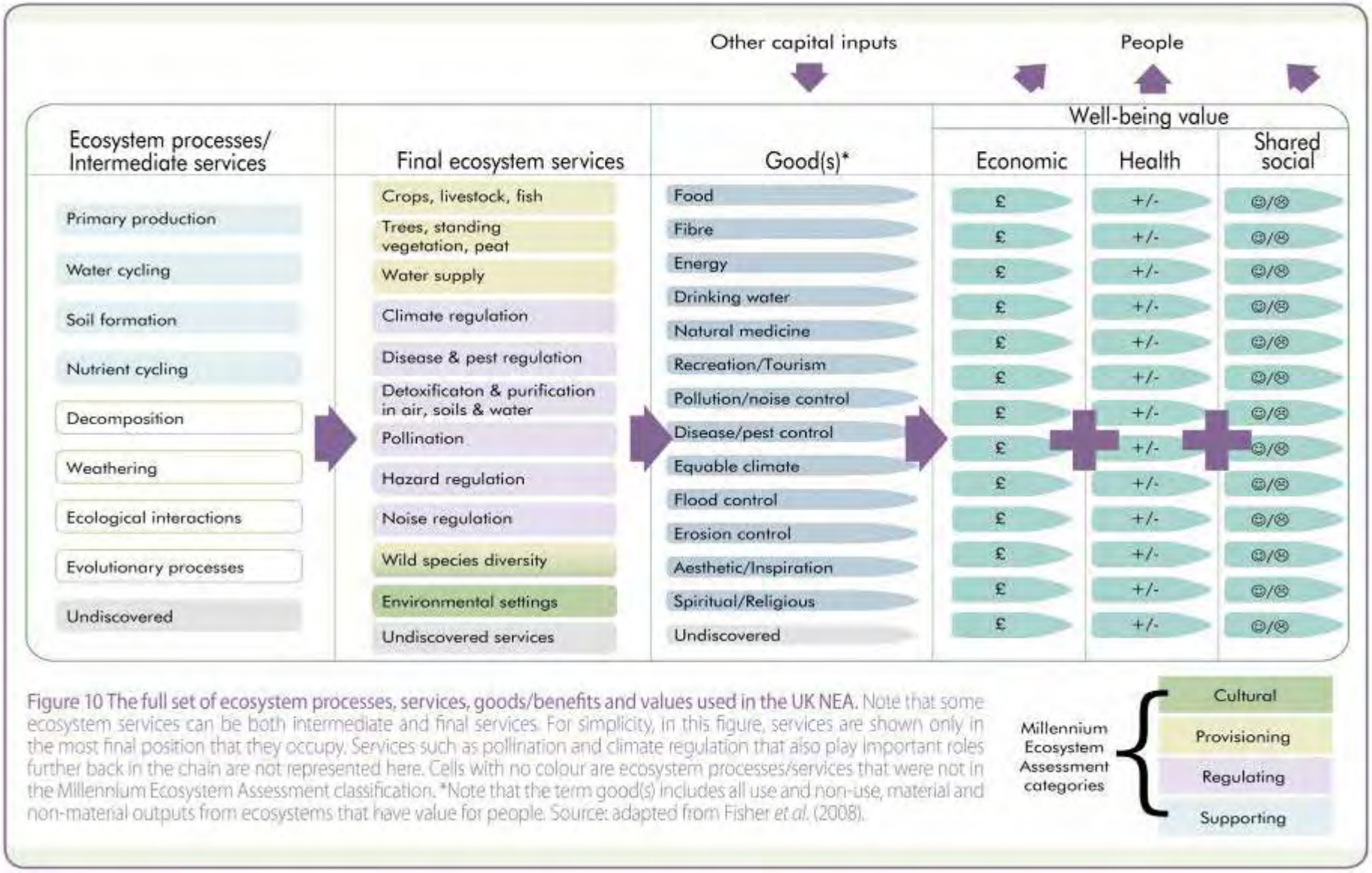


Figure 10 The full set of ecosystem processes, services, goods/benefits and values used in the UK NEA. Note that some ecosystem services can be both intermediate and final services. For simplicity, in this figure, services are shown only in the most final position that they occupy. Services such as pollination and climate regulation that also play important roles further back in the chain are not represented here. Cells with no colour are ecosystem processes/services that were not in the Millennium Ecosystem Assessment classification. *Note that the term good(s) includes all use and non-use, material and non-material outputs from ecosystems that have value for people. Source: adapted from Fisher *et al.* (2008).

UK Ecosystems (Broad Habitats)

Mountains/Moors/Heaths

Semi-natural grasslands

Woodlands

Enclosed farmland

Freshwater/Wetlands

Urban (settlement)

Coastal margins

Marine

Distribution of UK Habitats

Although lacking in extremes – there are no high mountains, no true deserts and no major rivers – the UK is in fact remarkably variable biophysically, ecologically and socially, with complex underlying geology, a wide climatic range, (from very wet to semi-arid), and large variations in the distribution of the human population, from extensive areas of near-wilderness (in Scotland) to one of the world's largest metropolitan areas (Greater London). In the UK NEA this diversity has been captured in eight Broad Habitat types (**Figure 12**):

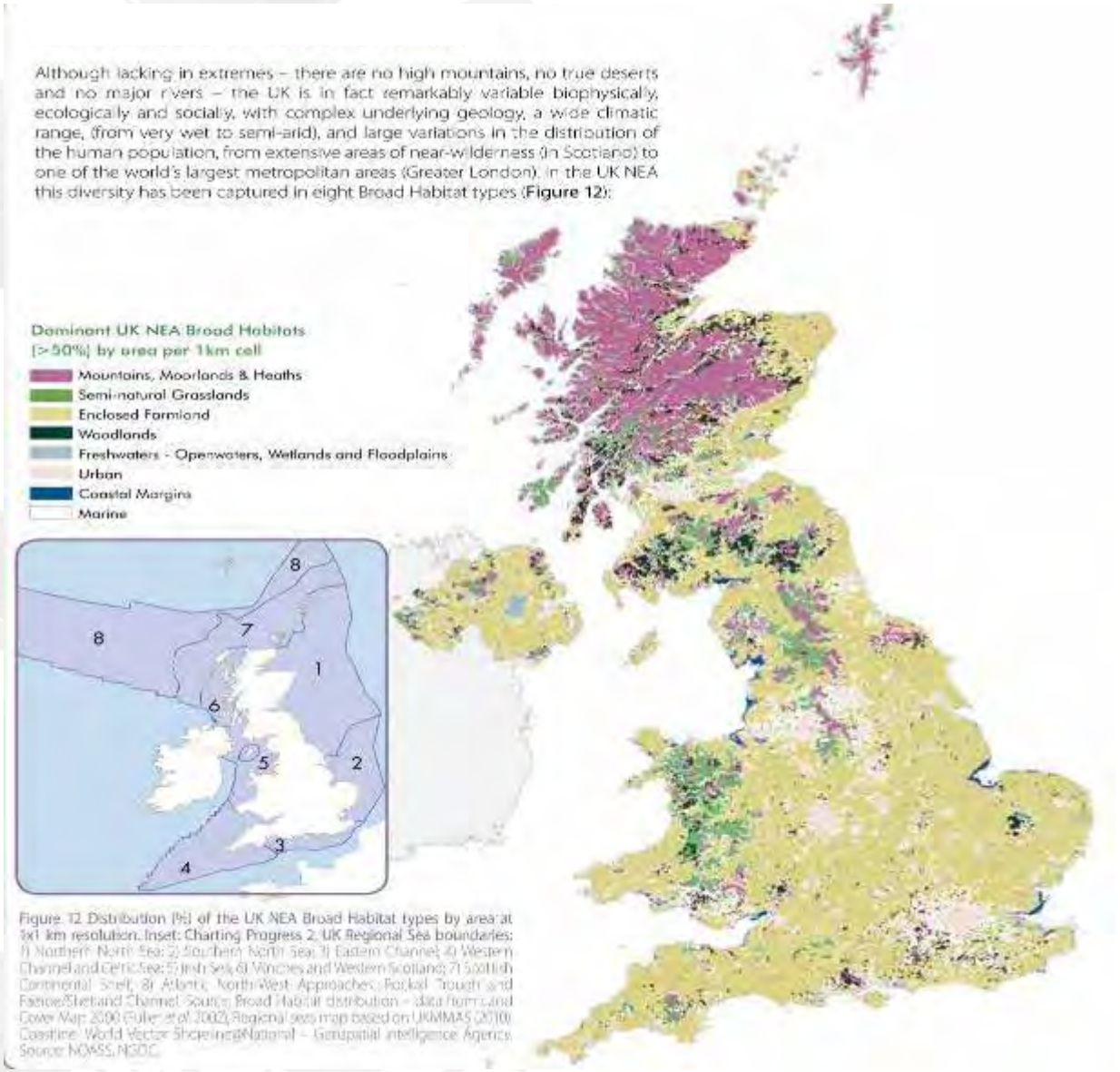
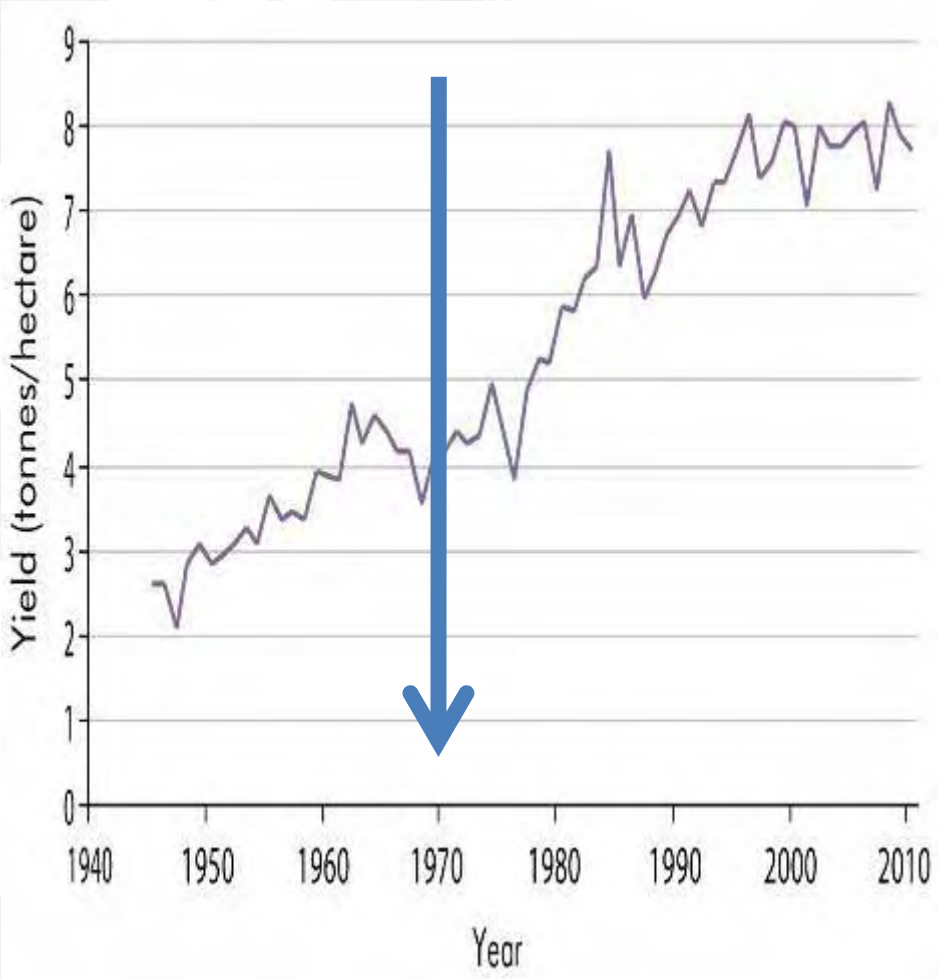


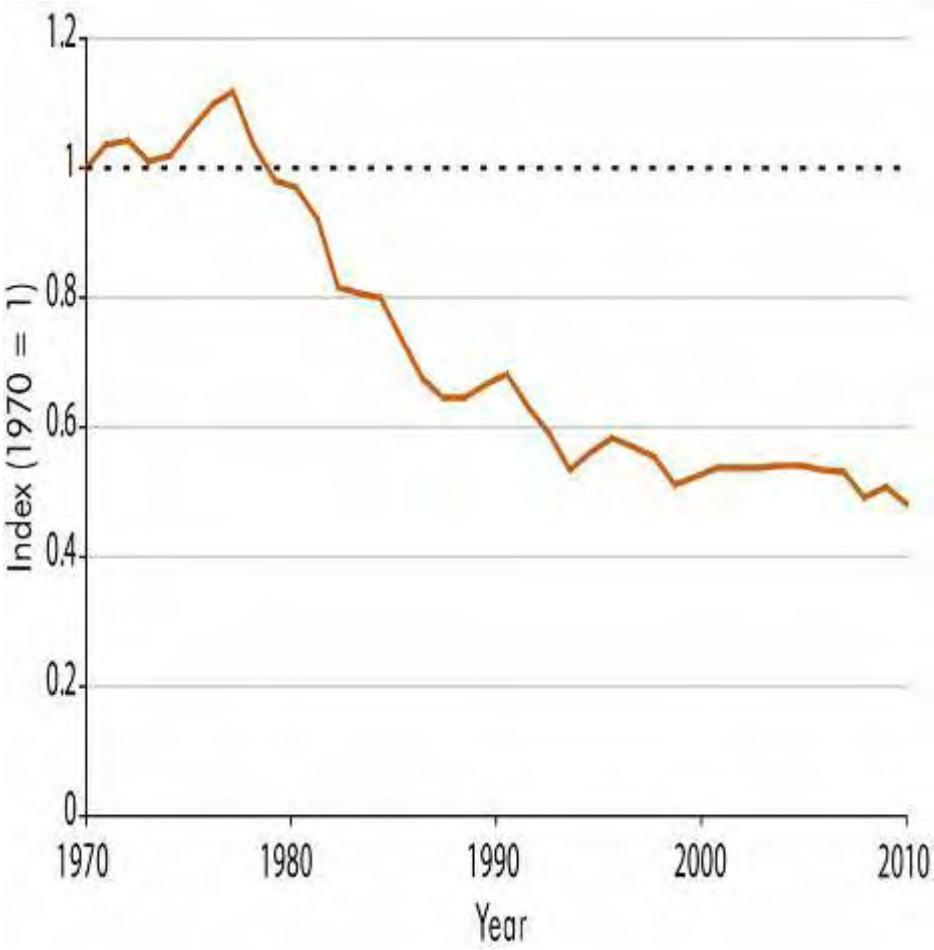
Figure 12 Distribution (%) of the UK NEA Broad Habitat types by area at 1x1 km resolution. Inset: Charting Progress 2, UK Regional Sea boundaries: 1) Northern North Sea; 2) Southern North Sea; 3) Eastern Channel; 4) Western Channel and Celtic Sea; 5) Irish Sea; 6) Minches and Western Scotland; 7) Scottish Continental Shelf; 8) Atlantic North-West Approaches. Rockall Trough and Faroe/Shetland Channel. Source: Broad Habitat distribution – data from Land Cover Map 2000 (Fuller et al. 2002). Regional seas map based on UKMMAS (2010). Coastline: World Vector Shoreline©National – Geospatial-Intelligence Agency. Source: NOAAS, NGDC.

Increased yields since 1945 but cost to biodiversity

a) Wheat

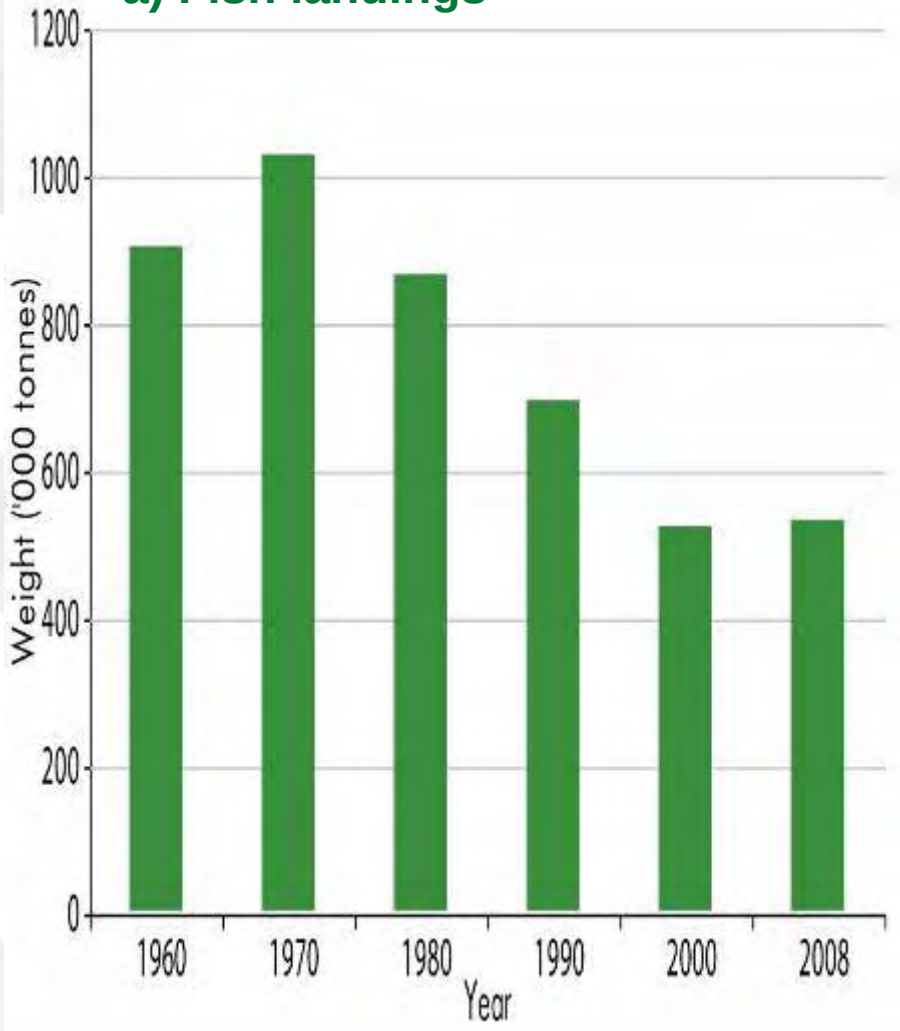


b) Farmland birds

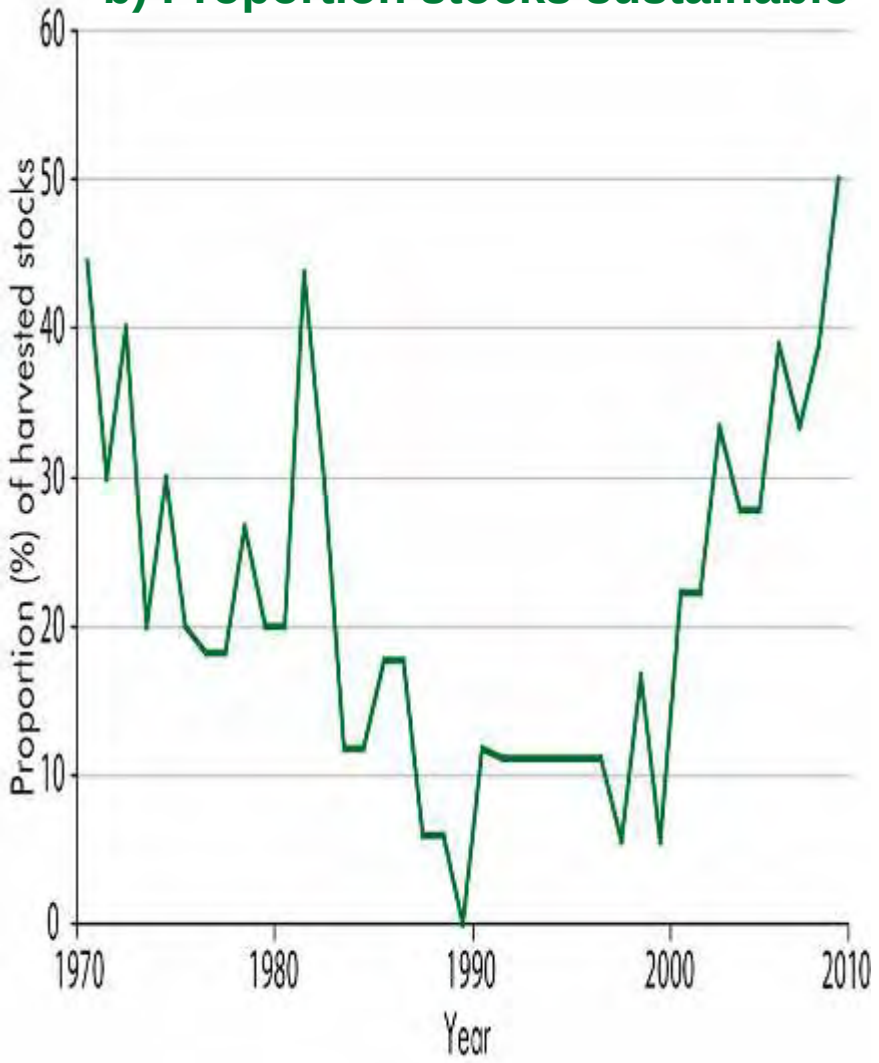


Decreased fish landings but some recovery

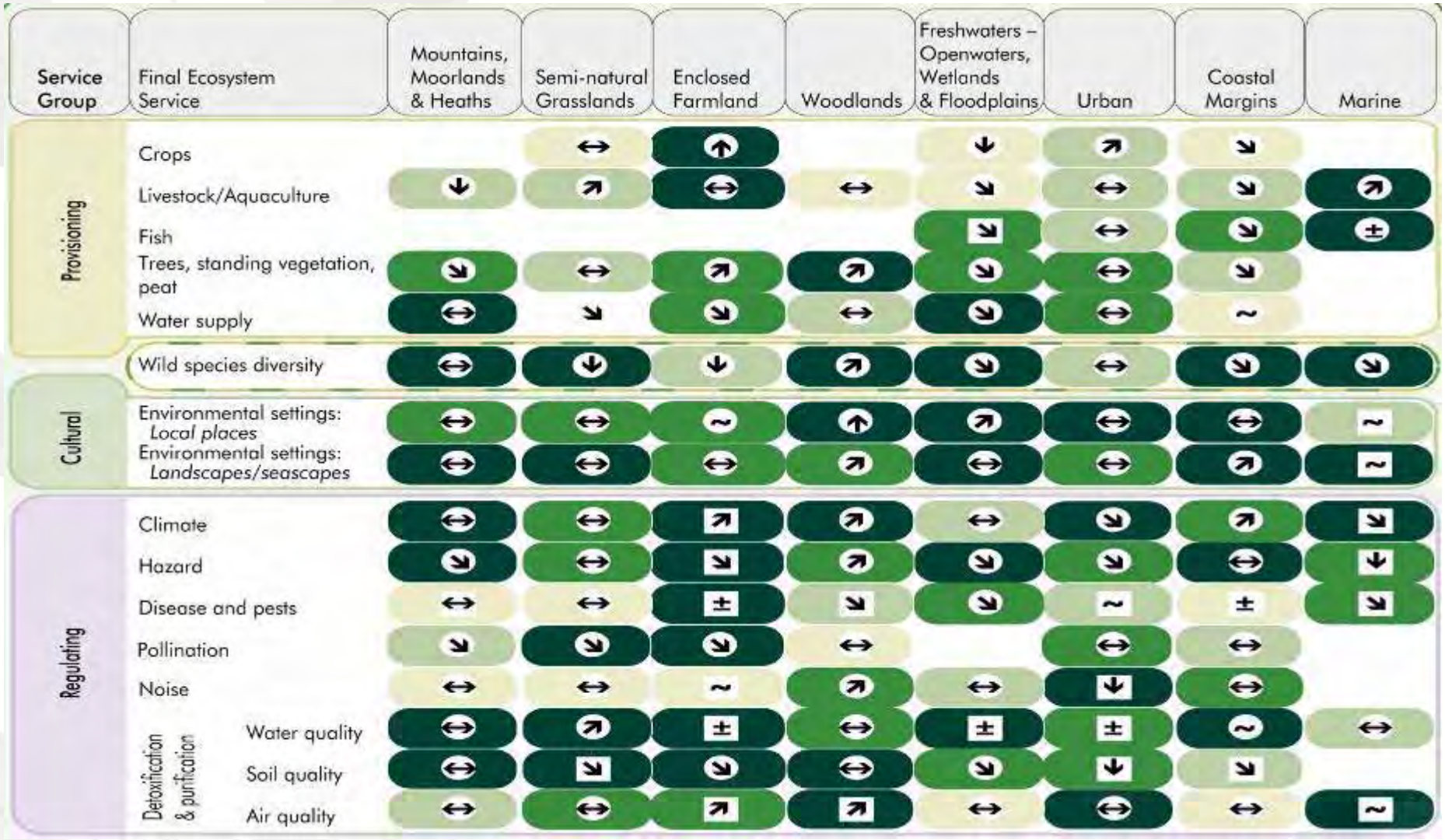
a) Fish landings



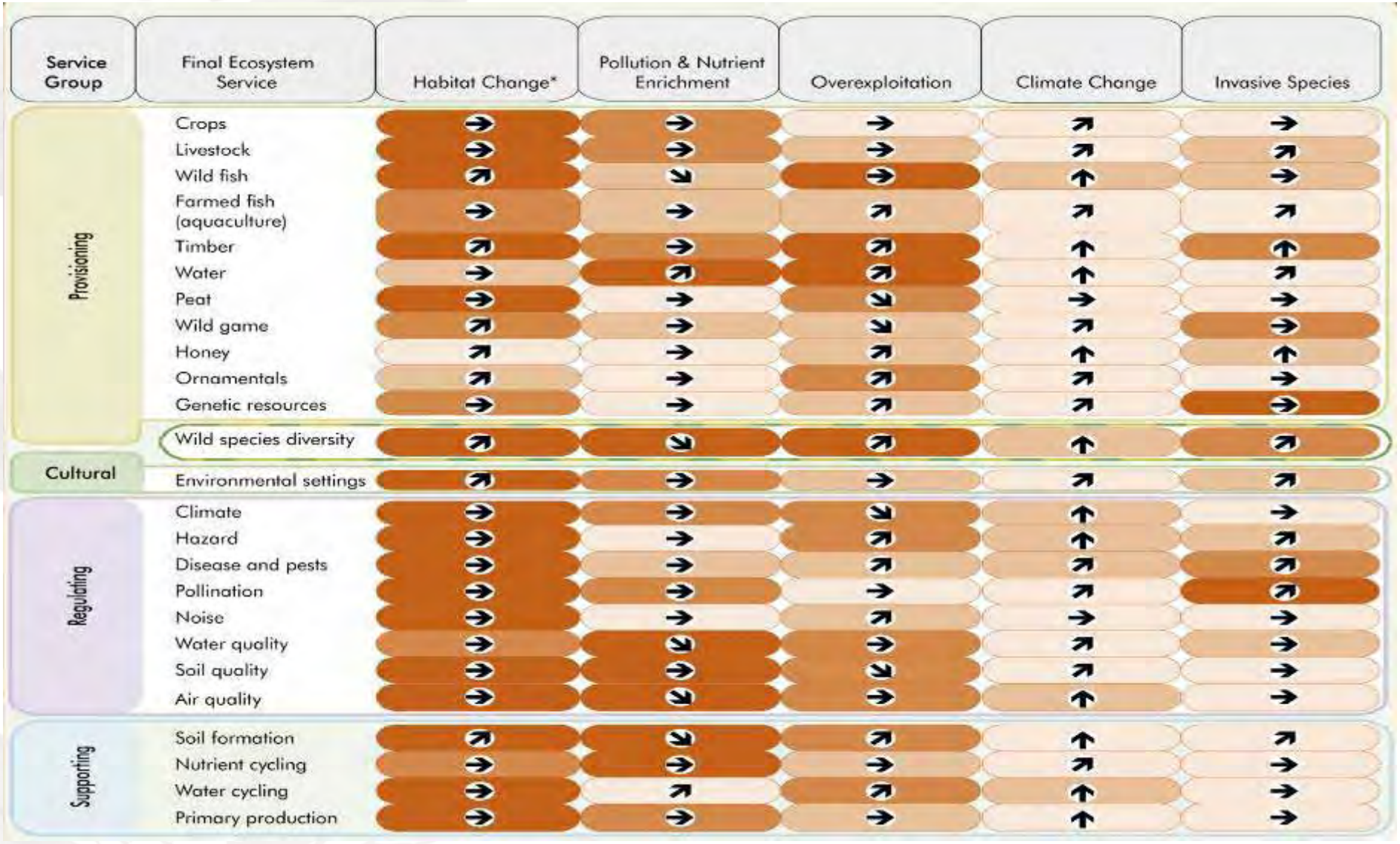
b) Proportion stocks sustainable



Relative importance of Habitats for Ecosystem Services and direction of change since 1990



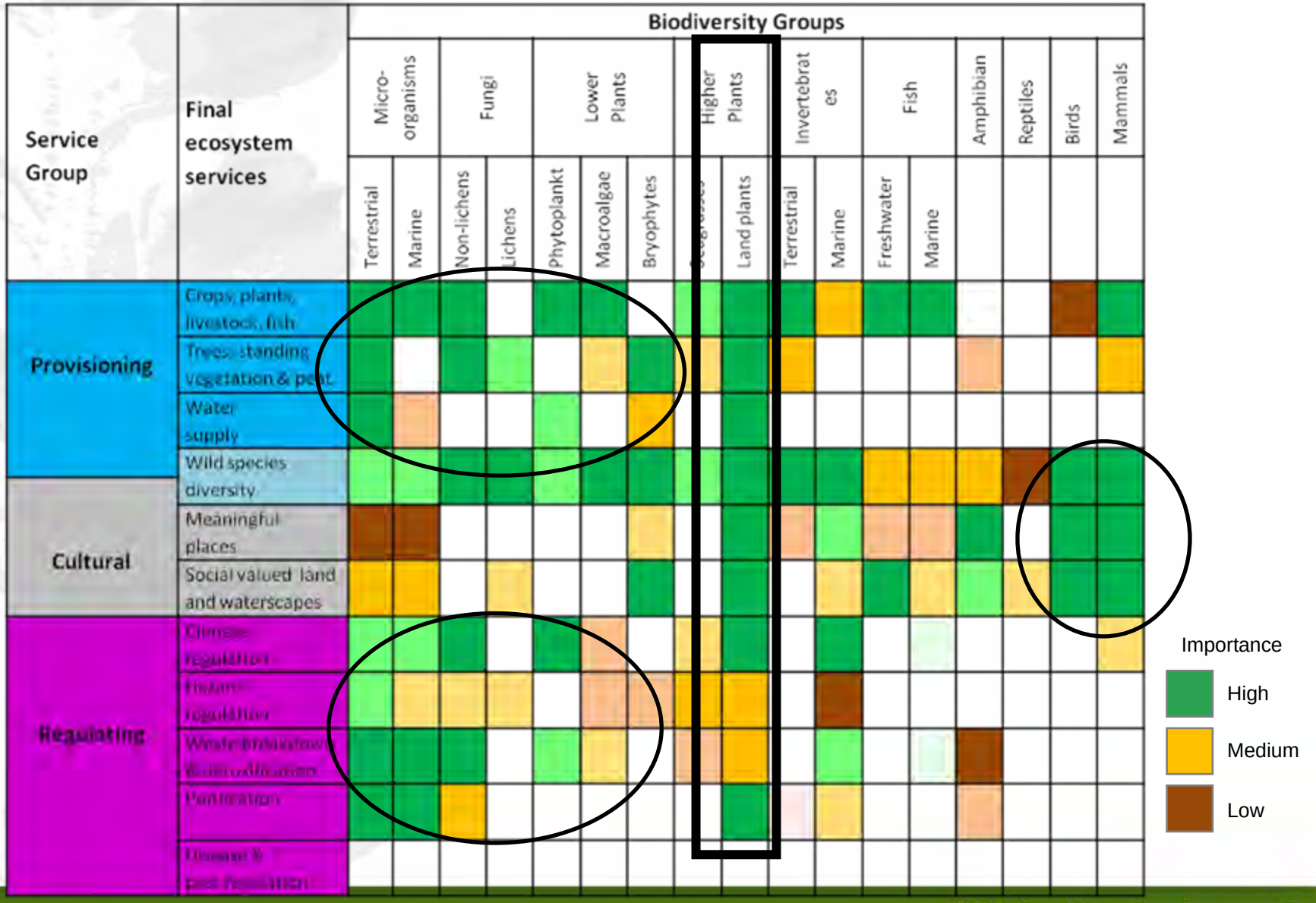
Importance and Trends in Drivers affecting Services



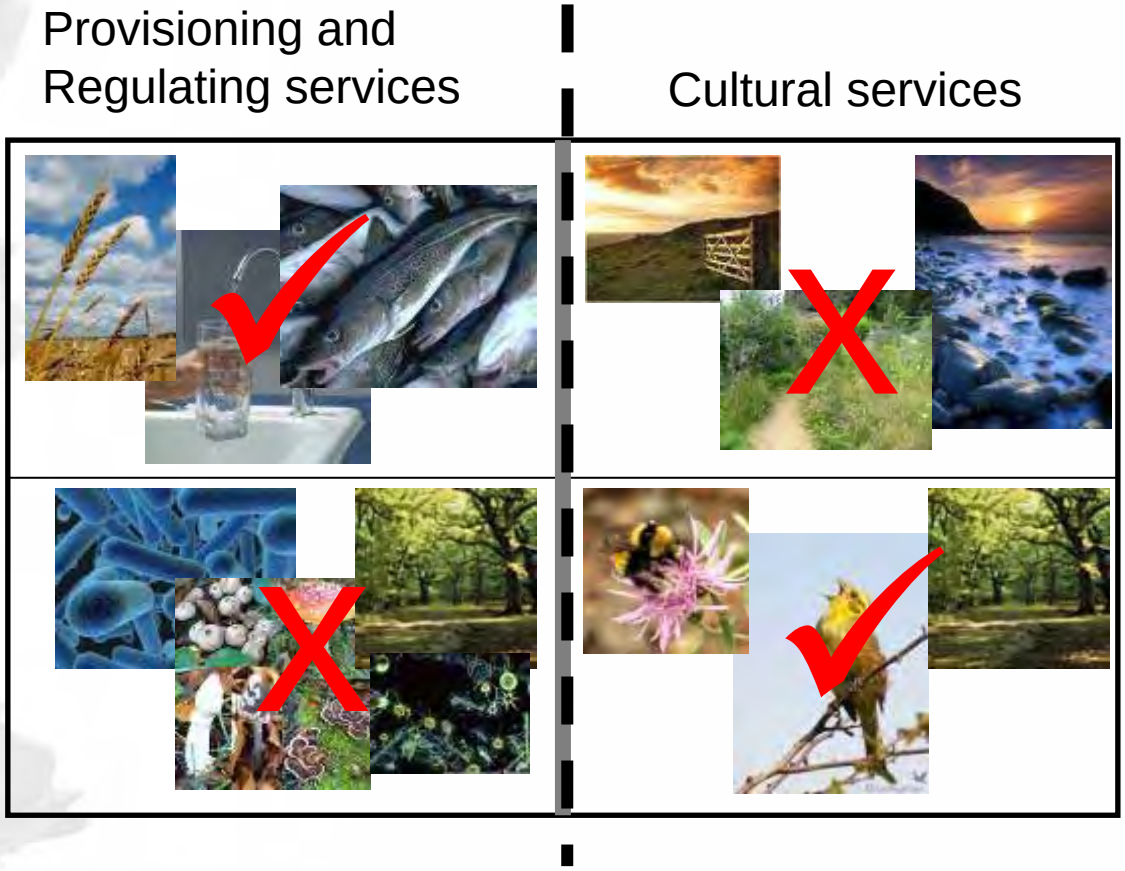
Knowledge gaps – Drivers of Change

- Generally less is known about the consequences of individual drivers on supporting, regulating, and cultural services.
- Even for provisioning services little known about interactions of multiple drivers.
- Issues of spatial and temporal scales over which drivers act alone and together.
- Require better, holistic models of systems at appropriate scales to understand uncertainties and highlight sensitivities.

Biodiversity – role in delivery of Ecosystem Services



Biodiversity – 'The Cultural Service Divide'



Challenges:

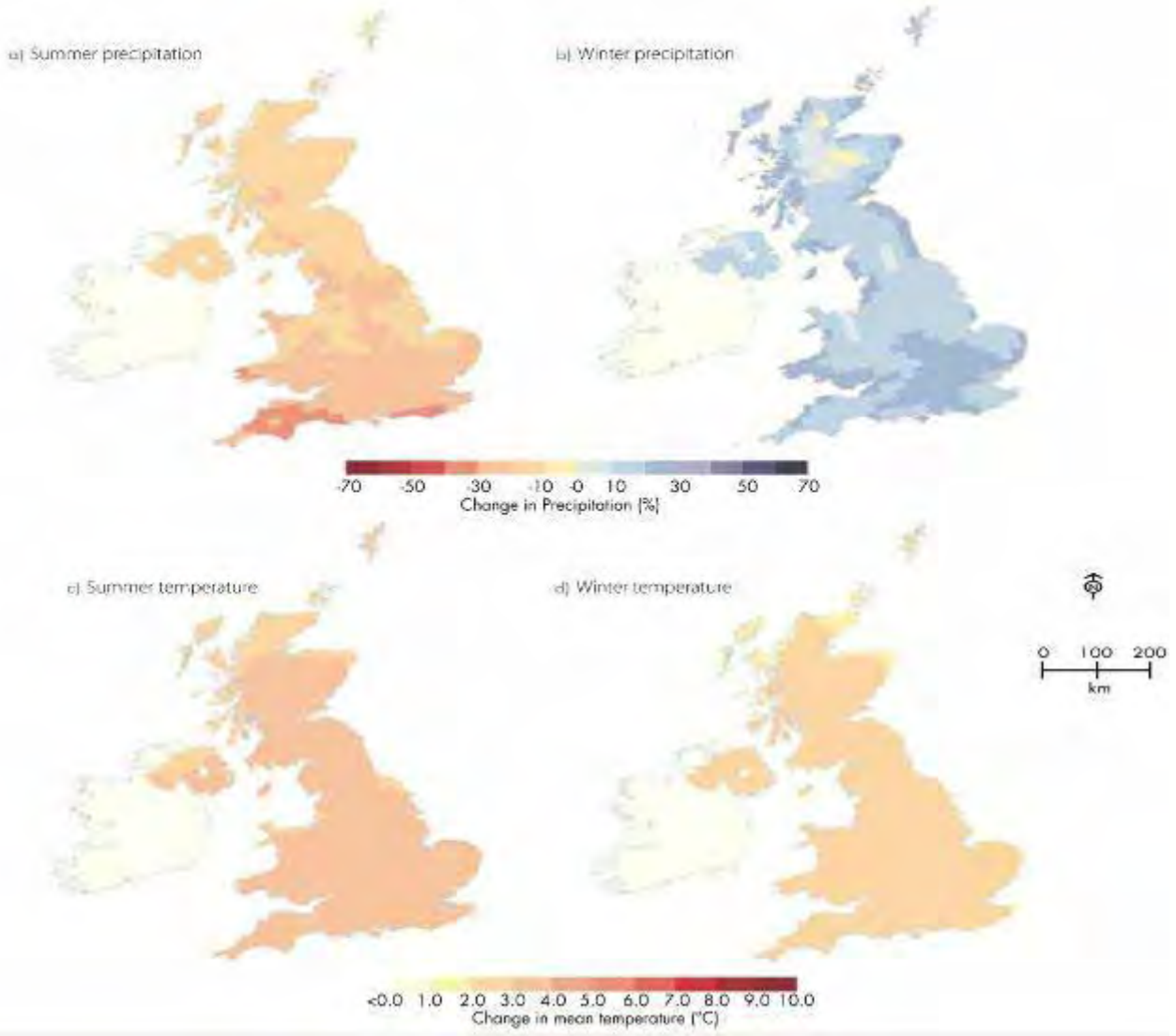
- Improve our understanding of how different biodiversity groups underpin ES
- Identify key indicator groups, changes in which have an important impact on ES
- Develop UK comprehensive, integrated monitoring programme for these indicator groups

Knowledge gaps – Biodiversity

Biodiversity Group		Trend information	Drivers of biodiversity change				
			Land-use change	Climate change	Invasive species	Exploitation (direct and	Pollutants
Micro-organisms	Marine	Patchy					
	Terrestrial	Poor					
Fungi	Non-lichenised	Poor					
	Lichens	Moderate					
Lower Plants	Phytoplankton	Good					
	Macroalgae	Patchy					
	Bryophytes	Moderate					
Higher Plants	Seagrasses	Patchy					
	Land plants	Good					
Invertebrates	Marine	Patchy					
	Terrestrial	Moderate					
Fish	Marine	Moderate					
	Freshwater	Good					
Amphibians		Moderate					
Reptiles		Patchy					
Birds		Good					
Mammals		Moderate					

- Land-use change & pollution are the major drivers of change.
- Exploitation has a significant impact in marine ecosystems.
- Emerging evidence of climate change impacts across most groups.
- Impact invasive spp less important for the majority groups.

Projected Changes in Precipitation and Temperature by 2060: High Emissions



UK Dependence on non-UK Ecosystems

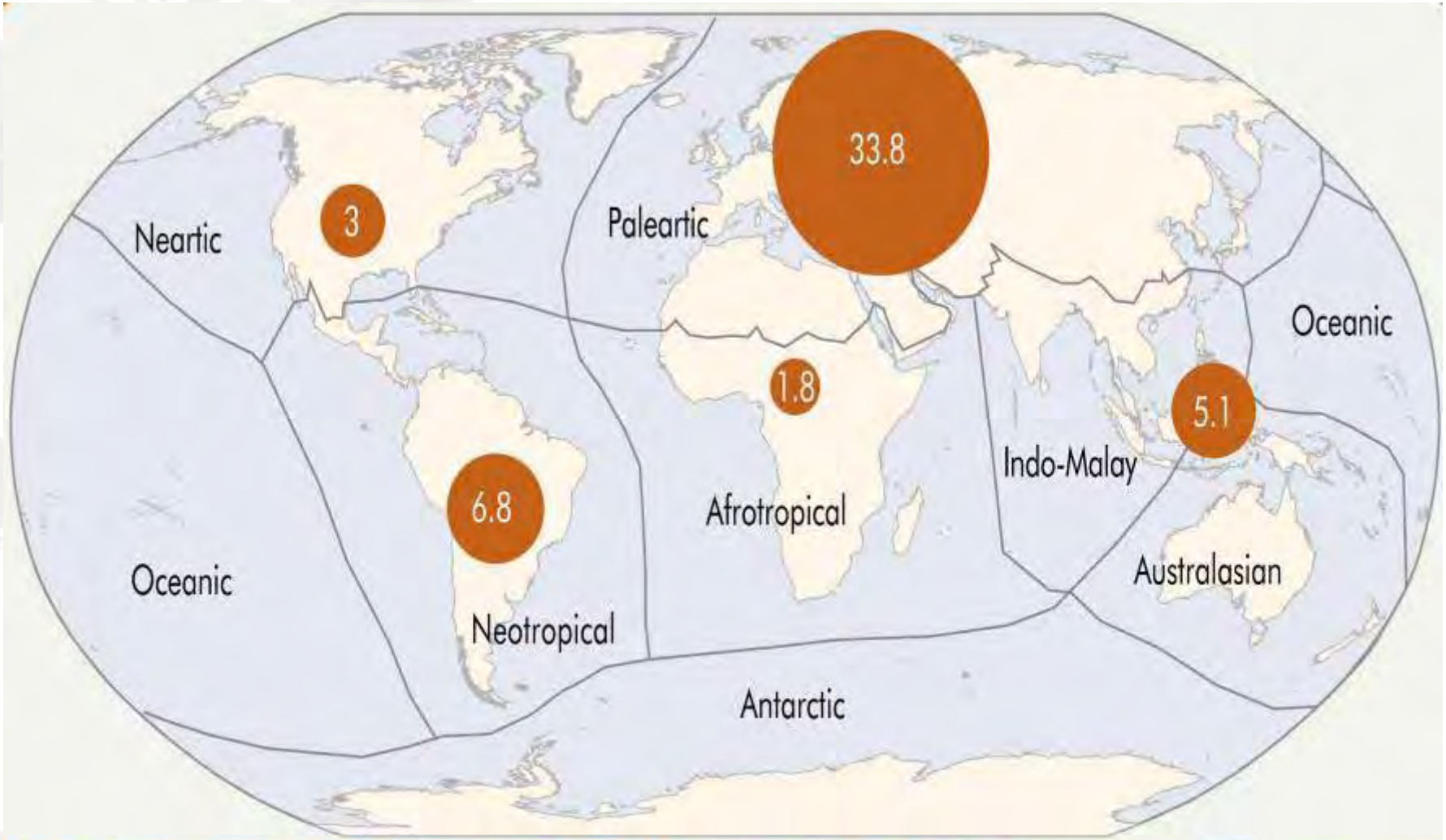
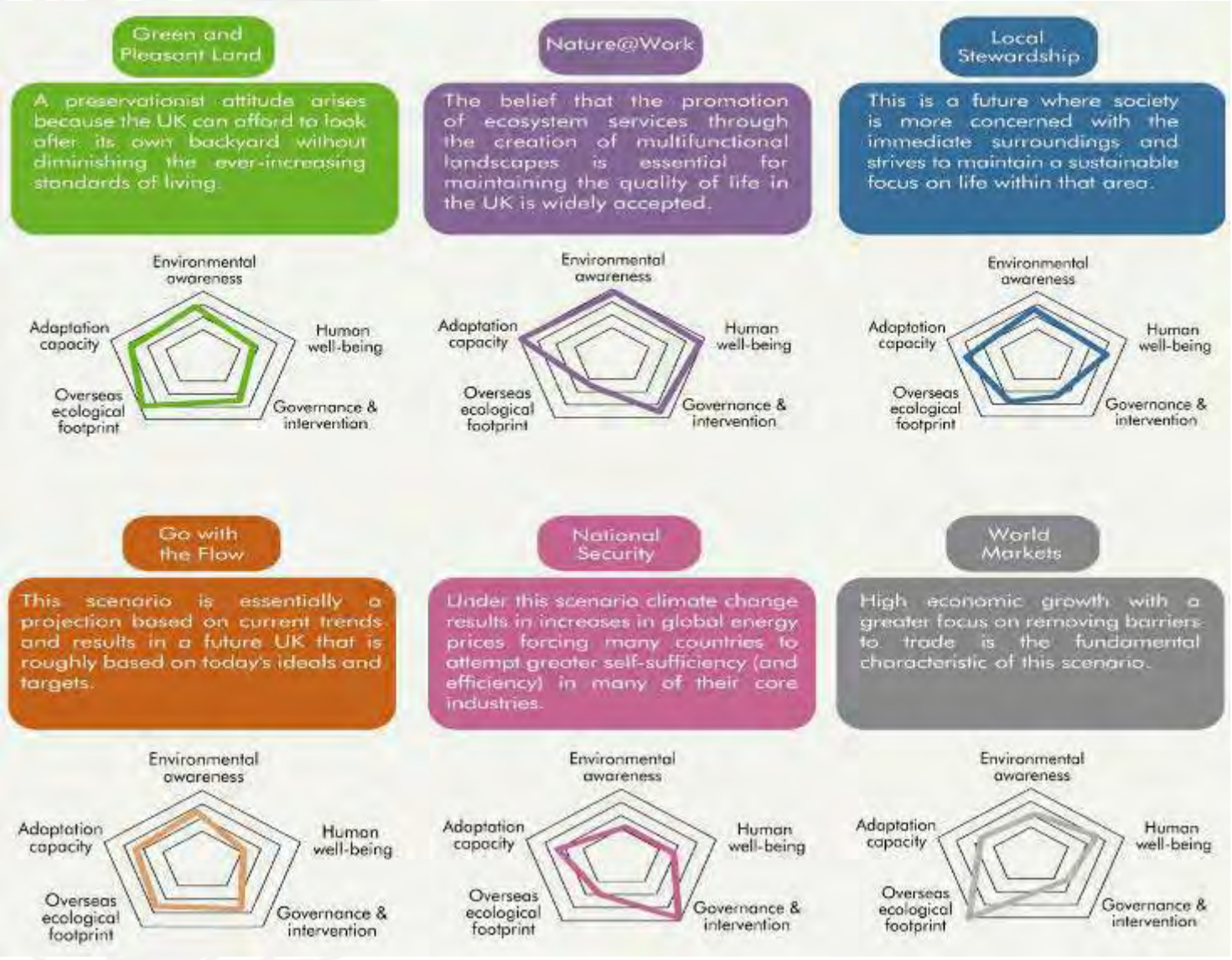
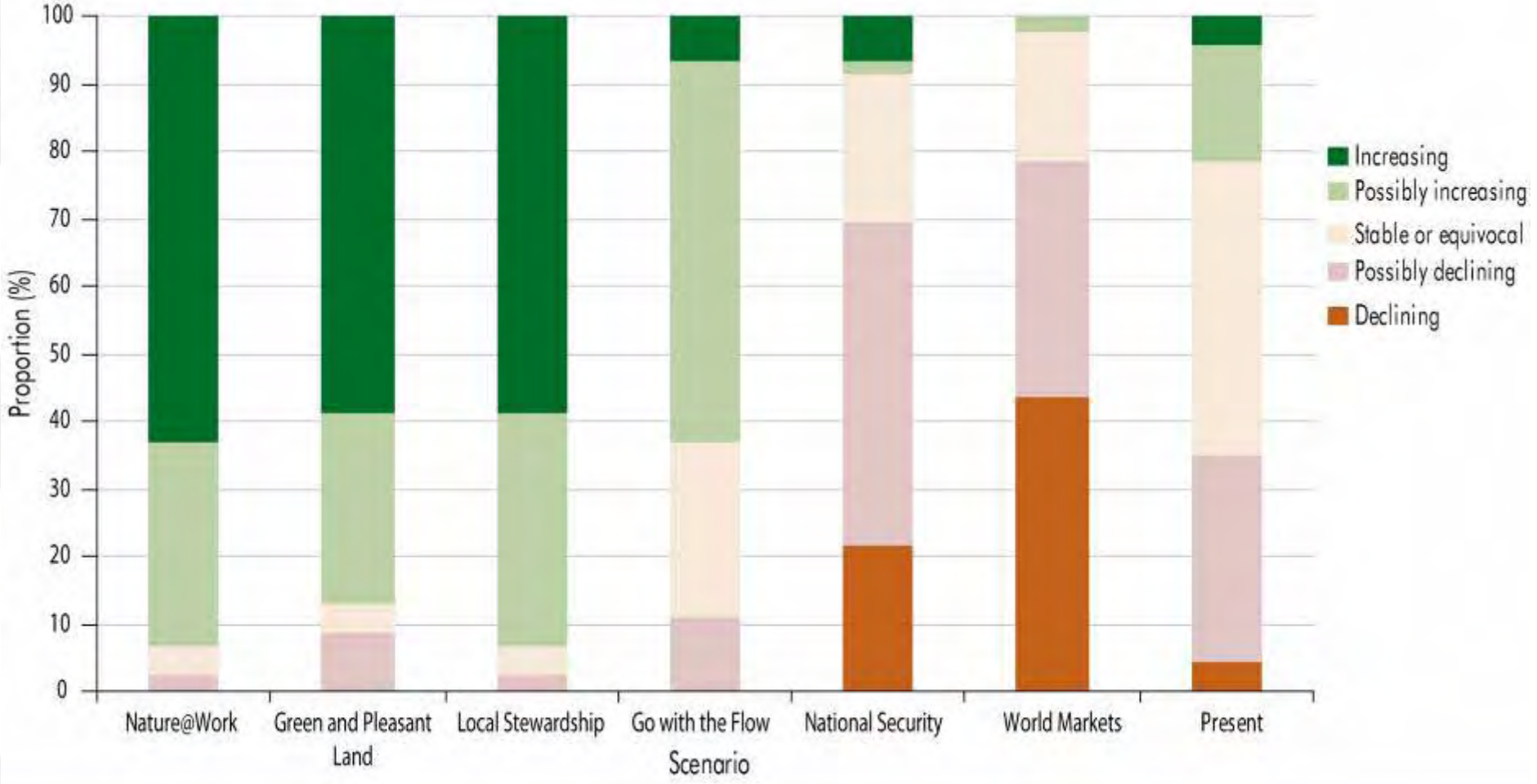


Figure 15 Source of biomass (millions of tonnes) imported into the UK by Biogeographical Realms in 2008. Source: data from HMRC (2008); underlying map based on Olson *et al.* (2004).

Contrasting Scenario projections



Implications of ‘storylines’ on Ecosystem Services



Economic Implications of contrasting 'storylines'

	GF	GPL	LS	NS	NW	WM
Market agricultural output values *	220	-290	350	680	-510	420
Non-market GHG emissions †	-800	2,410	-100	3,590	4,590	-2,130
Non-market recreation ‡	5,710	6,100	1,540	4,490	24,170	5,040
Non-market urban greenspace ¶	-1,960	2,350	2,160	-9,940	4,730	-24,000
Total monetised values §	**3,170**	**10,570**	**3,950**	**-1,180**	**32,980**	**-20,670**
Rank: Market values only	4	5	3	1	6	2
Rank: All monetary values	4	2	3	5	1	6

* Change in total Great Britain farm gross margin.

† Change from baseline year (2000) in annual costs of greenhouse gas (GHG) emissions from Great Britain terrestrial ecosystems in 2060 under the UK NEA Scenarios (millions £/year); negative values represent increases in annual costs of GHG emissions

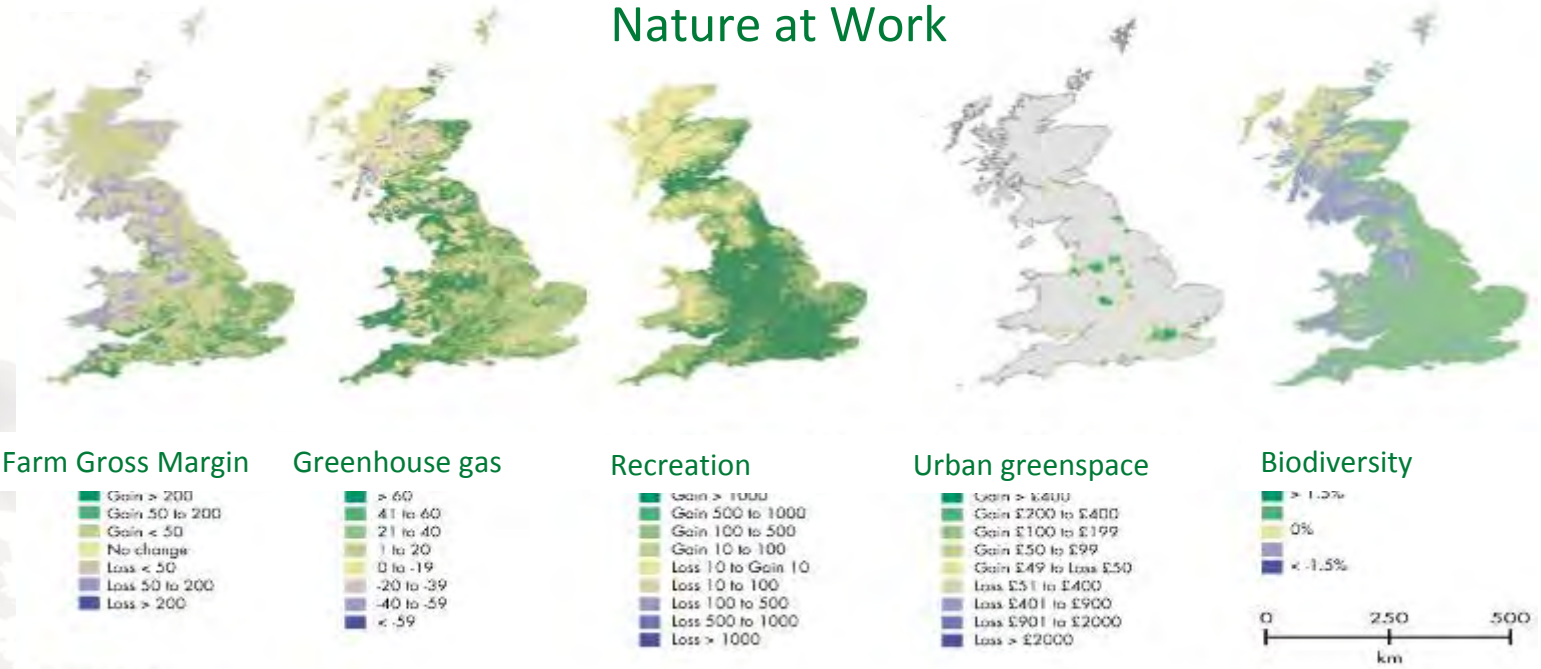
‡ Annual value change for all of Great Britain.

¶ Undiscounted annuity value; negative values indicate losses of urban greenspace amenity value.

§ We acknowledge some double counting between urban recreation and urban greenspace amenity value. Further data is needed to correct for this.

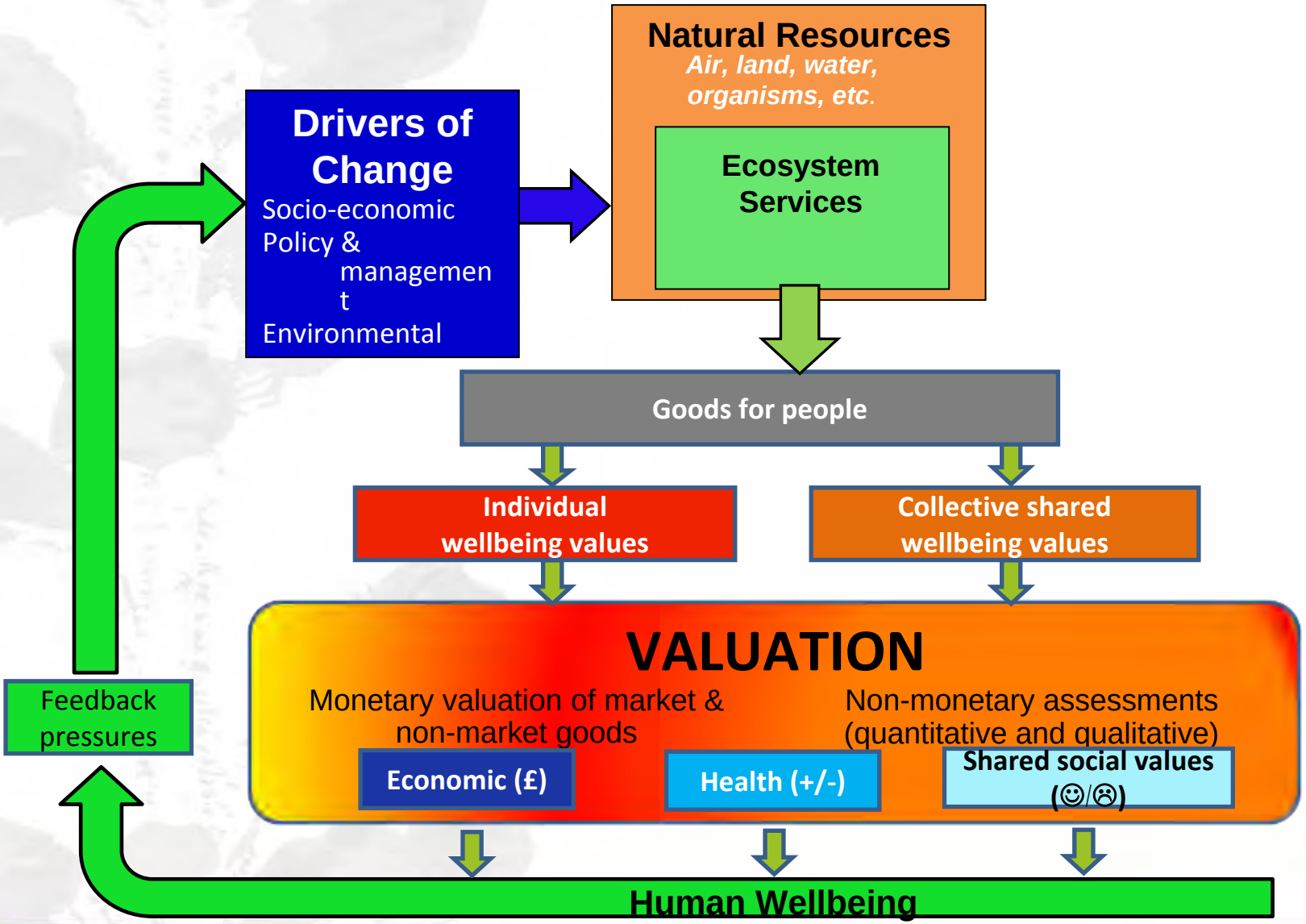
Spatial Economic Implications of two 'storylines'

Nature at Work



World Markets

Knowledge gaps – Well-being value



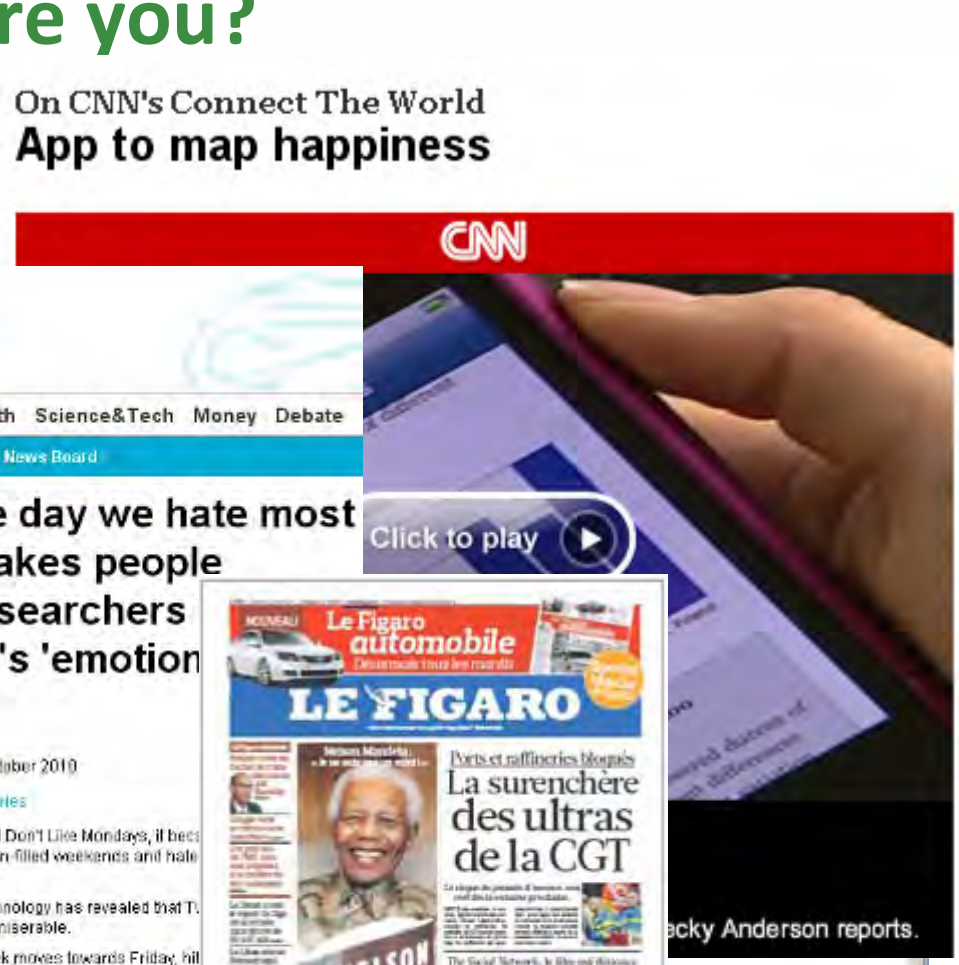
Well-being value: subjective life satisfaction

Dependent variables:

- 0–10 ***life satisfaction*** **scale**
- General and physical health:
  - use the ***physical functioning*** and ***emotional wellbeing*** subscales as outcome
- Mental and emotional health: Positive And Negative Affect Schedule (PANAS)

Explanatory variable	Difference in explanatory variable	Associated differences		
		Life satisfaction	*Physical functioning*	*Emotional wellbeing*
Physical exercise	+1 MET-day/week (e.g. +3 hours' vigorous activity)	–	**+0.3%**	**+0.3%**
Having a view over green space from your house	No view → any view	–	–	**+5.3%**
Use of own garden	Less than weekly → weekly or more	**+2.5%**	**+3.3%**	**+3.1%**
Use of non-countryside green space	Less than monthly → monthly or more	**+1.7%**	**+4.3%**	**+2.5%**

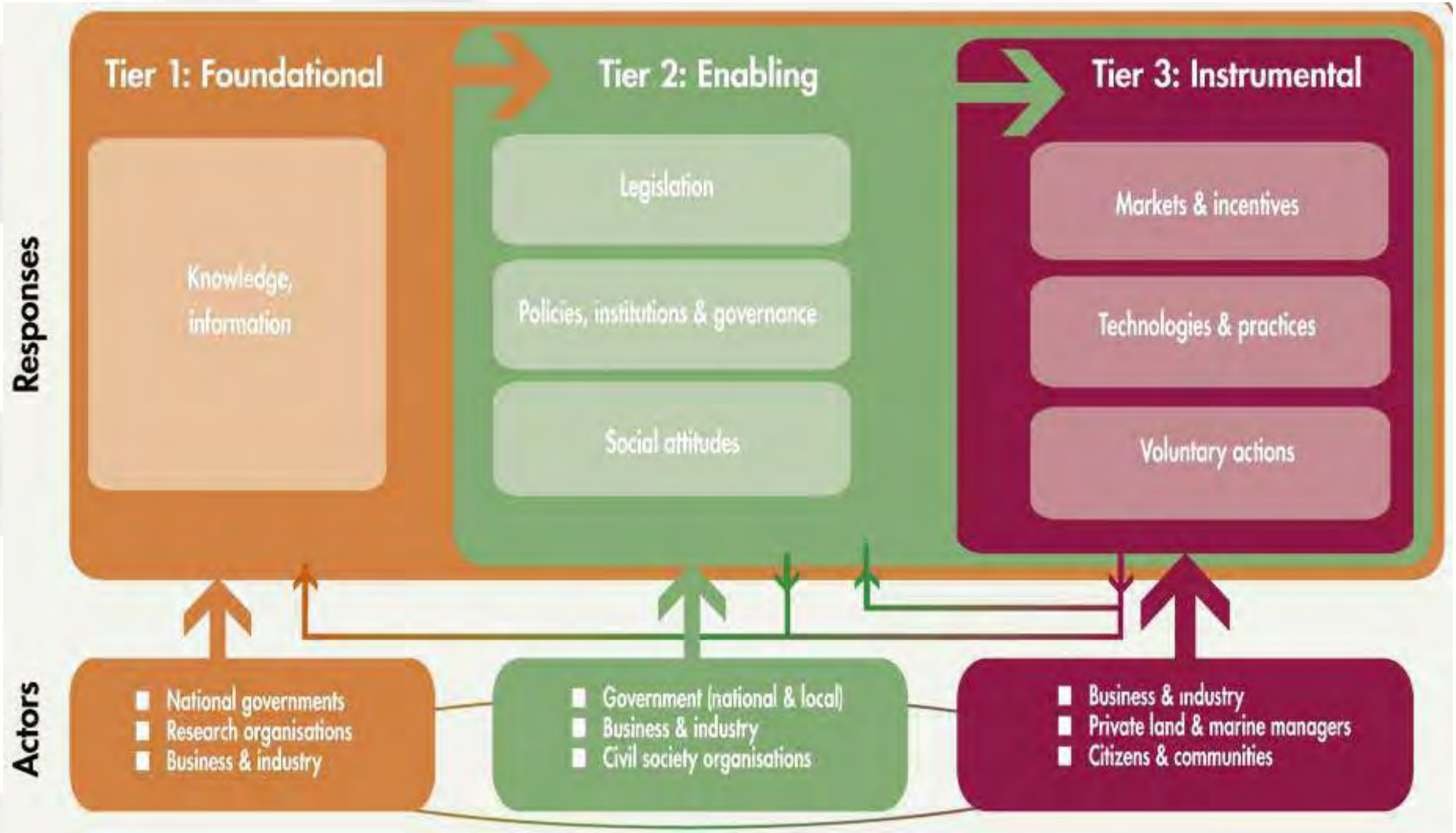
Well-being: How ’appy are you?



How to promote the ecosystem approach?

- **INTEGRATION:** responses that are initiated within a single sector often impact on other sectors and services; key element of ecosystem service based thinking
- **THINKING ACROSS SCALES:** spatial and temporal
- **COLLABORATION:** responses may be initiated by particular actors, but usually require engagement with others; collaborative partnerships between stakeholders
- **MULTIPLE RESPONSES:** require a mix of approaches, e.g. legislation and regulations supporting attitudinal changes, underpinning markets and incentives, technological innovation and voluntary compliance

Actors and Response Options



Summary

- We already have enough information to manage our ecosystems more sustainably and good evidence of the benefits of doing so.
- Nonetheless improving our understanding of how changes in our ecosystems, in particular halting the loss of biodiversity, influences the delivery of services remains a priority.
- Finally, while we have illustrated how considering both market and non-market benefits from ecosystem services can influence economic prosperity, we have to explore ways of also taking account of benefits to health and social values in decision making.
- Plans are being discussed for a follow-on phase to the NEA
  - Work on natural science, in particular, an asset check of ES stocks
  - Work on economics of wider range of ecosystem services
  - Work on cultural services in particular, shared social well-being
  - Work incorporating these measures in to the scenario projections
  - Tools using the ecosystem service framework within ecosystem approach

Acknowledgements

- **500 natural, economic and social scientists**
- **Claire Brown, Lucy Simpson & Megan Tierney** - UNEP-WCMC Secretariat.
- **Georgina Mace** - Overall Conceptual Framework
- **Ian Bateman** – Valuation
- **Ken Norris** - Biodiversity
- **Roy Haines-Young** - Scenarios
- **Bashkir Vira** – Response options

Key Messages 1

The benefits that we derive from the natural world and its constituent ecosystems are critically important to human well-being and economic prosperity, but are consistently undervalued in economic analysis and decision-making

Ecosystem and ecosystem services are constantly changing, driven by societal changes – demographic, economic, socio-political, technological and behavioural – which influence demand for goods and services and the way we manage our natural resources.

Key Messages 2

Ecosystems and their services have been directly affected by conversion of natural habitats, pollution of air, land and water, exploitation of terrestrial, marine and freshwater resources, invasive species and climate change

From the late 1940s onwards, emphasis in the UK was placed on maximising provisioning services to meet human needs for food, fibre, timber, energy and water

While productivity increased, there was a decline in the delivery of a wide range of ecosystem services, particularly those associated with biodiversity and air, water and soil quality

Changes in national policy and legislation, latterly often driven by EU policy, along with technological developments and changing attitudes and behaviour, have led to improvements in some ecosystem services, particularly in the past 10-20 years

Key Messages 3

Despite improvements many ecosystem services are still far below their full potential – often as a consequence of long-term declines in habitat extent or condition, or both – and some continue to deteriorate, with adverse impacts on human well-being

A growing population and the increasing impacts of climate change mean that the future is likely to bring more challenges.

The UK will remain an active trading nation, with substantial flows of biomass across its borders, generating a substantial ecological 'footprint' overseas and continuing to be affected by social, economic and ecological changes elsewhere

Key Messages 4

Reversing declines in ecosystem services will require the adoption of more resilient ways of managing our ecosystems, and a better balance between production and other ecosystem services – one of the major challenges is to increase food production, but with a smaller environmental footprint through sustainable intensification.

Contemporary economic and participatory techniques allow us to take into account the monetary and non-monetary values of a wide range of ecosystem services. These techniques need to be adopted in everyday decision-making practice.

Key Messages 5

Failure to include the valuation of non-market goods in decision-making results in less efficient resource allocation, with negative consequences for social well-being. Recognizing the value of ecosystem services would allow the UK to move towards a more sustainable future, in which the benefits of ecosystem services are better realized and more equitably distributed.

Exploring some of the plausible futures open to us shows that there is a huge range of potential outcomes for the state of the nation, its people and its ecosystems in the coming decades. Decisions that we all make now and in the immediate future will have a major impact on these outcomes

Key Messages 6

A move to sustainable development will require changes in individual and societal behaviour and adoption of a more integrated approach to ecosystem management

This will require an appropriate enabling environment (regulations, incentives and behaviour change) and the involvement of a wide range of different actors, including government, the private sector, voluntary organizations and civil society at large

Knowledge Gaps: Regulating – diseases/pests regulation

• What is the evidence-base that agri-environment schemes are effective in protecting biodiversity and that enhanced biodiversity delivers enhanced pest regulation.

• What effect has the huge (c15% pa) increase in herbicide use had on the yield and economy of crops, on weed flora and food webs, on the overall profile of pesticides in water and on the carbon footprint of arable cropping.

•To forecast the likelihood of pathogen establishment, laboratory studies of host and vector species susceptibility must be combined with detailed longitudinal field studies to understand the role of abiotic and biotic drivers in disease regulation.

• Use of key UK habitats by people, hosts, and vectors must be investigated within the same landscape framework, incorporating the work of ecologists, epidemiologists and social scientists to understand the processes underlying abrupt changes in disease incidence.

Knowledge gaps – Supporting Services

- The apparent decadal trends in loss of soil carbon, so crucial for ES, are contentious and need further study.
- Soil water dynamics, and consequences for nutrient and carbon cycling, under the influence of climate change.
- Increase resolution and reduce uncertainty of hydrological models to predict variability in the water cycle in space and time