Institution: University of East Anglia

Unit of Assessment: 7 – Earth Systems and Environmental Sciences

Title of case study: Impacting international policy on biodiversity through valuing ecosystem services and natural capital

Period when the underpinning research was undertaken: 1 January 2000 – 31 December 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Angela Anger-Kraavi	Lecturer	2013 - 2016
Ian Bateman	Professor	1989 – 2015
Brett Day	Professor	2002 - 2015
Silvia Ferrini	Senior Research Fellow	2007 – present
Andrew Jordan	Professor	1992 – present
Andrew Lovett	Professor	1990 - present
R. Kerry Turner	Professorial Fellow	1977 - present
Robert Watson	Professor	2007 - 2019

Period when the claimed impact occurred: 1 August 2013 - 31 December 2020

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact

Natural capital and the multiple ecosystem services derived from it are the essential basis of all life on Earth. Drawing on pioneering interdisciplinary research conducted over many decades, our School has: established the foundational principles of ecosystem assessment knowledge; refined them in international knowledge exchange platforms to impact, most notably, the *UN Convention on Biodiversity*; and translated them into UK-wide policy practices in Whitehall and wider civil society. Impact has been repeatedly achieved by exercising leadership via pathways such as *DEFRA* and the *UNs Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services,* and by making influential contributions to the *UK Natural Capital Committee* and HM Treasury's *Dasgupta Review on the Economics of Biodiversity*.

2. Underpinning research

Fundamental research insights

All human wellbeing and economic activity in the world is ultimately dependent upon the natural environment and the 'ecosystem services' it provides. Our research, published in some of the most highly cited journals, has, since 2000, successfully derived five fundamentally important research insights that are interconnected:

1) There are *many interrelated types of natural capital*. The conceptual work of **Turner** and **Watson [R1, R2]** has defined these types more precisely, by developing a well-used classification scheme **[R3]**. This work has demonstrated that the diversity of these basic types, and the services that flow from each type, require inter-disciplinary approaches to research, knowledge exchange and refinement, and policy Impact **[R1, R2]**. It has confirmed that there is unlikely to be a single classification scheme that is adequate for all ecosystems and policy-making contexts, hence demonstrating a policy demand for tailored, i.e. culturally attuned, knowledge (see Insight 5, below).

2) *Implementing principles* are necessary in order to move from these basic types to achieving policy change and other Impacts such as new practitioner understandings and business practices. These include being clear about the timing and location of ecosystem changes and the value of any resulting societal impacts **[R3, R4]**. Crucially, **Watson's** research **[R2, R4]** also powerfully underlined the importance of a new implementing principle – the need to include 'nature's contributions to people' as well as planetary health **[R4]**.

3) *A decision support toolbox* is needed to translate ecosystem knowledge into Impact, such as economic valuation techniques, natural capital asset checks, 'ecosystems at risk' registers, computer-based models and more qualitative-deliberative assessment tools. **Turner** and **Ferrini** developed a new 'Balance Sheet Approach' which combines traditional national income accounts data with fresh, ecosystem-specific data **[R1, R3]**. These and other tools were originally introduced via academic publications **[R5, R6]**, subsequently refined in knowledge translation platforms and then published in policy reports (see below).

4) *New, more policy-relevant data is required to inform specific decision tools used within government, such as policy appraisal*. Through the work of **Bateman, Lovett** and **Day**, novel combinations of data and tools were trialled and implemented, e.g. using the platform of geographical information systems to reveal the spatial variability of ecosystems and therefore of ecosystem services **[R1, R3, R6]**. Crucially, our research powerfully underlined the fact that different types of data (ecological, economic, cultural) are required to answer different policy questions, e.g., in relation to current ecosystem change vs. future ecosystem change. It also confirmed that particular attention should also be afforded to ecosystems (and ecosystem services) which exhibit thresholds below which restoration is difficult or even impossible (so-called 'critical natural capital') **[R7, R8]**.

5) *New classifications, tools and data are only ever a necessary but insufficient condition for generating long term Impact*. Original research must first be translated into usable policy relevant knowledge via ongoing dialogues with relevant stakeholders in knowledge exchange platforms that are widely perceived to have credibility and legitimacy. Our Impact work has shown that knowledge translation requires patience, trust and political sensitivity. By working closely with key stakeholders such as *DEFRA* **[S1]** and the *UN* **[S2]** over long periods of time, our researchers have repeatedly satisfied these requirements, to inform new policy objectives and specific policy instruments such as regulation and taxation.

Knowledge translation and refinement

Directly informed by Insight 5, these insights were extensively refined through discussion with stakeholders in knowledge exchange platforms, starting with the 2011 *UK National Ecosystem Assessment* (NEA). This platform was actually co-led by **Watson** in his role as Chief Scientist in *DEFRA*. The *NEA* was the first national ecosystem assessment in the world and was timed to coincide with (and directly inform) the launch of the Government's 2011 *White Paper on the Natural Environment*. **Bateman** and **Turner** were among several of our staff who served on the *NEA's* Expert Panel. **Bateman** authored its conceptual framework (drawing on Insight 1) and lead authored the main keystone chapters. At the launch, the then Secretary of State (Caroline Spelman) said the *NEA* was a *"vital step forward in our ability to understand the true value of nature"* (quote from BBC News website, 'Nature is 'worth billions' to UK', 1 June 2011). A subsequent *OECD* analysis identified it as an international best practice example of how to refine scientific research for enduring Impact.

3. References to the research

Underpinning research: The underpinning research outputs have all been published in competitive, international, peer-reviewed journals and form part of a larger body of such published work. [Citations from Google Scholar]. **UEA authors** in bold.

[R1] Defining and classifying ecosystem services for decision making
Fisher, B., **Turner, R.K**. and Morling P.
Ecological Economics, **2009**, 68(3), pp. 643-653. DOI: 10.1016/j.ecolecon.2008.09.014
[3352 citations]

[R2] Valuing nature's contributions to people: the IPBES approach.
Pascual, U., P. Balvanera, S. Diaz, G. Pataki, E. Roth, M. Stenseke, R.T. **Watson** *et al*
Current Opinion in Environmental Sustainability, **2017**, 26-27, pp. 7-16.
DOI: 10.1016/j.cosust.2016.12.006 [745 citations]

[R3] Valuing nature: lessons learned and future research directions
Turner, R.K., **Paavola, J**., **Cooper, P.,** Farber, S., **Jessamy, V**. and **Georgiou, S**.

Ecological Economics, **2003**, 46(3): pp. 493-510. DOI: 10.1016/S0921-8009(03)00189-7 [1038 citations]

[R4] Assessing nature's contributions to people
Diaz, S., U. Pascual, M. Stenseke, B. Martin-Lopez, R.T. **Watson** *et al*
Science, **2018**, 359(6373), pp. 270-272. DOI: 10.1126/science.aap8826 [949 citations]

[R5] Economic analysis for ecosystem service assessments.
Bateman, I.J., Mace, G.M., **Fezzi, C**., Atkinson, G. and **Turner, R.K.**
Environmental and Resource Economics, **2011**, 48, pp. 177-218.
DOI: 10.1007/s10640-010-9418-x [716 citations]

[R6] Applied Environmental Economics: A GIS Approach to Cost-Benefit Analysis.
Bateman, I.J., **Lovett**, **A.A**. and **Brainard**, **J.S**.
Cambridge University Press, **2003**. ISBN: 9780521809566 [256 citations]

[R7] Economic Reasons for Conserving Wild Nature
Balmford, A…**Cooper**, P.…**Jessamy**, V.…**Paavola**, J…**Rosendo**, **J**…& **Turner**, R.K.
Science, **2002,** 297(5583), pp. 950-953. DOI: 10.1126/science.1073947. [2063 citations]

[R8] Bringing Ecosystem Services into Economic Decision-Making: Land Use in the United Kingdom.
Bateman, I.J, **Harwood**, A…**Watson**, R.T, **Andrews**, B, **Binner**, A…**Day**, B, **Dugdale**, S, **Fezzi**, C…**Hadley**, D…**Lovett**, A.A, **Munday**, P…**Perino**, G, **Sen**, A. *et al*
Science, **2013**, 341(6141), pp. 45-50. DOI: 10.1126/science.1234379 [808 citations]

4. Details of the Impact

Conserving and enhancing nature are integral to the UN biodiversity convention's Aichi targets and the EU's 7th and 8th Environmental Action Programmes. Yet such targets have been repeatedly missed in the past. Our five research insights (see Section 2) have demonstrated that this is because natural capital (and the services it generates) is thought about too narrowly (Insight 1), that relevant knowledge is not adequately refined for policy Impact (Insight 2) and, consequently, ecosystems are systematically undervalued in contemporary policy analysis and decision making (Insights 3,4,5). Our five insights led the way in remedying this situation by significantly shaping both UK Government and international thinking on biodiversity, natural capital, and ecosystem conservation. These changes in thinking have, in turn, led directly to policy Impact, with multiple benefits for the environment, society and the economy.

National level Impact and leadership

Following the success of the *NEA* in 2011 (see Section 2), *DEFRA* launched a *National Ecosystem Assessment Follow-on* (NEAFO) in June 2014 **[S1]**, its entire *raison d'être* being to translate the findings of the *NEA* into lasting Impacts across Whitehall and wider civil society. The *NEAFO*, co-chaired by **Turner** and **Watson,** had three principal aims **[S1**, page 6]: to "(1) further understanding of the economic and social value of nature; (2) to develop tools and products to operationalise the Ecosystem Approach; and (3) to support the inclusion of natural capital in the UK's National Accounts." Our Insight 5 directly informed *DEFRA's* decision to appoint **Turner** (an environmental economist) to integrate social science thinking into its thinking and, through the work of **Jordan**, onwards into systems of government policy appraisal and land use planning (Insight 3). **Bateman** and **Turner** were directly responsible for producing *NEAFO's* conceptual framework [published as **R5] [S1**, page 12]; **Bateman** and **Day** produced the central economic model underpinning the entire assessment **[S3]**; and **Bateman, Day, Anger-Kraavi, Turner** and **Jordan** all led or co-led pivotal work packages (thus exemplifying the importance of Insight 5).

A second direct outcome of the *NEA* was the development of the *Treasury*/*DEFRA Natural Capital Committee* (NCC), established in 2012 to provide expert advice to HM Government. According to *DEFRA*, **Bateman** quickly emerged as an especially influential committee member, drawing directly on his *NEA* and *NEAFO* work **[S4, S5]**. The *NCC* subsequently produced annual state of natural capital reports (thus acting in response to Insight 4) and advised on many other strategic and operational matters (e.g. corporate accounting, cost benefit analysis and long-term policy planning).

A third direct outcome was the Treasury's 2019 decision to establish the *Global ('Dasgupta') Review on the Economics of Biodiversity* **[S6]** which reported jointly to the Prime Minister and Chancellor. **Watson** was a founding member of the *Dasgupta Review* group, and according to the Deputy Head of National Biodiversity at DEFRA "***UEA** [staff] continue to be involved in key ground-breaking research including the [Dasgupta review]. It is expected that this review will draw on the National Ecosystem Assessment (and Follow-On) reports"* **[S5]**.

Achieving these three policy Impacts in turn generated a cascade of other Impacts including impacting new UK plans, policy objectives and policy frameworks post-Brexit. Our research directly informed new policy objectives and policy frameworks. Specifically, the *NCC's* second annual report **[S7]**, referred directly to the work package led by **Bateman** and drew on extensive contributions from several other **UEA authors**. Its main recommendation was to produce a long-term Environment Plan **[S7],** directly informed by natural capital/ecosystem services thinking **[S5]**. The then Secretary of State for the Environment formally accepted that recommendation in July 2017 **[S8a]** which led directly, in 2018, to DEFRA publishing the UK's very first *25 Year Environment Plan* **[S8b]**. Page 15 of that Plan directly cited **Bateman's** *Science* paper on the use of ecosystem service research in UK decision making **[R8]** and Annex 1 contained numerous references to the work of the *NCC* (e.g., page 6) and the *NEAFO* (e.g., page 47) **[S8b]**.

According to the Deputy Head of National Biodiversity at DEFRA *"contributions by **UEA**… include[d] the integrated model [which] provided real-world land-use scenarios that quantified, perhaps for the first time, the economic and environmental impacts of land use choices".* Moreover, "*the outputs formed a significant component of the evidence base that helped the [NCC] convince Government of the value of a natural capital approach and in turn led to the adoption of that approach as a central tenet of the government's 25 Year Environment Plan."* **[S5]**. Furthermore, this plan will be the first in a rolling series of national *Environmental Improvement Plans* established under the *Environment Act*, expected to be adopted in 2021, the first UK environment act in a generation. According to a *DEFRA* Policy Paper (*Environmental Bill: Environmental Targets*, dated August 2020) the new Act will only set legally binding long-term targets in four priority areas, one of which will be biodiversity/ecosystems.

Our work also informed internal Whitehall guidance on policy development. *DEFRA's* Deputy Head of National Biodiversity confirms that our work informed *"findings from the NEAFO more broadly [which] were [in turn] used to support the development of Defra and Treasury guidance on integrating environmental considerations into policy appraisal (Defra's 'Enabling a Natural Capital Approach' and the Treasury 'Green Book')"* **[S5]**. It is noteworthy that *DEFRA* had earlier commissioned a whole work package of the *NEAFO* - Workpackage 9 'Embedding an Ecosystem Services Framework in Appraisal' **[S1**, page 60] - (co-led by **Jordan**) to address the (non) use of ecosystem knowledge in policy appraisal systems. These systems have since been overhauled to inform government spending right across Whitehall **[S5]**.

The Executive Director of *UN Environment Programme World Conservation Monitoring Centre* (*UNEP's WCMC*; the UN body that coordinated the *NEAFO* for *DEFRA*) states that the *"research performed at **UEA** … played a pivotal role in the [NEA] and [NEAFO]… Over the last two decades their research has been critically important in conceptualizing the relationship between nature, ecosystem services and economic and non-economic values"* **[S4]**. Moreover, it *"is apparent that these findings influenced the Treasury…. Green Book and the decision to form the Natural Capital Committee…."* **[S4]**.

International level Impact and leadership

Watson's leadership underpinned several related international knowledge exchange exercises, which directly impacted policy development activities in the UK and globally. For example, **Watson** chaired the international negotiations that led to the formation of the *Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)* in 2012 **[S2]**. His ideas permeate the conceptual framework that underpins all *IPBES's* work **[R2, R5]**, commensurate with Insights 1 and 5 (see Section 2). **Watson** was also instrumental in inventing the 'nature's contributions to people' approach (see Insight 2) **[R2, R4]**, which is now formally incorporated in the wording of the *UN Convention on Biological Diversity's* strategic plan for biodiversity. *IPBES's* first *Global*

Assessment, published in May 2019 [see for example **S9]**, is actively informing the UN's overarching biodiversity policy framework **[S2]**.

In the words of the Deputy Executive Secretary of the *UN Convention on Biodiversity*, **Watson** *"played a leading role in the negotiation, governance and work programme of [IPBES] … which is the primary mechanism for providing state of the art and governmentally approved assessments that support policymaking and implementation under the [Convention]."* Its Global Assessment was *"particularly influential, scientifically, politically and in raising public awareness and understanding… [It] brought much-needed attention to the loss of biodiversity… placing it along-side climate change as an issue that needs to be addressed by the global community with equal urgency"* **[S2]**. Furthermore, the Executive Director of *UNEP's WCMC* confirms that many *"**UEA… scientists** have contributed significantly to the NEA, NEAFO, IPBES, and IPCC assessments, which have played a vital role in national and international policies to conserve and restore biodiversity"* **[S4]**.

Meanwhile, the *Dasgupta Review* published its Interim report in April 2020 **[S6]**, citing **Watson's** ideas about nature's contributions to people **[R2, R4]** and drawing directly on the *NEA* and *NEAFO* **[S6]**. Its final report will be published in February 2021, but its preliminary findings **[S5]** were being anticipated in government throughout 2020. For example, the then Prime Minister, Boris Johnson, attended a preparatory *UN Convention on Biological Diversity* meeting on 26 September 2020 and announced a brand new UK-wide policy goal to improve ecosystem protection - that 30% of its land and seas will be specially protected by 2030, up 4% from 26% **[S10]**.

Summary

Foundational interdisciplinary research conducted at UEA since 2000 continues to exert a significant impact on many influential knowledge exchange activities at national, EU and international levels [e,g, **S2, S4, S5]**, leading directly to substantial and long-lasting policy and societal Impacts. The foundational Impact of **Turner** (CBE, 2000), **Watson** (knighted, 2012; a UN Champion of the World for Science and Innovation) and **Bateman** (OBE, 2013) has been formally recognised by HM Government and the UN.

5. Sources to corroborate the impact

[S1] UK National Ecosystem Assessment, Follow On (2014) *The UK National Ecosystem Assessment Follow On: Synthesis of the Key Findings*. UNEP-WCMC, LWEC, UK. [UEA (co)authors included **Turner**, **Watson**, **Anger**… **Bateman**…. **Turner…. Jordan**].

[S2] *Testimonial: Deputy Executive Secretary of UN Convention on Biodiversity*, 10-12-20.

[S3] UK National Ecosystem Assessment-Follow On, Work Package Report 3: Economic Value of Ecosystem Services. **Bateman, I.,** *et al* **2014**.

[S4] *Testimonial: Executive Director of* UN Environment Programme World Conservation Monitoring Centre, 2-12-20.

[S5] *Testimonial: Deputy Head of National Biodiversity and Ivory Division, Natural Environment and Rural, DEFRA*, 11-12-20.

[S6] HM Treasury (2020) *The Dasgupta Review: Independent Review on the Economics of Biodiversity: Interim Report*. London.

[S7] Natural Capital Committee (2014) *The State of Natural Capital: Restoring Our Natural Assets*. Second report of the Economic Affairs Committee. DEFRA, London.

[S8] a) Protecting Our Environment Through the 25 Year Environment Plan (2017). Letter from Secretary of State for Environment, Food and Rural Affairs to Chair of the NCC; b) HM Government (2018) A Green Future: Our 25 Year Plan to Improve the Environment

[S9] IPBES (2019) *Summary for Policy Makers of the Global Assessment Report on Biodiversity and Ecosystem Service,* IPBES, Bonn, Germany.

[S10] Press release: "PM commits to protect 30% of UK land in boost for biodiversity" (28 Sept 2020).