

<b>Institution:</b> UCL		
<b>Unit of Assessment:</b> 5 - Biological Sciences		
<b>Title of case study:</b> Developing and embedding policy-relevant measures of the value of the natural environment		
<b>Period when the underpinning research was undertaken:</b> 2009 - 2018		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Georgina Mace	Professor	2012 - 2020
<b>Period when the claimed impact occurred:</b> 1 August 2013 - 31 December 2020		
<b>Is this case study continued from a case study submitted in 2014?</b> No		
<b>1. Summary of Impact</b>		
<p>The continuing rapid loss of biodiversity and the associated transformation of natural ecosystems is of major societal concern but as long as the economic value of nature is unknown or uncounted biodiversity is excluded from many decision-making processes and treated as if its loss does not incur immediate costs and risks. Research co-led by Professor Georgina Mace has helped develop an approach for valuing ecosystem services and accounting for natural capital. This research has shaped key components of the government's '25 Year Environment Plan' (2018) and the 2020 Environment Bill, which will help ensure the long-term security of biodiversity and natural assets.</p>		
<b>2. Underpinning research</b>		
<p>Landscapes generate a wide range of valuable ecosystem services, without which economic and social development would not be possible, yet land-use decisions often ignore the value of these services. This body of research, co-led by Mace in collaboration with economists, developed novel approaches to incorporate natural capital (stocks of renewable resources, such as plants and animals) and valuation of ecosystem services into decision-making. Furthermore, the research demonstrated that failure to incorporate economic valuation of natural capital would lead to short-term growth and social injustice.</p>		
<b>Putting the ecosystem services approach into practice in the UK (from 2012 to 2013)</b>		
<p>This research investigated the social value (in monetary terms) of taking a broader set of ecosystem services into consideration when making large-scale, land-use decisions in the UK. The analysis demonstrated that the social value of ecosystem services that are not traded in markets (such as recreation, carbon storage and soil fertility) greatly exceed the market value of agriculture and timber, which usually underpin land use decisions. It thereby highlighted an important gap in existing policy for land use. The research also took a new approach to biodiversity valuing in ecosystem assessment that recognised its multiple roles in the ecosystem services framework. Recognising that biodiversity conservation outcomes were not monetizable, the analysis modelled the maintenance of species diversity and of high priority habitats as a constraint in the land use optimisation procedure. Using such an ecosystem services framework showed that, in contrast to perceptions that conservation measures are an additional cost, the opportunity costs of conservation are small or trivial while overall benefits to society increase many hundreds of times over [R1].</p>		
<b>Developing an approach to natural capital assessment and valuation (from 2013 to 2015)</b>		
<p>This research developed and deployed an ecosystem-science based approach to link ecosystem services to natural capital. In [R2], Mace led the work to propose a classification of natural assets and a desk-based review to investigate the ecosystem service benefits that were degrading, or at risk of loss, in the UK. It led to specific recommendations to the UK Government</p>		

that identified the ecosystem service benefits at highest risk (e.g. clean water, wildlife conservation, climate regulation) and identified ecosystem restoration projects that could secure them for the future (e.g. restoring and conserving woodlands, maintaining wetlands and coastal marshes, restoring peatland) [R2].

### Embedding the value of biodiversity in economic analysis

This research is a review of the ecological and biodiversity science in a book written for economists that outlines the approach taken. It introduces the distinction between ecological stocks and flows of ecosystem services in a paper geared to economics interests [R3]. A review of the book by an economist states this is '*an excellently crafted exposition of the meaning, roles and status of biodiversity, chapter three is a must read.*'

### 3. References to the research (indicative maximum of six references)

[R1] Bateman, I.J., Harwood, A.R., **Mace, G.M.**, Watson, R.T., Abson, D.J., Andrews, B. et al. (2013). 'Bringing Ecosystem Services into Economic Decision-Making: Land Use in the United Kingdom'. *Science*, **341**, 45-50. DOI: [http://doi.org/ 10.1126/science.1234379](http://doi.org/10.1126/science.1234379) (cited by >700 [Google Scholar])

[R2]. **Mace, G.M.**, Hails, R.S., Cryle, P., Harlow, J. & Clarke, S.J. (2015). 'Towards a risk register for natural capital.' *Journal of Applied Ecology*, **52**, (3) 641-653. DOI: <http://doi.org/10.1111/1365-2664.12431>. (This paper describes an approach to risk assessment for natural capital and shows how it can be implemented using available data from England. The online supporting information includes the results of the desk-based review. (cited by >90 [Google Scholar])

[R3]. **Mace, G.M.** (2014). 'Biodiversity: its meanings, roles and status'. In: *Nature in the Balance: the economics of biodiversity*, chapter 3 (eds. Helm, D & Hepburn, C). Oxford University Press Oxford. DOI: <https://doi.org/10.1093/acprof:oso/9780199676880.003.0003>. (cited by 17, Google Scholar)

### 4. Details of the impact

Between 2012 and 2018 Mace, as an influential member of the UK Government's Natural Capital Committee, has worked closely with colleagues on the committee to provide independent advice to the government on the sustainable use of natural capital. Most of the work described in this case study was done in collaboration with Professor Ian Bateman, an environmental economist at the University of Exeter and member of the Natural Capital Committee, as well as the economists Julian Harlow (Department for Environment, Food and Rural Affairs - Defra) and Russell Elliot (Natural Resources Wales). Mace led the ecological aspects of the work.

#### Developing and applying a comprehensive approach to the valuation of UK ecosystem services

Market-based decisions inevitably favour monetizable and tradeable services such as food and fuel, but the social value of non-market services such as carbon storage, recreation or urban green space is hundreds of times greater than than the value of marketed food and other produce. The first part of the work, as presented in [R1], was influential in stimulating activities such as:

- i. the funding of a 'Valuing Nature Network' (VNN, a five-year, GBP6.5m programme with over 2,000 members) by NERC to grow research capability. As part of the Natural Capital Coalition (NCC) management team, Mace utilised [R1] as a framework to ensure a direct flow of evidence from the VNN to government, resulting in policy changes (e.g. the UK Peatland Code) via the project's policy briefings and engagement network. [E1]
- ii. the Defra 'Ecosystem Markets Task Force,' which reported to Defra, DECC (Department of Energy and Climate Change) and BEIS (Department for Business, Energy and Industrial Strategy) and advised on opportunities for UK business from expanding green goods, services, products, investment vehicles and markets which value and protect

- ecosystem services. Working with Mace, Bateman briefed the Ecosystem Markets Task force in its early days on the UK National Ecosystem Assessment and its implications for business opportunities [E2].
- iii. the cross-sector NCC that was founded in the UK and is now developing globally. The NCC has become the global leader in mainstreaming natural capital approaches in the private sector, with over 370 leading organizations engaged. [R1] was cited directly in both the NCC's biodiversity protocol and the UK Ecosystem Assessment [E3].

#### **Development of natural capital approaches and their implementation in policy.**

Natural capital is recognised by economists as one of the four major types of capital that underpin human welfare (along with human capital, financial capital and produced capital). Ecosystem services are the flows of benefits to society that are delivered by well-maintained natural capital assets. In [R2], Mace and her colleagues proposed a framework for the classification of natural assets and investigated the ecosystem service benefits that were degrading or at risk in the UK (the natural capital 'risk register'), and [R3] was influential in translating ecological concepts for application by economists. This work led to specific recommendations to the government by the Natural Capital Committee, concerning the ecosystem service benefits at highest risk (e.g., clean water, wildlife conservation, climate regulation) and the ecosystem restoration projects that could secure them for the future (e.g. restoring and conserving woodlands, maintaining wetlands and coastal marshes, restoring peatland) [E4].

#### **Advising on the UK Government's 25 year Environment Plan and the 2020 Environment Act**

In 2017, a new Defra Secretary of State (Michael Gove) revitalised the research to meet the 2012 policy commitment 'to be the first generation to leave the natural environment in a better state than it inherited'. The Natural Capital Committee recommended that this generation-scale commitment needed a long-term plan. The work described in [R1], [R2] and [R3] directly informed work in Defra to develop a 25 Year Environment Plan for England. This plan, launched by the Prime Minister in January 2018, highlighted six target outcomes for society which directly trace back to the risk register work [R2], as well as work contributed by Mace and colleagues to the Natural Capital Committee's third report [E5]. Julian Barlow, deputy head of land-use policy at DEFRA, has commented that "*At the heart of this 25 YEP [Year Environment Plan] is the natural capital conceptual framework and metrics developed by Professor Mace.*" [E6]

A significant consequence of the UK's decision to leave the EU was the need to establish a system to replace the Common Agricultural Policy (CAP), to support food production but also to secure the wider benefits from the natural environment. Two new Government bills were developed in Defra: the Agriculture Bill and the Environment Bill.

The Agriculture Act (2020) adopts a novel objective that public money should support public goods, emphasising that land owners need to be incentivised to secure the non-market goods of high public value that were highlighted in [R1], rather than private goods of limited public value.

The Environment Bill deals more centrally with environmental outcomes identified in the 25 Year Environment Plan. Legislation is pending (the bill has reached the Report Stage and was debated by MPs on 26 January 2021), but its framing and draft indicator set published by Defra in May 2019 is founded on the NCC framework (described in section 2) and the targets and indicators identified in [R2]. Defra's Julian Barlow has written that "*The Government is currently in the process of legislating for future Environmental Improvement Plans and a suite of environmental targets, all of which flow directly from the NCC's [Natural Capital Committee's] work – specifically the contributions of Prof Mace which wholly underpins the approach.*" [E6]

#### **5. Sources to corroborate the impact**

[E1] UKRI VNN report, <https://nerc.ukri.org/research/funded/programmes/valuation/vnn-final-report/>

[E2] Ecosystem Markets Task force report

<https://webarchive.nationalarchives.gov.uk/20140304164534/http://www.defra.gov.uk/ecosystem-markets/files/Ecosystem-Markets-Task-Force-One-Year-On-Update2.pdf>

[E3] UK National Ecosystem Work Package 3 Final Report. July 2014. [PDF]

[E4] Natural Capital Committee End of Term Report. November 2020.

<https://www.gov.uk/government/publications/natural-capital-committees-end-of-term-report>

[E5] Nature Capital Committee's third report,

<https://www.gov.uk/government/publications/natural-capital-committees-third-state-of-natural-capital-report>

[E6] Statement from the Head of local environmental delivery and local nature recovery strategies, Defra. [PDF]