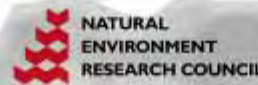


UK National Ecosystem Assessment

Key Findings and Future Research Directions

Steve Albon & Robert Watson

*British Ecological Society Annual Meeting, Sheffield
13 September 2011*



Press coverage at NEA Synthesis launch - 2 June

BBC NEWS SCIENCE & ENVIRONMENT

2 June 2011 Last updated at 00:06

Nature 'is worth billions' to UK

naturenews

Published online 1 June 2011 | Nature | doi:10.1038/news.2011.339

UK ecosystem services declining

Report urges changes in policy governing natural capital.

Many UK ecosystem services, including fish catches and soil quality, are declining or have already become degraded as a result of over-exploitation, poor management and habitat change, according to the first national assessment of the United Kingdom's ecosystems, released today.

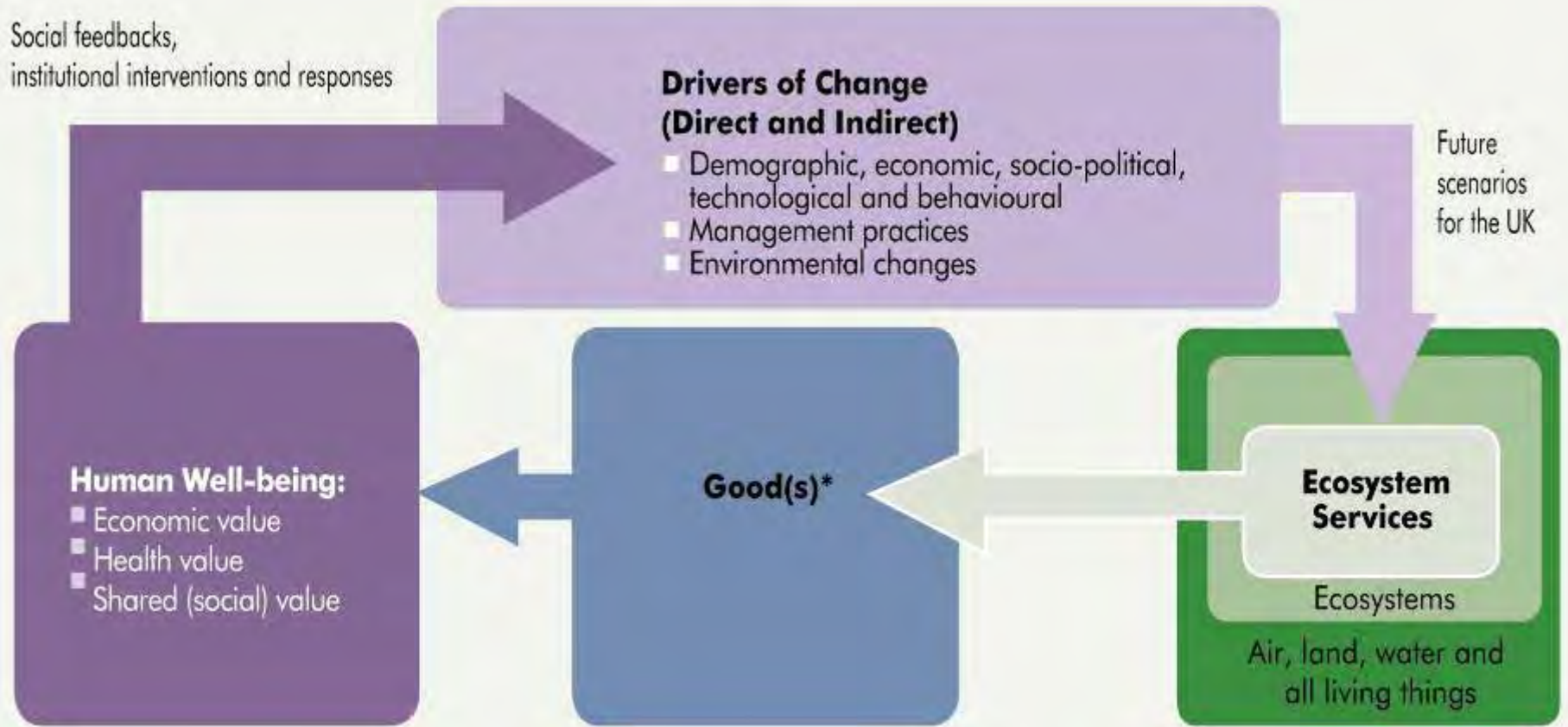
Over the past 60 years, there have been declines in around 30% of ecosystem services – the benefits that humanity receives from the natural environment. Only 20% of services got better, says [The UK National Ecosystem Assessment](#), despite

How much is this lovely hedgerow worth?



Conceptual Framework – evolution from the MA

Social feedbacks,
institutional interventions and responses



Conceptual Framework – focus on well-being

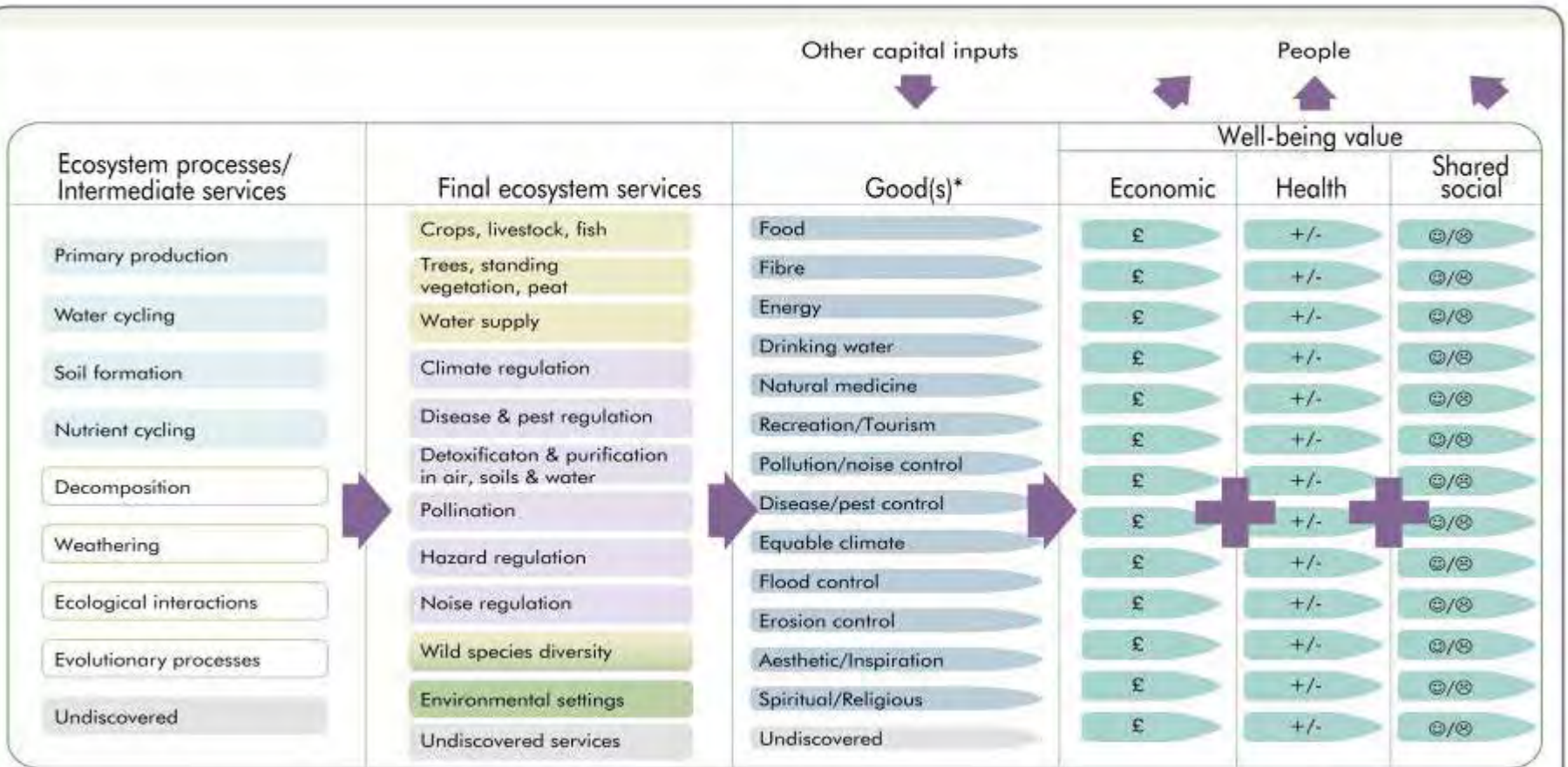
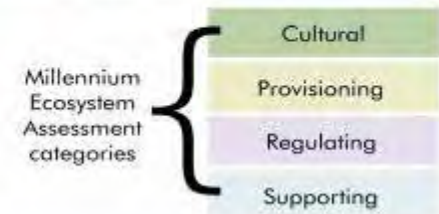


Figure 10 The full set of ecosystem processes, services, goods/benefits and values used in the UK NEA. Note that some ecosystem services can be both intermediate and final services. For simplicity, in this figure, services are shown only in the most final position that they occupy. Services such as pollination 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

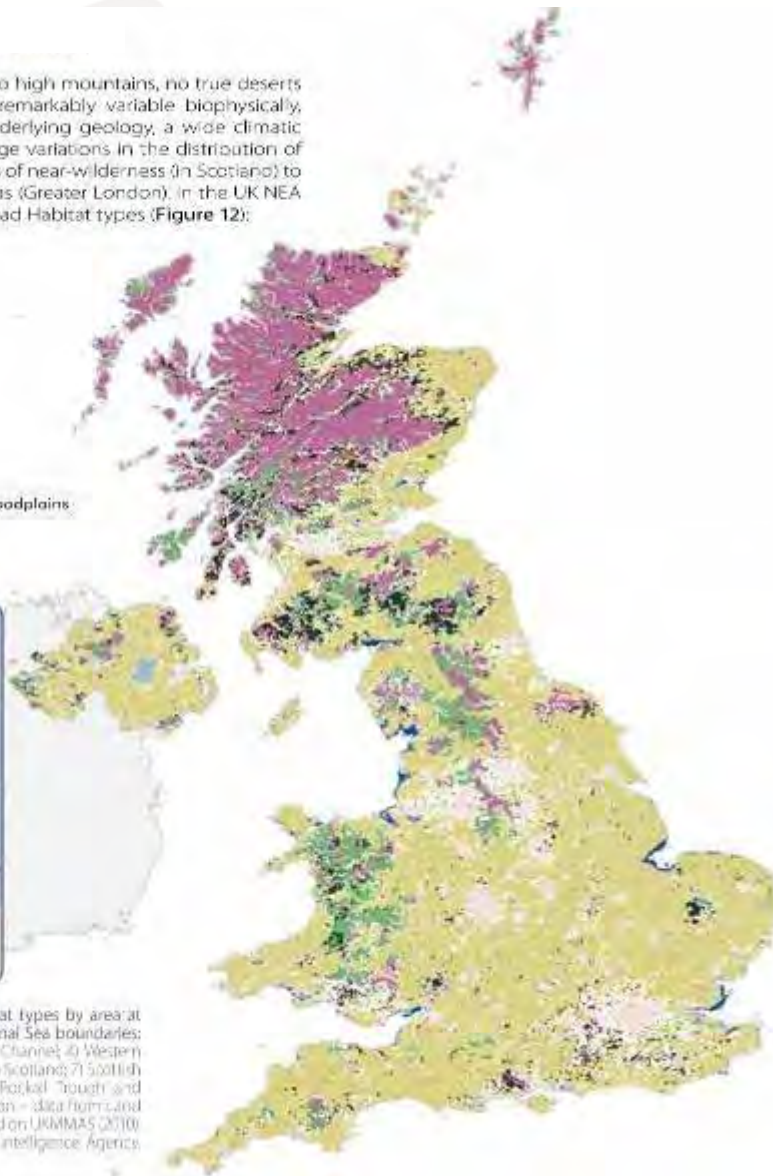


Distribution of UK Habitats

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):

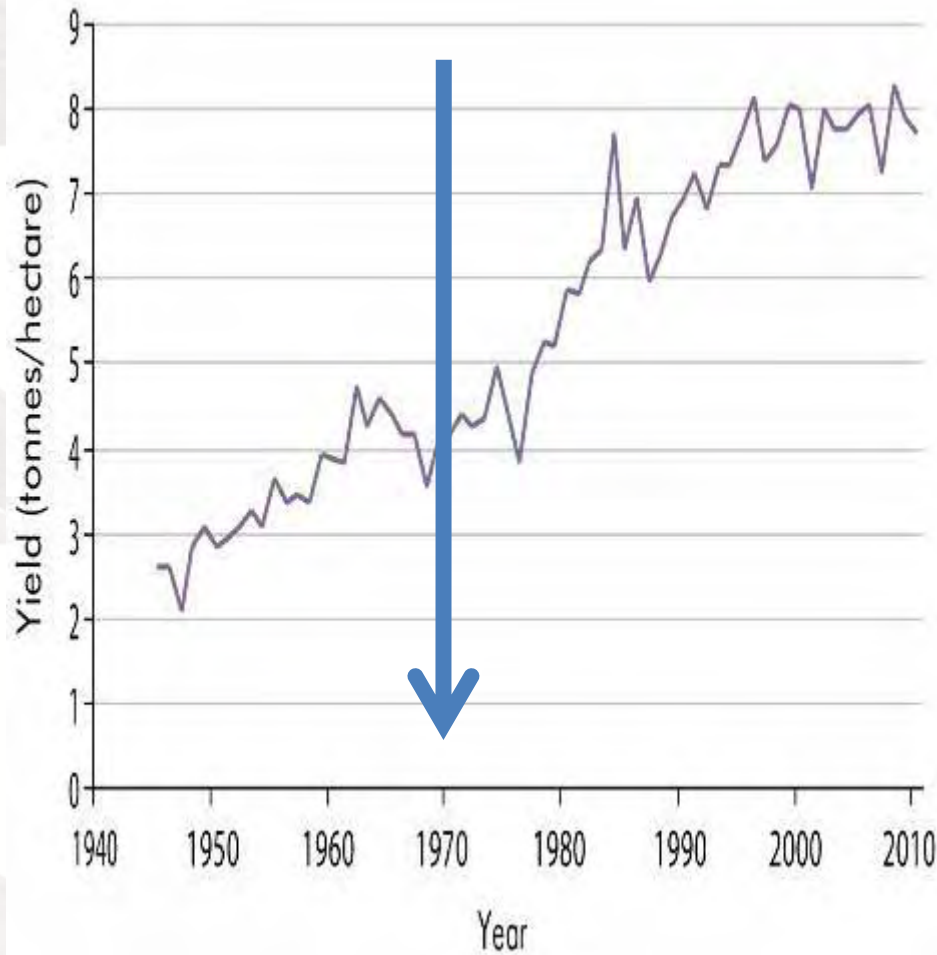


Figure 12 Distribution (%) of the UK NEA Broad Habitat types by area at 1x1 km resolution. Inset: Charting Progress 2, UK Regional Sea boundaries: 1) Northern North Sea; 2) Southern North Sea; 3) Eastern Channel; 4) Western Channel and Celtic Sea; 5) Irish Sea; 6) Vintoes and Western Scotland; 7) Scottish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

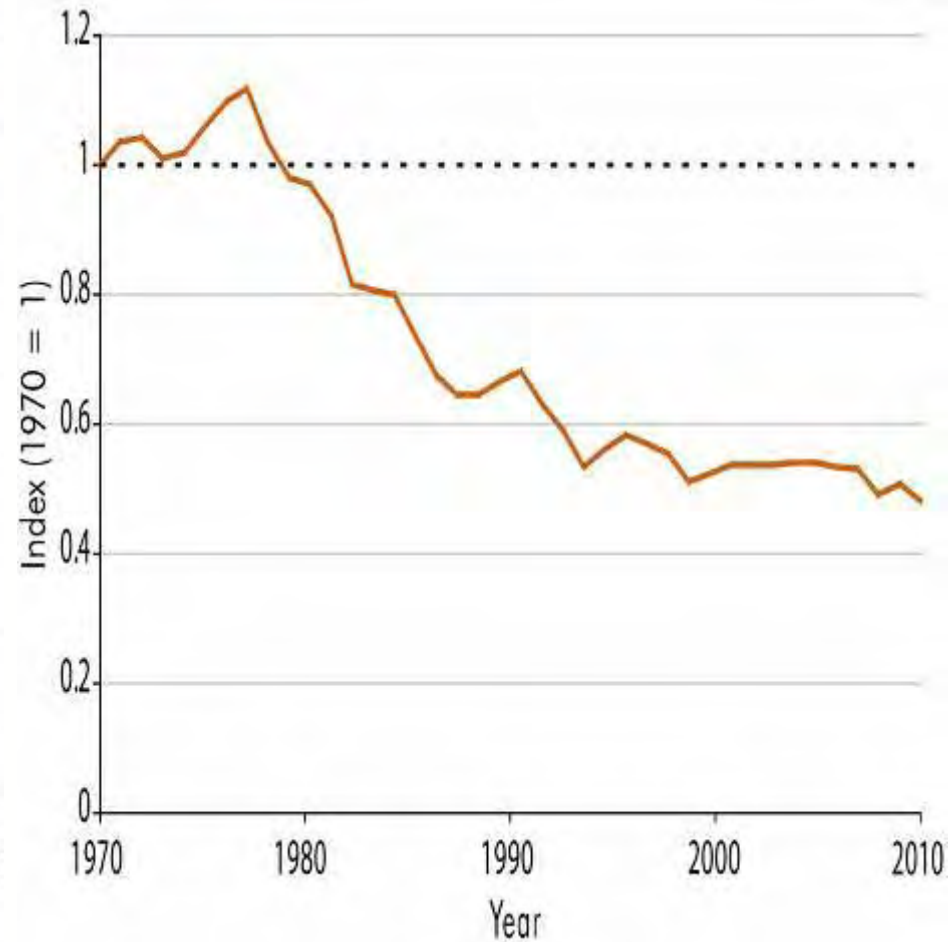


Increased yields since 1945 but cost to biodiversity

a) Wheat

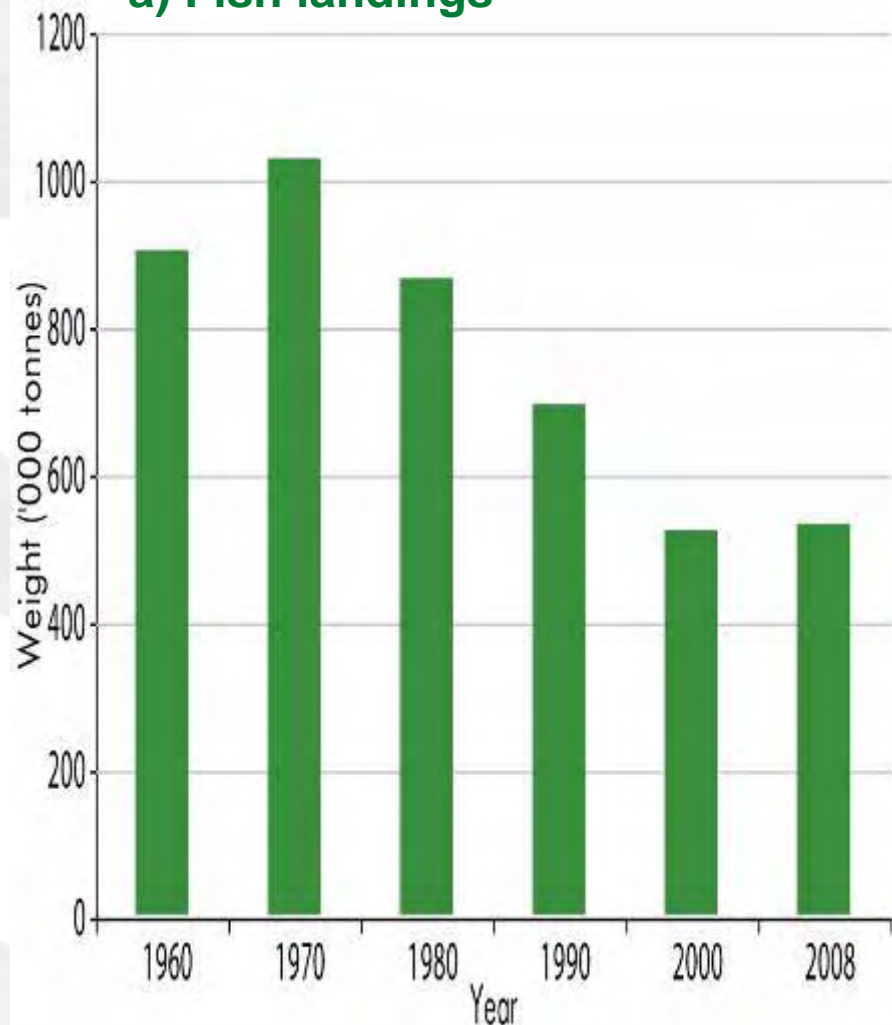


b) Farmland birds

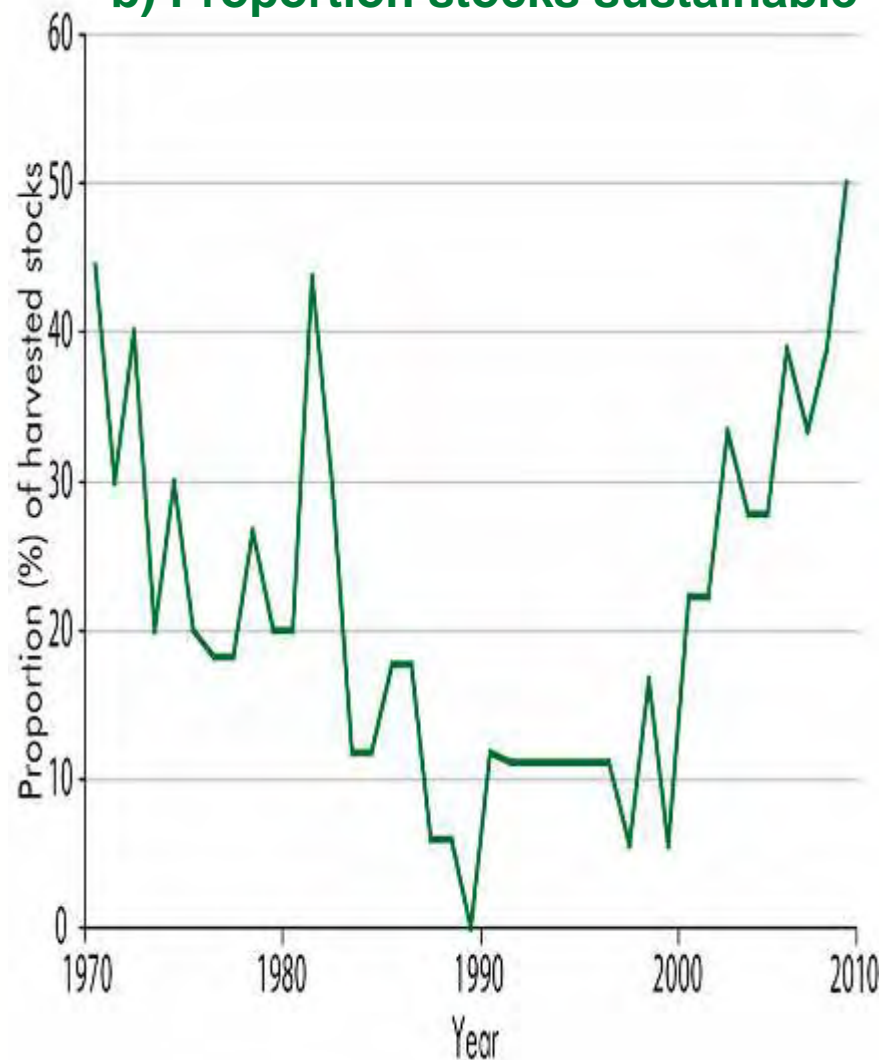


Decreased fish landings but some recovery

a) Fish landings



b) Proportion stocks sustainable



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

Service Group	Final Ecosystem Service	Mountains, Moorlands & Heaths	Semi-natural Grasslands	Enclosed Farmland	Woodlands	Freshwaters – Openwaters, Wetlands & Floodplains	Urban	Coastal Margins	Marine	
Provisioning	Crops		↔	↗		↘	↖	↘		
	Livestock/Aquaculture	↘	↗	↕	↔	↘	↕	↘	↖	
	Fish					↘	↕	↘	+	
	Trees, standing vegetation, peat	↘	↔	↖	↗	↘	↕	↘		
	Water supply	↕	↘	↘	↕	↘	↕	?		
	Wild species diversity	↕	↖	↖	↗	↘	↕	↘	↘	
Cultural	Environmental settings: Local places	↕	↕	?	↗	↖	↕	↕	?	
	Environmental settings: Landscapes/seascapes	↕	↕	↕	↗	↕	↕	↖	?	
Regulating	Climate	↕	↕	↖	↗	↕	↘	↖	↖	
	Hazard	↘	↕	↘	↗	↘	↘	↕	↖	
	Disease and pests	↕	↕	+	↘	↘	?	+	↖	
	Pollination	↘	↘	↘	↕		↕	↕		
	Noise	↕	↕	?	↗	↕	↖	↕		
	Detoxification & purification	Water quality	↕	↖	+	↕	+	+	?	↕
		Soil quality	↕	↘	↘	↕	↘	↖	↘	
Air quality		↕	↕	↖	↖	↕	↕	↕	?	

Importance and Trends in Drivers affecting Services

Service Group	Final Ecosystem Service	Habitat Change*	Pollution & Nutrient Enrichment	Overexploitation	Climate Change	Invasive Species
Provisioning	Crops	→	→	→	↗	→
	Livestock	→	→	→	↗	↗
	Wild fish	↗	↘	→	↑	→
	Farmed fish (aquaculture)	→	→	↗	↗	↗
	Timber	↗	→	↗	↑	↑
	Water	→	↗	↗	↑	↗
	Peat	→	→	↘	→	→
	Wild game	↗	→	↘	↗	→
	Honey	↗	→	↗	↑	↑
	Ornamentals	↗	→	↗	↗	→
	Genetic resources	→	→	↗	↗	→
	Wild species diversity	↗	↘	↗	↑	↗
Cultural	Environmental settings	↗	→	→	↗	↗
Regulating	Climate	→	→	↘	↑	→
	Hazard	→	→	↗	↑	↗
	Disease and pests	→	→	↗	↗	↗
	Pollination	→	→	→	↗	↗
	Noise	→	→	↗	→	→
	Water quality	→	↘	→	↗	→
	Soil quality	→	→	↘	↗	→
	Air quality	→	↘	→	↑	→
Supporting	Soil formation	↗	↘	↗	↑	↗
	Nutrient cycling	→	→	→	↗	→
	Water cycling	→	↗	↗	↑	→
	Primary production	→	→	→	↑	→

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.

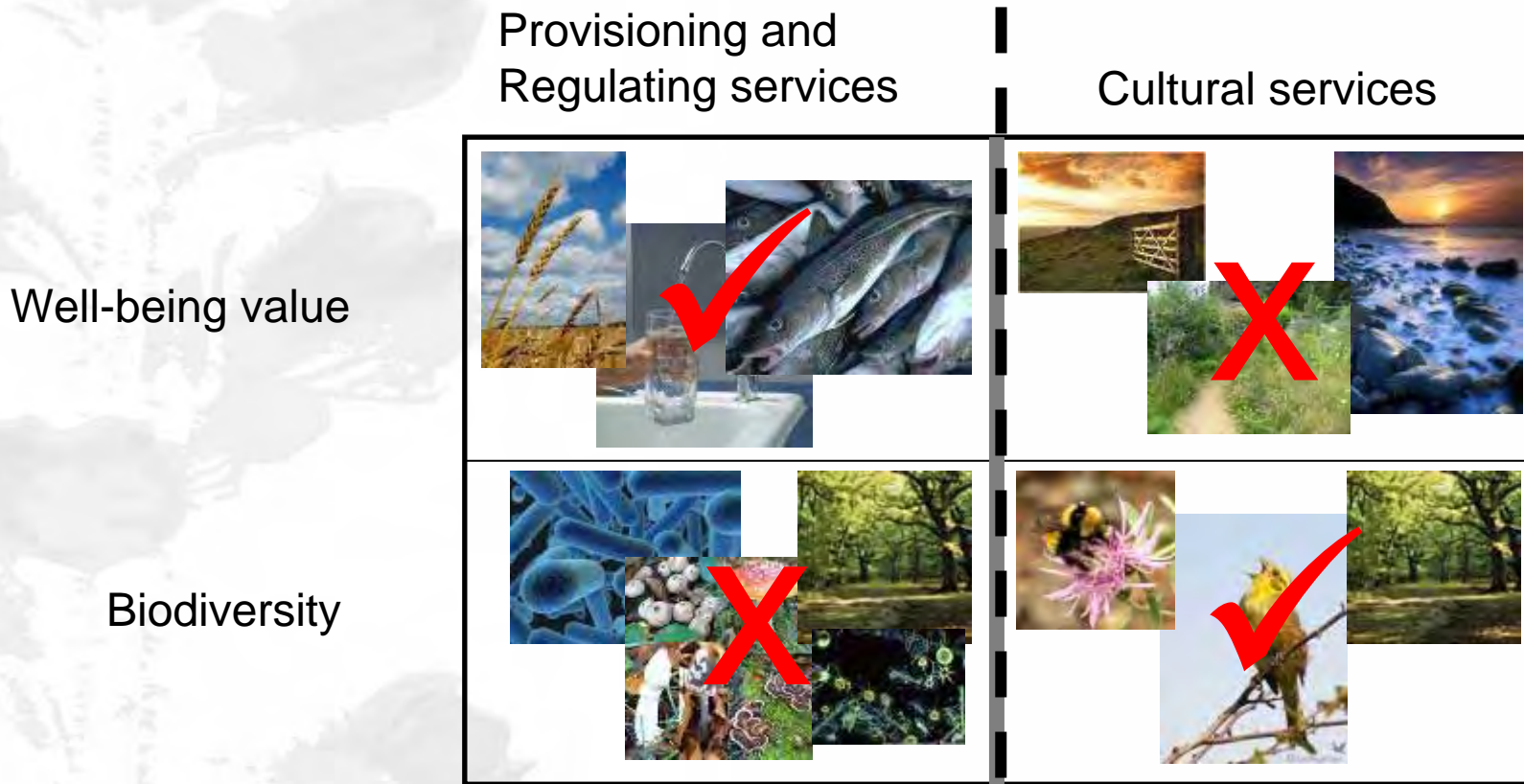
Biodiversity – role in delivery of Ecosystem Services

Service Group	Final ecosystem services	Biodiversity Groups															
		Micro-organisms		Fungi		Lower Plants			Higher Plants	Invertebrates		Fish		Amphibian	Reptiles	Birds	Mammals
		Terrestrial	Marine	Non-lichens	Lichens	Phytoplankt	Macroalgae	Bryophytes	Vegetables	Land plants	Terrestrial	Marine	Freshwater	Marine			
Provisioning	Crops, plants, livestock, fish	High	High	High	High	High	High	High	High	High	Medium	High	High	Low	Low	Low	High
	Trees, standing vegetation & peat	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Water supply	High	Medium	High	High	High	High	High	High	High	High	High	High	High	High	High	High
Cultural	Wild species diversity	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Meaningful places	Low	Low	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Social valued land and waterscapes	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
Regulating	Climate regulation	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Floods regulation	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Waste breakdown & detoxification	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Pollination	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High
	Disease & pest regulation	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High	High

Importance

- High
- Medium
- Low

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	Yellow	Yellow			Red
	Terrestrial	Poor	Red	Yellow			Yellow
Fungi	Non-lichenised	Poor	Light Red	Green	Green		Light Red
	Lichens	Moderate	Red	Yellow	Yellow		Red
Lower Plants	Phytoplankton	Good		Red	Yellow		Yellow
	Macroalgae	Patchy	Yellow	Green	Green		Red
	Bryophytes	Moderate	Red	Light Green	Yellow	Yellow	Red
Higher Plants	Seagrasses	Patchy	Green	Green	Yellow	Green	Light Red
	Land plants	Good	Red	Light Green	Yellow	Yellow	Red
Invertebrates	Marine	Patchy	Yellow	Yellow	Green	Red	Green
	Terrestrial	Moderate	Red				Red
Fish	Marine	Moderate		Yellow		Red	
	Freshwater	Good	Red	Light Green	Green	Green	Red
Amphibians		Moderate	Red	Red	Yellow		Red
Reptiles		Patchy	Red	Yellow			
Birds		Good	Red	Yellow		Red	Light Green
Mammals		Moderate	Red	Light Green	Yellow	Yellow	

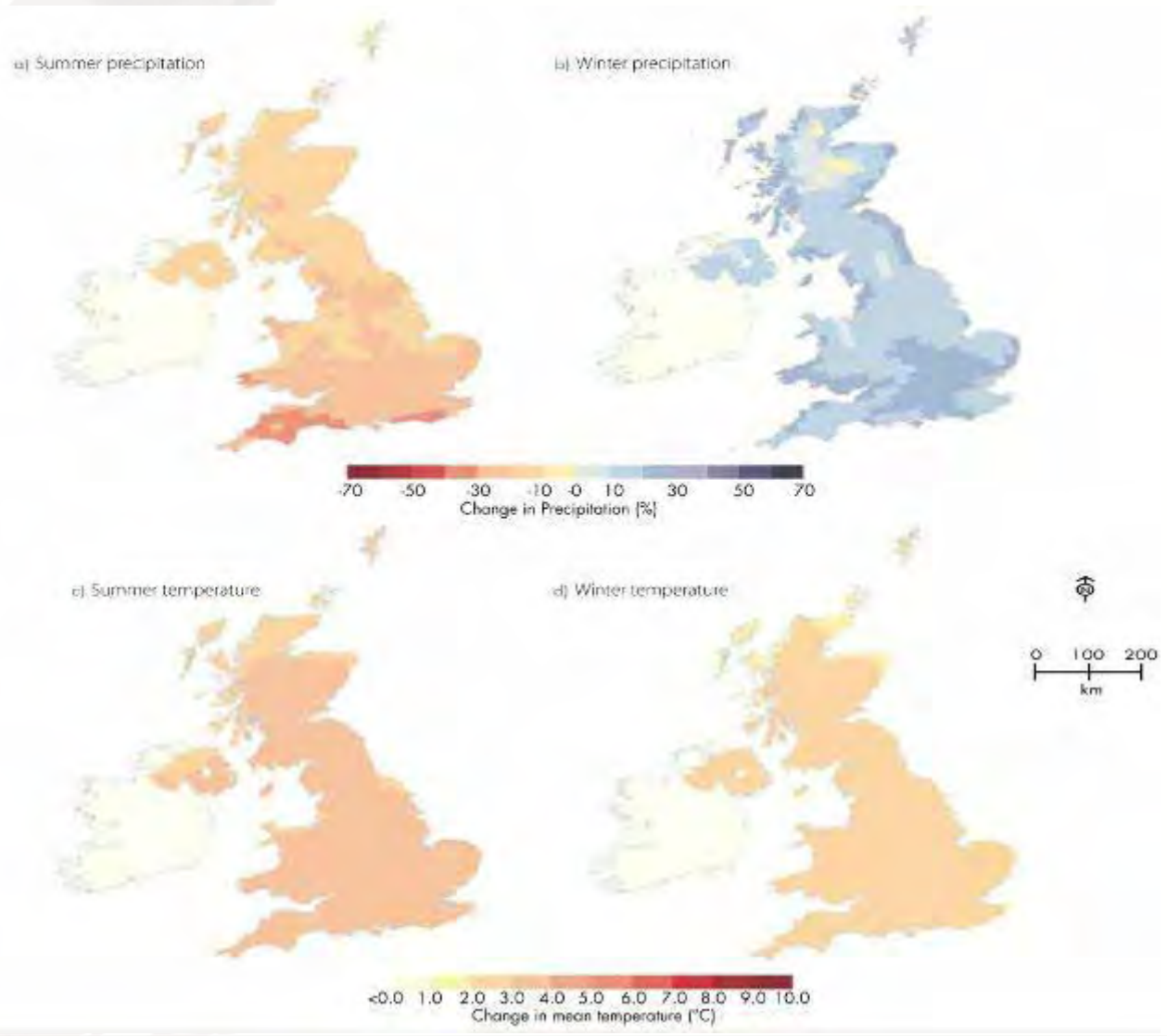
- Land-use change & pollution are the major drivers of change.

- 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

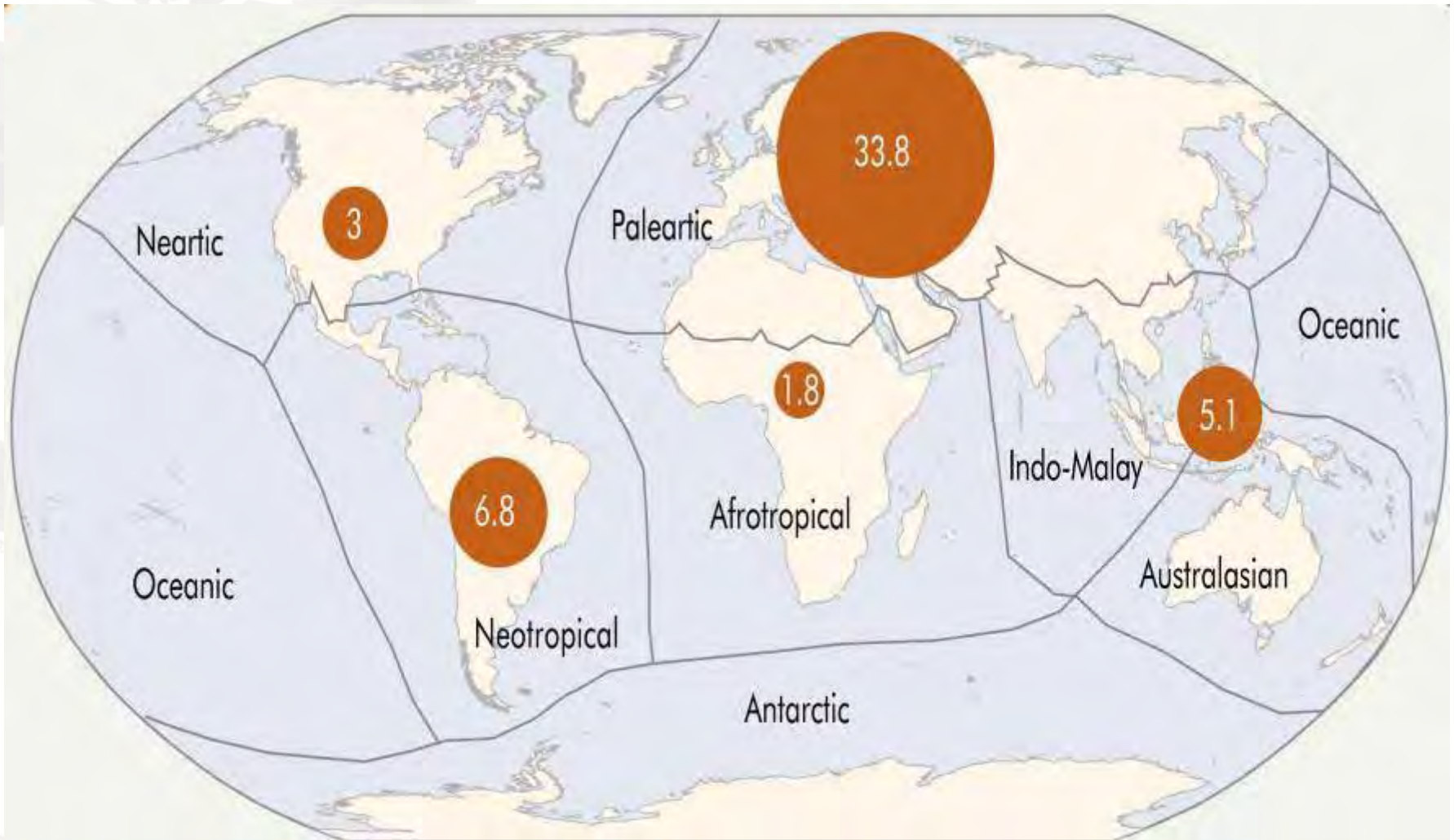


Figure 15 Source of biomass (millions of tonnes) imported into the UK by Biogeographical Realms in 2008. Source: data from HMRC (2008); underlying map based on Olson *et al.* (2004).

Contrasting Scenario projections

Green and Pleasant Land

A preservationist attitude arises because the UK can afford to look after its own backyard without diminishing the ever-increasing standards of living.



Nature@Work

The belief that the promotion of ecosystem services through the creation of multifunctional landscapes is essential for maintaining the quality of life in the UK is widely accepted.



Local Stewardship

This is a future where society is more concerned with the immediate surroundings and strives to maintain a sustainable focus on life within that area.



Go with the Flow

This scenario is essentially a projection based on current trends and results in a future UK that is roughly based on today's ideals and targets.



National Security

Under this scenario climate change results in increases in global energy prices forcing many countries to attempt greater self-sufficiency (and efficiency) in many of their core industries.

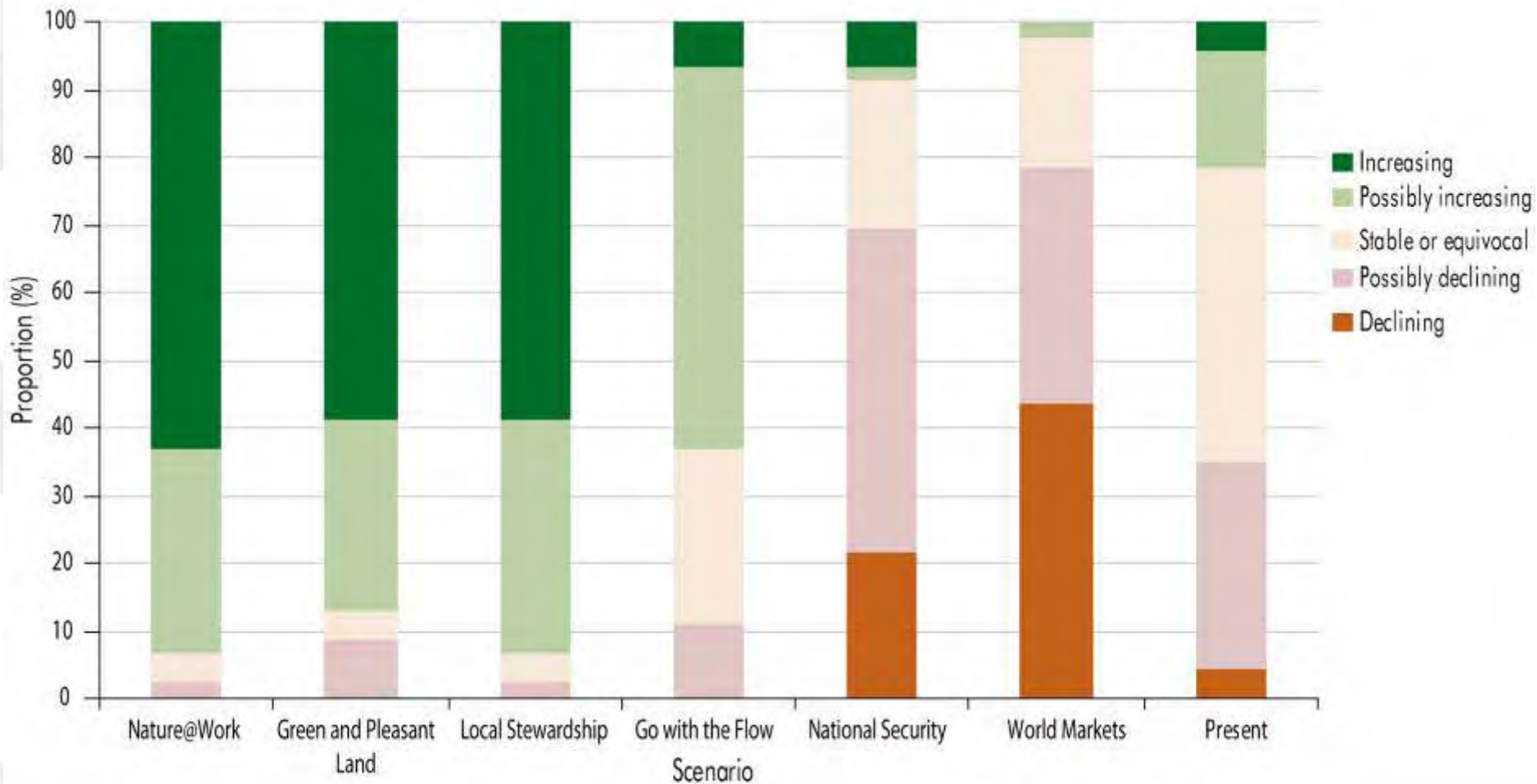


World Markets

High economic growth with a greater focus on removing barriers to trade is the fundamental characteristic of this scenario.



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.

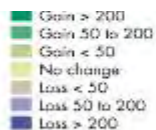
§ We acknowledge some double counting between urban recreation and urban greenspace amenity value. Further data is needed to correct for this.

Spatial Economic Implications of two 'storylines'

Nature at Work



Farm Gross Margin



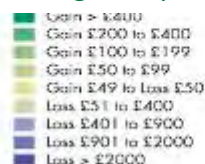
Greenhouse gas



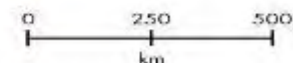
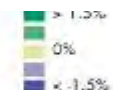
Recreation



Urban greenspace



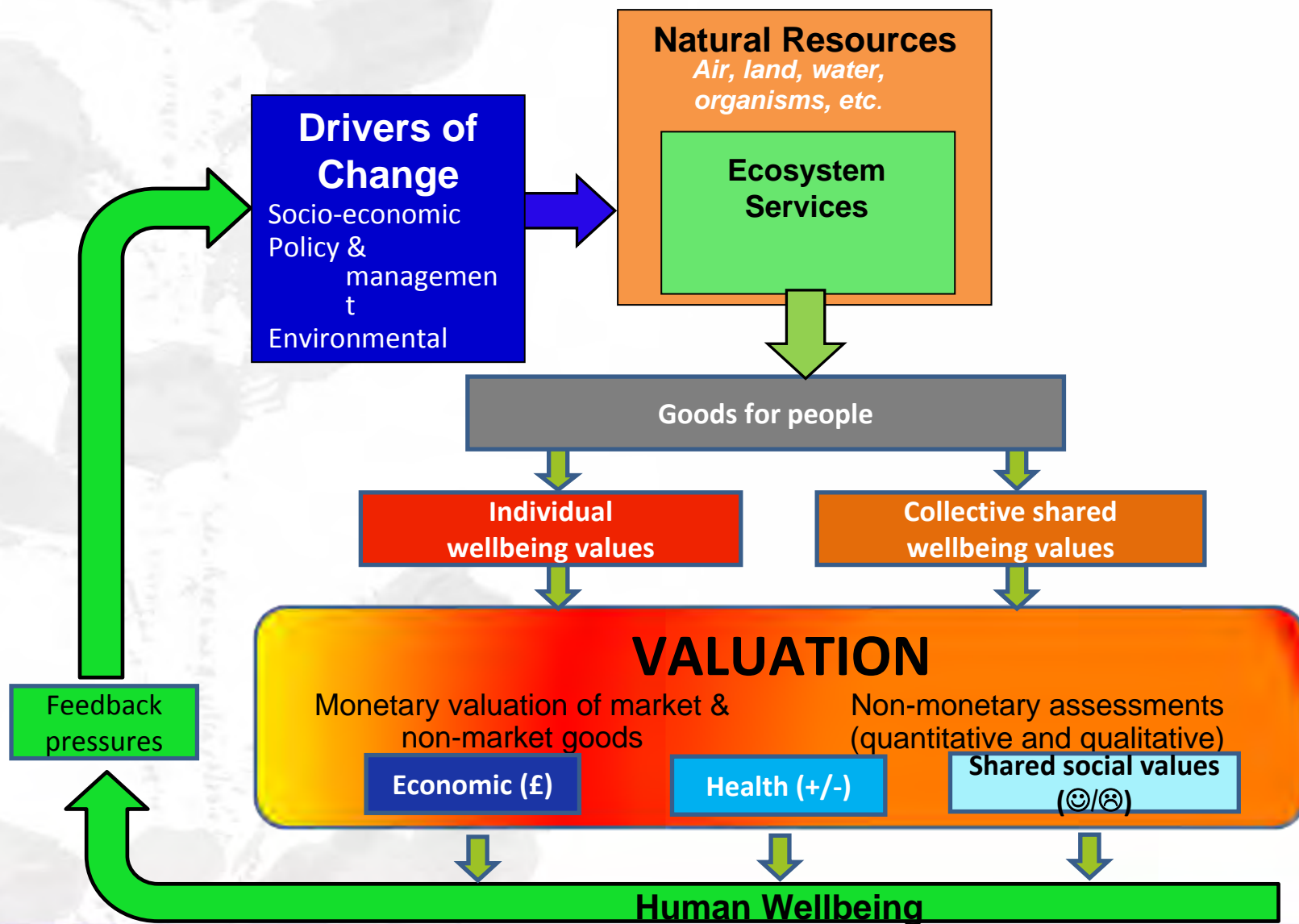
Biodiversity



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?

Telegraph.co.uk

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Apple iPhones to 'map

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By Matt Warman, Consumer Technology Editor
Published: 11:33AM BST 16 Aug 2010

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Tuesday is the day we hate most and Slough makes people miserable: Researchers to compile UK's 'emotion index'

By DAILY MAIL REPORTER
Last updated at 10:51 AM on 11th October 2010

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When Bob Geldof wrote his hit song I Don't Like Mondays, it became a anthem for every office worker who enjoy their fun-filled weekends and hate week and back to the daily grind.

Now a survey using smartphone technology has revealed that Tuesday is the day most people feel miserable.

Their happiness picks up as the week moves towards Friday, hit and the feelgood factor is still high on Sunday



Le Figaro automobile

LE FIGARO

Nelson Mandela

La surenchère des ultras de la CGT

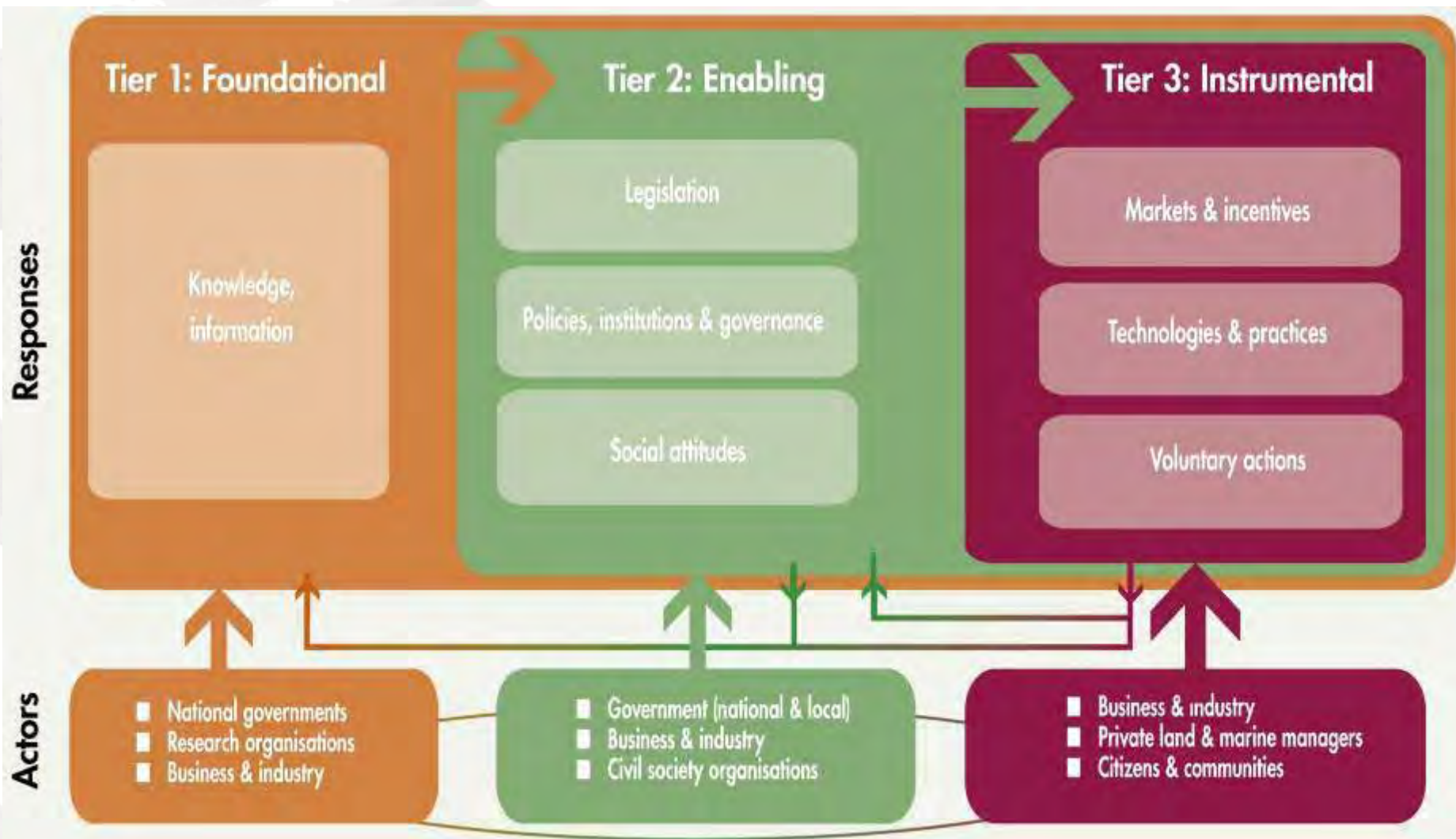
Le monde est déprimé, 84 de dépression

Jacky Anderson reports.

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