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Ferreira, C

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The contested instruments of a new governance regime: accounting for nature and building markets for biodiversity offsets

Abstract

Purpose – this paper analyses the processes involved in the creation and eventual demise of a market for biodiversity offsets in the UK. The reasons for the failure of this market to take hold as a governance mechanism are considered, and its subsequent effects examined.

Design/methodology/approach – the research examines a single case study of the creation of a pilot market for biodiversity offsets in the UK. Data includes policy and industry papers, complemented with interviews with biodiversity offset practitioners, regulators and non-government organisations.

Findings – the case study demonstrates that a market for biodiversity offsets was piloted with the intent to contribute to the reform of the UK planning regime. However, disagreements about this political project, uncertainties in the knowledge base, and continued entanglements with existing biodiversity meant it was impossible stabilise the assemblages necessary to support the market, leading to its eventual demise. However, the principles and devices of offsetting have proved more resilient, and have started to combine with the existing arrangements for the governance of nature.

Practical implications – the paper presents a situation where a political project to reform governance arrangements through the creation of a market was not successful, making it of interest to researchers and policymakers alike.

Originality/value – while biodiversity offsetting has been widely discussed from scientific, legal and political perspectives, this article addresses it as a market, explicitly designed to become a part of a governance regime. It also advances the understanding of the mechanisms by which similar processes of marketisation can fail, and suggests avenues for future research in those contexts.

Keywords Biodiversity offsetting, Accounting for Biodiversity, Social Studies of Marketisation, Governance, Ecological accounting

Introduction

Biodiversity loss has been recognised as one of the most serious aspects of the ongoing environmental crisis in both academic and policy literature (MEA, 2005; Pimm et al., 2014; Seto et al., 2012; TEEB, 2008, 2010; Yule et al., 2013). Scientists, policy-makers, Non-Governmental Organisations (NGOs), businesses and civil society groups have repeatedly raised concerns about the rate at which biodiversity is being lost. The scale of the problem is extremely serious: For example, the November 2015 update of the International Union for the Conservation of Nature's Red List of Threatened Species indicated 23,250 species threatened with extinction, out of a total of 79,837 species assessed (IUCN, 2015). In this context, there is growing interest in policies which aim to reduce biodiversity loss, especially around governance initiatives. Commenting on this issue, Liverman (2004) identified three main questions for the future of environmental governance regimes: who governs; at what scale; and at what price. Agents, spaces and values are thus three important dimensions in the evolving governance of biodiversity. This paper argues that equally important to the discussion are the assemblages in which agents, spaces and value come together to govern biodiversity: The mechanisms by which agents calculate the value of biodiversity at a given scale. In particular, the paper explores how accounting for biodiversity can be employed as a mechanism for creating market-like biodiversity governance mechanisms, but also the tensions and contradictions it suffers.

If accounting can contribute by measuring the value of biodiversity, it consists only of one step towards achieving reductions in biodiversity loss. In addition to estimating the value of biodiversity, there need to be mechanisms by which that value can be captured, thus assuring that businesses and individuals have the appropriate incentives to protect nature (TEEB, 2008). Among the mechanisms by which the 'emancipatory potential' of ecosystems accounting can be realised is biodiversity offsetting (ten Kate et al., 2004; ten Kate and Inbar, 2008; Treweek et al., 2009). Biodiversity offsets consist of '...conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to ensure *no net loss of biodiversity*' (ten Kate et al., 2004: 13). In a biodiversity offsetting situation, a company seeking to develop an area must compensate for the biodiversity losses it causes by paying a third party to supply and protect equivalent biodiversity elsewhere. Offsetting involves the measurement and valuation of existing biodiversity, a market-based 'management' of biodiversity, and the possibility of 'trading' different biodiversities (Tregidga, 2013). In doing so, biodiversity offsets contribute to managing the relationship between biodiversity conservation and land development (Ferreira, 2014), by permitting developments which sacrifice nature of one area in return for (theoretically) commensurate conservation values elsewhere (Williams, 2012).

However, despite the promises of the approach, biodiversity offsetting has proved to be a controversial topic. Research into the outcomes of offsetting has produced mixed results, with conservation biologists disagreeing on whether offsets can help conserve nature, or contribute to losses (Pawliczek and Sullivan, 2011). Some of the weaknesses of the approach include a narrow definition of biodiversity; the fact that the concepts underpinning offsetting are based on an immature, imprecise and complex science; likely problems with management of offset areas and compliance monitoring; and overall lack of resources for implementation (Bull et al., 2013; Burgin, 2008; Quétier and Lavorel, 2011). As a result, the domain in which biodiversity offsets can deliver on the promise of no net loss of biodiversity remains small (Maron et al., 2012). Furthermore, an examination of individual corporations' no net loss claims has revealed that most have advanced little beyond defining the concept, offering no specifics in terms of implementation strategies or expected outcomes (Rainey et al., 2015). In addition, it has been that noted biodiversity offsetting would require the creation and development of institutions dedicated to managing it (Quétier and Lavorel, 2011; Wissel and Wätzold, 2010). Combined, these issues suggest achieving no net loss of biodiversity through offsetting is both 'administratively improbable and technically unrealistic' (Walker et al., 2009: 149). Based on these limitations, some authors have concluded that the creation of markets for biodiversity

offsets consists only of a neoliberal political project, the motivation for which is not to promote conservation (Apostolopoulou and Adams, 2015a, 2015b; Pawliczek and Sullivan, 2011). But despite these criticisms, there is continuing interest in the potential of markets for biodiversity offsets.

In 2010 the UK government announced the creation of 6 'pilot' biodiversity offsetting areas, designed to study the potential of offsets in Britain (DEFRA, 2011b; Lawton et al., 2010). The scheme was supported by the Department for Environment, Food and Rural Affairs (DEFRA) and endorsed by the government-sponsored Ecosystems Markets Task Force (EMTF, 2013). Six local authorities agreed to host the pilot projects and implement them, reporting to DEFRA about findings and best-practice (DEFRA, 2012c), and a number of consultancies became involved in advising the processes and implementing the measurements and calculations necessary (Caldecott and Dickie, 2011; eftec and IEEP, 2010; Treweek et al., 2009). In addition, a private company (Environment Bank) was created to '…apply a system of biodiversity accounting to the impacts of development and generate investment in wildlife conservation via 'habitat banking' and biodiversity compensation schemes, such as offsetting.' (Environment Bank, 2013c). The pilots started in 2012, and were completed in 2014. However, despite initial interest, as of early 2017 no more attempts had been made to roll out markets for biodiversity offsetting in the UK. DEFRA has shown no interest in pursuing the initiative (DEFRA, 2014), and the idea appeared to drop off the political agenda.

The apparent failure of the market for biodiversity offsets to take hold in the UK context provides a challenge to some of the prevalent academic analyses of marketisation as a form of governance. On the one hand, it confounds the belief that neoliberal governance by the market can simply be pushed by a coalition of capital and government (Castree, 2008). Despite the coming together of these interests in the promotion of the offsetting pilots, they did not result in reproducible markets. On the other hand, the results also belie the performativity thesis, that markets exist as a reflection of the models and findings of economics (Callon, 1998b). By analysing how and why the attempts to create a market for biodiversity offsets in the UK failed, this paper contributes to the understanding of how experiments in creating markets as governance mechanisms can be unsuccessful. The paper makes two claims: First, that the reasons for failure lie with the difficulty of establishing assemblages – of politics, knowledge and actual existing biodiversity – which would have provided a stable and reproducible market infrastructure. Second, that despite these difficulties – and the eventual demise of biodiversity offsets in the UK – the different components of the assemblages have lived on beyond the attempt to create a market, and have the potential to interact with the existing governance regime to reconfigure in novel, yet-unseen assemblages. At the centre of these debates is accounting for biodiversity: It is a fundamental component of the socio-technical assemblages upon which governance mechanisms depend to operate, but it remains dependent on the politics of the market and on the physical reality it purports to account for.

The paper is organised as follows. First, the importance of politics and knowledge in the creation of markets is presented, discussing how calculation is a fundamental aspect of markets as governance mechanisms. Following this, the role and applications of accounting for environmental problems is discussed and critiqued. The research approach is then discussed, including a detailed overview of the case under analysis. Findings are subsequently presented, addressing directly the two stated research contributions: 1) analysing the processes by which the market for biodiversity offsets in the UK failed to become stable and reproducible; and 2) identifying how this failure has not stopped many of its components from meshing with the existing arrangements, leading to hybrid governance mechanisms. The article concludes with an integrating discussion, which considers the possible roles of environmental accounting in the context of debates over the governance of nature.

Markets and accounting: Governance, calculation and contestation

The creation and expansion of markets as governance mechanisms has been characterised as a fundamental aspect of the neoliberal project (Birch and Siemiatycki, 2015; Peck, 2012). Two aspects appear intrinsic to the neoliberal project (Barnett, 2005; Brenner et al., 2010): first, that neoliberalisation is the result of a deliberate collaboration between capital and states. Neoliberalisation advances by rolling back existing regulations which go against the interests of capital, and rolling out new regulations which promote the process of capital accumulation (Castree, 2008; Pawliczek and Sullivan, 2011). Second, that because markets favour the interests of capital, the neoliberal project would advance through the marketisation of hitherto-unmarketed aspects of economic and social life (Castree, 2011; Robertson, 2004, 2006, 2007). This view suggests that the origin of markets can be found in the political project to use them as the key tool for governance practice. Ontologically, this perspective assumes that markets can be conceptualised as independent objects, to be created according to the agency and objectives of political and economic actors. In contrast, research in the fields of economic sociology and social studies of science has suggested an alternative view, which sees markets as embedded in economic sciences. Rather than simply describing the economy, economics is responsible for imagining it and producing the tools which contribute to its creation, guiding agents' actions in the process (Callon, 1998b, 2007). Markets are, in this view, socio-technical constructions, originating from the discourses, data, models and tools produced by the discipline of economics (Garcia-Perpet, 2007; MacKenzie, 2007). This thesis of the *performativity of economics* implies that to understand markets requires researching how the agents, entities exchanged and rules of exchange are constituted (Breslau, 2013; MacKenzie, 2009c). Of particular interest is the concept of calculation.

In a market setting, calculation and agency are two sides of the same coin (Miller, 2008), implying that to construct a market requires equipping agents with the tools required to calculate. This is achieved by developing metrological regimes – sets of devices, rules and mechanisms through which non-market externalities are identified, measured and quantified, so they can become a part of agents' calculations (Callon, 1998a). For a market to emerge, a new commodity must be created and established (i.e., given a stable legal status and recognised technical properties), and made transferable between economic agents (MacKenzie, 2009b). This is achieved by employing calculative devices, whose role it is to frame non-market entities into commodities (Callon, 1998a; Callon and Muniesa, 2005; Holm and Nielsen, 2007). Accounting is one of the fields of knowledge which donates tools and practices to calculative devices; however, these devices are constituted by more than technical aspects alone. Calculative devices are better understood as balancing acts of calculation and other elements, which bring together scientific and technical knowledge, but also legal aspects, business and strategic priorities, political projects and implicit cultural preferences, among others. In practice, they are better understood as assemblages for intervening over and governing economic life (Miller, 2008), whose role is to align the combined knowledge, preferences and objectives of various agents (Miller, 2008; Miller and O'Leary, 2007; Van Hoyweghen, 2014). The role of accounting is to serve as a mediator, aligning political discourses and models from economics and other sciences into mechanisms of governance (Miller and O'Leary, 2007; Vosselman, 2014).

Governance, and the 'programmes of government' which underpin it, involves two aspects: First, the object to be governed must be given existence, acknowledged and described as an economic object to be governed. This is achieved through discourses of governing, which imagine arenas of governance and its constituents. Discourses are, in this case, 'intellectual technologies', through which economic domains are given existence, and thus made amenable to calculation (Miller and Rose, 1990). But the role of discourse goes beyond producing knowledge about the object to be governed: Discourses of governing inevitably carry conceptions of morals, justice and ethics, as well as a conceptualisation of power and where the legitimacy to wield that power lies (Rose and Miller, 1992). So in addition to creating the object to be governed, discourse is also responsible for setting out how that object is to be

governed, and by whom. The second aspect of the creation of 'programmes of government' involves the translation of discourses into practice, turning 'systems of thought' into 'systems of action' – in other words, extending the legitimacy to exert power to the minutiae of existence (Miller and Rose, 1990).

However, to create a metrological regime does not serve as assurance that it will successfully perform as a governance mechanism. In practice, there are no guarantees that any given political projects of governing are acceptable. These reasons for this, and how they might apply to the specific case of environmental accounting, are discussed in the next section.

Contesting metrological regimes: Environmental accounting as hot topic

The process of turning (economic) ideas into (governance) actions is not always straightforward. The establishment of metrological regimes has consequences which go beyond the operation of the market, or the logics of the sciences which provide the knowledge-base on which the regime is built. Politics is often a crucial aspect in processes of market formation: The construction of markets requires political projects to motivate them, identifying problems and promoting the market as a potential solution (Muniesa and Callon, 2007). Examples of this have been identified in specific examples of market creation, including the European Union's Emissions Trading Scheme (MacKenzie, 2009a), or Individual Trading Quotas for fisheries in Norway (Holm and Nielsen, 2007). In each of these cases, political activity was framed through the use of calculative devices; a metrological regime was created, which instituted a set of calculative devices; and, crucially, political disagreements about how to govern were hidden under the operation of calculative 'black boxes' – what has been described as the *anti-politics machine* (Barry, 2002; Barry and Slater, 2002). However, this 'cooling down' (Callon, 1998a) of politically contested situations is not always successful. Calculation is always contestable, especially in situations where the knowledge base and the methods of measurement are uncertain. Uncertainty about the principles and knowledge base which underpins calculation can result in the various groups of agents in a market failing to come to an agreement over the economic facts in that market (Callon, 1998a). Calculation becomes, in this context, fraught with disagreement. In these situations, the transition from discourses to technologies of governance can become the stage for conflicts and disagreements (MacKenzie, 2008; MacKenzie and Millo, 2003; Vollmer et al., 2009). One area where this effect is visible is the field of environmental accounting, and especially accounting for biodiversity.

Policy interest in ecosystems accounting has resulted in a number of high profile attempts to create accounting standards to estimate the value of nature. Examples include the UK's *Principles of Ecosystems Accounting* (DEFRA and ONS, 2014) and the United Nations' *System of Environmental-Economic Accounting – Central Framework* (UN-Stats, 2012). Two aspects emerge from these suggested standards: First, that ecosystems accounting can include a number of aspects and methods. The two standards set out broad frameworks for valuing and accounting for components of ecosystems which are not normally marketed, employing for the purpose a variety of principles and methods. Second, the knowledge base undergirding these accounting standards remains uncertain. Both documents constitute outputs from ongoing projects, to be updated as progress is made in the field of biology, and translated into workable accounting standards. However, despite these uncertainties, the interest in the role of accounting in helping counter biodiversity loss remains high: Accounting for biodiversity, it has been suggested, '…can, by reporting organisations' impacts on biodiversity and their efforts to enhance and protect biodiversity, raise stakeholders' awareness of corporations' impact on wildlife and the extent to which organisations are attempting to mitigate this impact' (Jones and Solomon, 2013: 670).

Traditionally, the field of environmental accounting has drawn heavily on the principles of neoclassical economics. As a result, the practice of environmental accounting has focused on

issues such the appropriate reporting of environmental values and liabilities (see, for example, Wambsganss and Sanford, 1996). However, this perspective has been criticised when applied to environmental issues. In particular, environmental accounting is often concerned with economic efficiency to the detriment of other considerations, including social equity, environmental sustainability, and ethics and moral suasion (Milne, 1996a). In terms of social equity, the practice of environmental accounting risks creating adverse distributive effects, displacing the consequences of environmental degradation from better-off groups in society to poorer communities (Gibson, 1996). As a result, there is the risk that it will perpetuate inequality, rather than addressing the underlying causes of it (Lehman, 1996; Lohmann, 2009).

There are also concerns that environmental accounting might increase and perpetuate environmental damage. The reason for this lies in the ontology of the relationship between nature and the economy it envisages, which sees nature as a set of externalities to be managed for economic value. This positionality fails to contextualise the mutual dependences between humanity and nature, proposing instead to solve environmental problems via a single economic instrument, the market (Gibson, 1996). The result of this is an incomplete appreciation of the value of nature, which reflects only the preferences inherent in the capitalist system (Lehman, 1996; McAfee, 1999, 2012). This issue is especially noticeable in the case of complex environmental dimensions, such as biodiversity. Trading requires simple, measurable and interchangeable commodities, which all market agents understand and agree on; in contrast, biodiversity consists of complex, difficult-to-measure, and mostly non-interchangeable resources (TEEB, 2008). As a result, accounting often operates by reducing biodiversity to simple components, losing track of the interrelations between the various components and the biophysical and social environment in which they live in the process (Kosoy and Corbera, 2010; Robertson, 2006, 2007).

The issue of ethics and moral suasion presents another set of challenges to environmental accounting, which derive from implicit assumptions about the respective rights of companies and society with regards to environmental degradation. The operation of markets for environmental protection requires that licenses to degrade the environment be issued to companies[1]. This practice attributes to businesses the right to cause environmental degradation up to a given limit. As a result businesses gain the right to pollute, up to a given level, appropriating society's rights to a clean environment in the process. This inverts the logic that society has the right to an unspoiled environment, in pursuit of market efficiency (Milne, 1996a). Society will not always favour nature over development; in fact, it is entirely possible for people to favour (perceived) growth in work and wages to the detriment of the natural world (Milne, 1996b). But the use of environmental accounting practices to institute markets for environmental commodities assumes that position as standard, and in essence contributes to remove society's right to strike a preferred balance between development and conservation.

Environmental accounting and markets for environmental commodities operate by framing nature through political discourses (Ascui and Lovell, 2011); and this political dimension makes it inherently unstable and subject to contestation. Commenting specifically on the practices of carbon accounting and cost-benefit analysis, Lohmann (2009) suggests that:

> …while both techniques might seem destined to reinforce the political power of accounting expertise, each in fact helps engender intractable reactions and resistances to itself. Although each technique to a certain extent uses the public's distance from its centres of calculation to 'black-box' areas of measurement controversy, and thus maintain some public faith in the abstract idea of computability, in both cases, the more intimately acquainted people become with

[1] Examples of these licenses include CO_2 and SO_2 emissions permits, biodiversity offsets or water pollution discharge permits, among others.

> the relevant accounting practices, the less plausible and more contested they become. (2009: 529)

This suggests an inherent risk that environmental accounting, for all its 'emancipatory potential', may fail to securely align the various discourses and knowledge into functional assemblages. But while the effect of disagreements over calculation is understood, comparatively less is known about the effects of disagreement in terms of the discourses of governing. This is especially important given the proliferation of situations where each of the groups of agents promoting alternative discourses hold a degree of political power, giving them the ability to influence the construction of technologies of governing, and ultimately the governance regimes themselves. This paper analyses one such case, the creation of pilot markets for biodiversity offsets in the UK.

Research Approach

The empirical materials for this paper are drawn from a single case study (Yin, 2009), of an existing economic experiment in the creation of a biodiversity offsets market, the Biodiversity Offset Pilots scheme in England. The case study approach was selected for two reasons: first, it provided a broader, contextual analysis of the phenomena explored. Case study research allows complex phenomena to be analysed with reference to the socio-political and economic context within which they take place, understanding how and why social phenomena take place (Yin, 2009). The analysis followed what Sayer (2000) described as an intensive research approach: Focusing on how causal processes work in a limited number of cases, and understanding the action of individual agents within those causal contexts. Second, the case study approach allowed for the use of multiple sources of evidence to converge the data and corroborate findings, in a process of methodological and data triangulation (Stake, 1978, 2000; Yin, 2009).

Data sources, data collection and data analysis

The empirical analysis presented in this paper used both secondary and primary data to analyse the emergence of the pilot markets for biodiversity offsets in England.

In a first phase, publicly-available reports about offsetting from a number of sources, including the UK government, consultancies, NGOs and environmental activists were analysed. These reports were used to trace the history of the idea of biodiversity offsetting in the UK, from the first mentions of the topic until after the end of the programme; to identify important agents and groups involved; and to detail the methods used to measure and value biodiversity.

In a second phase, primary data was collected with the actors identified in the first phase. This involved 24 interviews with specialists on biodiversity offsetting worldwide, of which 16 worked exclusively in the UK. These included central government bureaucrats, local government (planning officers), NGOs, consultants and a senior executive of the only private company involved in biodiversity offsets in the UK. The interviews took place during the period in which the programme was in operation (2012 to 2014). Interviewees were asked about the rationale behind the Biodiversity Offsets pilots, their own involvement with offsetting, and the experience of 'doing biodiversity offsetting' in practice. Further interview questions focused on the methods used to measure and value biodiversity, the challenges and obstacles faced by practitioners, and their preferences for future developments in biodiversity offsetting. Each interview lasted between 45 and 90 minutes. All but one were recorded and transcribed, as were the participant observation notes collected during the workshops. Additional primary data was also collected through participant observation in workshops and meetings in the area of biodiversity and business and environmental valuation. This was done for reasons of data

triangulation (Yin, 2009), and allowed for the collection of further information about practices of ecosystems accounting and environmental valuation. It also provided access to the views of large multinational corporations which, while not directly involved in the biodiversity offsetting pilots, were frequently quoted by practitioners as potential future buyers. The data was coded in order to simplify and aggregate the amount of information gathered, following the methodology suggested by the Grounded Theory literature (Glaser and Strauss, 1967). This involved an iterative process of reducing the data collected to a series of codes, grouping those codes under major themes, and establishing the relationships between those themes (Bryman and Bell, 2007; Grams, 2001; Strauss and Corbin, 1990). Using this grounded theory-derived methodology, the data analysis process produced a number of dimensions of the discourses and representations about biodiversity and markets.

Research Context

The case study selected was the creation of a pilot biodiversity offsetting programme in the UK. This programme is not unique, and exists in the context of similar initiatives worldwide (Ecosystem Marketplace, 2014; Ferreira, 2014; Madsen et al., 2010). As of 2017, the main source of publicly available information on environmental markets (the Ecosystems Marketplace website) listed 59 different biodiversity offsetting programmes, operating in 23 countries (Ecosystem Marketplace, 2014). The programmes vary in terms of structure and forms of operation (Madsen et al., 2011), but share two important aspects: The requirement to compensate for biodiversity losses due to development; and the expectation that said compensation results in no net loss of biodiversity (BBOP, 2012b; Madsen et al., 2010, 2011). In practice this means that, for each case, biodiversity must be measured and quantified, and that the value of biodiversity provided as compensation must at least equal the value of biodiversity lost to development. This requires the development of mechanisms to measure and value biodiversity, so as to demonstrate that no net loss of biodiversity has been achieved (BBOP, 2012a). No net loss of biodiversity serves both as a promise of welfare to society and as a quasi-technical guidance for the functioning of the market. In terms of its promise, no net loss of biodiversity represents a world in which both biodiversity conservation and development are allowed to take place, where nature and economic growth co-exist. This makes it a desirable option for governments wishing to balance economic growth and nature conservation (EMTF, 2013). The guidance aspect of no net loss of biodiversity relates to the requirement that equivalence between biodiversity lost and the associated offset is demonstrated: No net loss means establishing equivalence between two alternative land uses, "a state whereby the expected benefit (credit) generated approximately equals the damage (debit)" (eftec and IEEP, 2010: 8). This understanding of equivalence is firmly rooted on a metrological regime which can determine benefits and damages; but, crucially, it is also steeped in the language of accounting, of translating biodiversity into credits and debits.

The UK's Biodiversity Offsets programme started in July 2012 (DEFRA, 2012c) and operated for almost two years, until the end of 2014. Six independent pilot areas were selected: Devon; Doncaster; Essex; Greater Norwich; Nottinghamshire; and Warwickshire, Coventry and Solihull. Initiated and overseen by the Department for Environment, Food and Rural Affairs (DEFRA), the scheme was designed to test the feasibility of applying biodiversity offsetting in the UK context, and to explore the potential for the deployment of the mechanism on a wider scale (DEFRA, 2011a, 2012b). A further decision involved identifying, before the start of the programme, what aspects of biodiversity would be offset – in other words, what the appropriate commodity would be in this market[2]. In the case of the Biodiversity Offset pilots, a decision

[2] The complexity of biodiversity, a term which covers aspects of nature from the intracellular to the ecosystem level, means that it is virtually impossible to compensate for all biodiversity losses. This has led to different programmes worldwide covering different aspects of biodiversity, effectively meaning

was made that biodiversity offsets should compensate for all biodiversity lost to development (DEFRA, 2012a; eftec and IEEP, 2010). In theory, this meant that all negative impacts resulting from development in the pilot areas would be covered by the biodiversity offsetting programme.

Several of the participants in this research remarked that markets for biodiversity offsets typically require regulation to compel developers to acquire offsets in order to work as there is no 'natural' demand for compensation. However, no such regulation was enacted in this instance; instead, the regulator insisted that the experimental character of the pilots meant regulation was unnecessary. Participating councils were asked to include discussions about offsetting in their planning process, and DEFRA offered support and oversight (DEFRA, 2012b). The concept of requiring developers to provide compensation for damages to biodiversity which result from their activities has long been present in the UK's planning regulations. Under Section 106 of the Town and Country Planning Act 1990, developers can enter into legally binding planning agreements with planning authorities, in order to provide compensation for adverse environmental impacts associated with projects (Latimer and Hill, 2007). This regulatory context defined that demand for biodiversity offsets would originate in developers looking to obtain planning application for their projects.

Supply of biodiversity offsets, on the other hand, was the subject of further definition by the regulator. DEFRA's guidance materials described 'biodiversity offset providers' as any individuals or organisations prepared to provide compensation for damages (DEFRA, 2012a). This meant that individual landowners were allowed to sell biodiversity offsets – in practice, to sign a commitment to preserve a given type of habitat in their land for a fee. Considering how fragmented supply and demand were, local authorities were expected to serve as intermediaries between developers and landowners. In addition, a private company (The Environment Bank) was created with objective of serving as a market intermediary and providing legal advice and technical support for offsetting (Environment Bank, 2013c).

In practice, the pilots operated as very limited markets: There were very small numbers of buyers and sellers of biodiversity offsets, which contrasted with the extensive discussions which took place between regulators, promoters and potential intermediaries (CEP, 2013). The pilots were seen as the first stage for the construction of a new governance regime, providing guidance in terms of best practice for future implementations (DEFRA, 2011a).

Research findings

The failure to build a market: Politics, knowledge, commodity

The economic experiment in creating a market for biodiversity offsetting in the UK involved the alignment of political projects about reforming the governance of nature; the knowledge-base in terms of measuring and accounting for biodiversity; and the living, existing biodiversity itself. The role of each of these, and how they failed to align, is analysed in the sections below.

The politics of the market: Biodiversity offsets as a governance project

The existence of a regulatory framework which allowed for developers to agree with local authorities to provide compensation for the impacts of their projects (Section 106 of the Town and Country Planning Act 1990) would appear to obviate the need for a standalone biodiversity offsets scheme in the UK. However, promoters of offsetting highlighted a number of limitations in the existing governance regime, framed around two categories of failings: Market failure

that specialised measurement and valuation tools must be developed for each individual programme (Crowe and ten Kate, 2010).

and government failure. In the opinion of a senior executive of a company offering offsetting services:

> ...we are where we are with regard to biodiversity in this country because we have managed to under-sell it and under-value it dramatically. It is the thing that underpins everything we do, and yet we put zero value on it, and treat it as a luxury. (...) if you over-exploit them, then you won't have natural resources in the future to use sustainably. [*Interviewee A*]

This assertion that nature is lost because its economic value is not apparent, which is widely used in the field of environmental economics (Baumol and Oates, 1988; Hanley et al., 2007), cements the idea that the relationship between the modern economy and biodiversity is faulty, as the former consistently fails to value the latter. Modern societies, this view suggests, have a *defective economic compass* (TEEB, 2008). This echoes some interpretations of the concept of the *tragedy of the commons* (Hardin, 1968, 1994), which argue that lack of property rights in nature's goods and services causes underinvestment and excessive extraction, compromising long-term sustainability (Smith, 1981). Market failure, according to this view, is one of the root causes of biodiversity loss in the UK.

Neoclassic economic theory suggests that the mechanism to counter market failure is government intervention, via regulation (Ostrom, 1990). The existing UK planning regime (including the aforementioned Section 106 of the Town and Country Planning Act 1990) is one such attempt, consisting of a piece of legislation which attempts to prevent excessive negative impacts over nature. However, this regime has also been presented as failing, not least because of a substantial gap between compensation agreed and delivered. This gap is attributed to the inadequacy of enforcement of compensation agreements (Latimer and Hill, 2007). This systemic government failure was described by the senior executive of the company offering offsetting services:

> …the developer will sign up to anything prior to getting planning permission. Once he's got the planning permission he'll start to try and negotiate: 'This will be a bit too difficult and too costly. I don't think we can do this…', and local authorities don't say 'Right, stop the development now, or cease your development, or sell your site, because you've broken your agreement on mitigation'. They just have to work with the developer to work round it, and it ends with nothing being delivered. [*Interviewee A*]

By characterising the existing governance regime as suffering from both market failure and government failure, this set of discourses has produced substantial interest in alternative mechanisms to address biodiversity loss. Biodiversity offsetting was among these mechanisms, having come to particular prominence in conservation circles since the creation of the Business and Biodiversity Offsets Programme (BBOP) in 2004. What biodiversity offsetting offered was nothing short of a radical new way to govern biodiversity.

Accepting that the previous governance regime was failing and that biodiversity offsets were a possible alternative, DEFRA sponsored a number of research and policy papers in the area. These included the first scoping study for the development of a biodiversity offsets programme in the UK (Treweek et al., 2009) and a review of conservation priorities in England, which considered how offsetting could be deployed (Lawton et al., 2010). Following the May 2010 UK General Election biodiversity offsetting gained political prominence, as the Conservative Party, now in coalition government, had pledged in its electoral manifesto to pilot offsetting if elected. Under the new government, DEFRA produced a consultation document on offsetting (DEFRA, 2010). The results of this consultation eventually led to a new policy document (DEFRA, 2011d), where it was confirmed that voluntary, pilot biodiversity programmes would be established in England from 2012. After the start of the pilots, and before they could report on their findings, DEFRA sponsored the Ecosystem Markets Task Force (EMTF), a business-led group tasked with identifying the economic growth potential of environmental markets. The EMTF identified biodiversity offsetting as their first priority, suggesting that:

> Designed correctly, a nationwide system of biodiversity offsetting would: save developers time and money through reduced risk and uncertainty and a more streamlined planning approval process, as well as offering reputational benefits and more efficient and valuable net developable areas. (EMTF, 2013: 10)

This assessment of the business case for biodiversity offsetting highlighted the opportunity to change how the relationship between conservation and development was governed, at a nationwide scale. Faster, simpler and eventually cheaper planning was identified as a driver of economic growth, an important objective to businesses and government alike. In response to the EMTF report, DEFRA announced a second consultation paper, in September 2013, on the options to introduce biodiversity offsetting in all of England (DEFRA, 2013). Writing to Parliament on the occasion of the launch of this second consultation paper, the then-Secretary of State for Environment, Food and Rural Owen Paterson, MP, remarked that:

> The best planning decisions do manage to protect and enhance biodiversity; however, the system does not always work as well as it should. Some planning decisions take too long and the outcome can be too uncertain, which can hinder development. At the same time biodiversity impacts are not always adequately taken into account, or mitigated or compensated for in ways that deliver enduring environmental benefit.
>
> Biodiversity offsetting has the potential to help the planning system deliver more for the environment and the economy. (Paterson, 2013)

By this stage, just over one year into the pilots, biodiversity offsetting had become a political project at central government level. Seen from this prism, offsetting amounted to a concerted attempt to change how decisions about conservation and development were taken in England – a wholesale change in the governance regime. To achieve this, the pilots needed to demonstrate that this new regime was coherent and reproducible, and that the ideas could be translated into functioning markets. However, this political project was marred by conflicting ideas: Having started out as a market to protect biodiversity, it had since changed into a mechanism to deliver economic growth by streamlining planning. The two objectives, while compatible in the internal logic of biodiversity offsets (in which more development results in more conservation), raised alarm among environmental activists and NGOs, who suspected that the government's intention was to weaken the planning process. During the consultations about the creation of a nationwide biodiversity offsets market in England, an alternative idea emerged: That biodiversity offsetting would become a *license to trash* (Carrington, 2013; Howarth, 2013; McGrath, 2013; Monbiot, 2012).

The expression license to trash became an important symbolic qualifier to describe the creation of markets for biodiversity offsetting, used to the opposite effect as no net loss of biodiversity. The term encompasses aspects such as fears that biodiversity offsets would displace damages rather than compensating for them; uncertainty about the possibility that no net loss of biodiversity can be achieved in reality; and, perhaps most importantly, about the ethical and equity aspects of allowing rich and powerful companies a free hand at destroying the common good. A member of a large UK-based NGO explained how their organisation did not condone biodiversity offsetting, connecting both environmental and political concerns:

> [Opinions within the NGO] range from quite positive and interested in the idea of offsetting, the opportunities it raises, to the highly sceptical, highly cynical, who think it's just another way of developers being allowed to get away with damaging sites and not really paying the true costs [*Interviewee N*]

Through the coalescence of this opposition, the project to reform the governance of nature in the UK through a market for biodiversity offsets became politically threatened. By including obvious allusions to economic growth and development as one of the objectives of offsets, promoters failed to secure the support of other important actors involved in the governance of nature. Rather than build a coalition of actors which would support the market, this resulted in

the coalescing of an opposition to offsetting. This would eventually reflect in one of the key decisions made by the political backers of biodiversity: that the market should compensate for all damage to biodiversity.

An uncertain knowledge base: The technologies of a new governance regime

The political project to use biodiversity offsetting as a mechanism to reform the governance of nature, and the UK planning regime with it, is reflected in how the commodity to be traded in the market was defined. As noted in the 'research context' section, the pilot biodiversity offsets were supposed to cover all existing biodiversity and habitats (DEFRA, 2012a). While consistent with the UK's strategic mechanism for directing biodiversity conservation, the Biodiversity Action Plan (BAP) (Lawton et al., 2010), this choice was a rarity among biodiversity offsetting programmes, which generally focus on specific aspects of biodiversity[3]. But because biodiversity offsets were promoted as a mechanism to reform planning, the UK's biodiversity offsets had to be usable in a broad spectrum of contexts. However, this created an important challenge: There were no techniques to quantify and commodify biodiversity. While it is arguably possible to count or estimate the numbers of individuals of an endangered species, the same is not possible to do for all biodiversity. Biodiversity is a complex, composite concept, referring to aspects of nature extending from the microcellular to the individual, species and ecosystems scales (TEEB, 2008). This complexity makes biodiversity extremely difficult to measure, quantify or value (BBOP, 2012a, 2012b; Burgin, 2008; Gomez-Baggethun and Perez, 2011). Recognising this basic failure of the knowledge base required to make biodiversity calculable, DEFRA opted to issue guidelines for establishing a biodiversity *metric*:

> Biodiversity in its entirety is impossible to measure so a 'metric' is used to represent, and provide a measure of, overall biodiversity. Metrics are surrogates, or combinations of measurements, that together provide an assessment of the biodiversity value of a particular area. The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of the compensatory action, can be clearly defined. Metrics are transferable between sites and habitats, allowing an impact on one habitat type to be offset with conservation action elsewhere, or involving a different habitat type and/or quality of habitat. (DEFRA, 2011c: 2)

The metric is an adaptation of the habitat-hectares method approach, presented in the initial scoping study for offsets in the English context commissioned by DEFRA (Treweek et al., 2009). The method takes into account two dimensions: *distinctiveness* and *condition* (DEFRA, 2011c; Rayment et al., 2011). Biodiversity distinctiveness "...includes parameters such as species richness, diversity, rarity (at local, regional, national and international scales) and the degree to which a habitat supports species rarely found in other habitats and/or their Biodiversity Action Plan (BAP) designation" (DEFRA, 2011c: 4). An area suffering impacts which result in biodiversity losses would first be scored along bands of distinctiveness – 6 points to a High distinctiveness area, 4 to a Medium distinctiveness and 2 in the case of Low distinctiveness. Following this, the same area would be scored for biodiversity condition, in a scale from ranging from Optimum (4 points), Good (3), Moderate (2) to Poor (1). To complete the calculation, the scores for distinctiveness and condition were multiplied, producing a score – a single index – of biodiversity units per hectare. This was the key indicator of the biodiversity value affected by the development project. Calculation was entirely dependent on this single index, which was predicted to underpin all agents' calculations. To complete the calculation, the score would then be multiplied by the area (number of hectares) affected, and a set of

[3] For example, the two most prolific market-based biodiversity offsets programmes in operation, in the United States and in Australia, focus on compensation to losses of endangered species (Bonnie and Wilcove, 2008; Crowe and ten Kate, 2010; Treweek et al., 2009; Wotherspoon and Burgin, 2009).

safeguards applied[4]. An offset was said to result in no net loss of biodiversity whenever its total score is at least equal to the total score for the site impacted.

DEFRA's metric was an attempt at producing a calculative device which could be used in the context of a national biodiversity offsetting programme. The role of the metric was to reduce the complexity of biodiversity to a unit which allowed comparability between two distinctive biodiversities (the impact area and the offset area). This was achieved by producing a single figure, a common governance mechanism, which assured comparability and governability (Miller, 2008). The complexity of the task at hand involved aligning the calculating practices of various fields of knowledge (including biology, environmental management and accounting). However, a number of issues are immediately apparent: First, the decision to score biodiversity in terms of distinctiveness demonstrates the extent to which calculative device is dependent on existing political and institutional aspects, such as the English BAP, rather than aspects of ecological equivalence alone. This illustrates how biodiversity was being framed by a calculative device whose work is, itself, framed by existing political aspects. Second, the inexistence of a standardised mechanism to score sites for condition signalled the potential for contestation in terms of the calculative mechanisms in practice. In fact, this aspect of the device raised its own problems, including the inexistence of a standard habitat condition assessment tool (Rayment et al., 2011). This again confirmed that the necessary knowledge base for the calculation was at best uncertain, and at worst non-existent.

In practice, the metrological regime was seen as ineffective and incapable of delivering on the main promise of biodiversity offsets, no net loss of biodiversity. This contributed to fuelling the critics, who saw biodiversity offsets only as a license to trash nature. The inability to present a consistent and trustworthy metrological regime contributed to biodiversity offsets becoming a 'hot topic', which struggled to be cooled down (Callon, 1998a). Overall, the political project of creating a market for biodiversity offsets was fundamentally at odds with the knowledge base on biodiversity quantification and commodification: The former demanded that the definition of the commodity was expanded, while the latter necessitated that less was included in order to work. In addition to these, a third dimension would prove to be at odds with offsetting: Biodiversity itself.

Biodiversity: Commodity and power

Making nature calculable is complicated by the fact that biodiversity is strongly dependent on its specific geographical location. Most animal and plant species depend on a given habitat for their survival, so much so that the very definition of biodiversity includes mentions of the relationships between an individual of a species and the environment they inhabit. The result of this geographical dependence is that, when framed into a commodity biodiversity does not easily 'travel'; its fungibility and exchangeability are circumscribed to a specific location. Biodiversity offsetting promoters and regulators recognise this fact, and most such programmes worldwide recognise that the distance between the area of impact and the offset area must be limited (Doswald et al., 2012). In the case of the UK biodiversity pilots, the difficulty in creating a fungible commodity from biodiversity was addressed by clearly circumscribing the areas where the pilots took place. This local embedding meant that a biodiversity offset was only a valid commodity within the pilot areas, and lost its commodity status outside of them. Biodiversity limited the space where exchange could take place. Rather than one market for biodiversity offsets in the UK, there were a number of independent small markets, operating at a very localised scale.

[4] Safeguards included provisions to assure that the score of the offset area of the offset must never be inferior to the area of the area impacted, and that multipliers were employed to account for the risk of success in the delivery, risk associated with the area where the offset would be built, and the projected time the offset site would take to reach the same condition as the impacted site.

The geographical constraints imposed by biodiversity on the market had a second consequence: They shifted power from central government to local government. As described above, the biodiversity offset pilots operated within the confines of the existing planning arrangements, where it falls to local authorities to decide between conservation or development proposals. This made local planners, who traditionally were at the very core of the existing governance regime, the agents responsible for implementing biodiversity offsetting on the ground. However, these planners did not necessary buy into the principles of biodiversity offsetting. Interviews with planners in three of the six pilots revealed that all had misgivings about the potential consequences of extending the use of biodiversity offsets. As a planner in one of the pilot offsetting areas explained, in a typical quote:

> Some people have seen offsetting as almost a license to trash: A developer can damage that, pay a sum of money and wash their hands with the situation. [*Interviewee U*]

The fact that a planner readily invoked the terminology of opponents of offsetting shows how they were aware of the political debates around the practice. But it was the uncertain knowledge-base in making biodiversity calculable which handed planners significant power to shape how the market would eventually operate. Despite the efforts of promoters and regulator, no standardised measures of distinctiveness or of habitat condition were available for the pilots. At the same time, the pilots had an experimental character: DEFRA and Natural England set out to collect evidence of the diversity of mechanisms which could be employed to make biodiversity calculable. This meant giving local planners a degree of freedom to experiment with changing the metric, in order to try to devise 'best practice' in the context. The degree of local influence over offsetting is also apparent in DEFRA's instructions to practitioners, which specify that "...offsets should be targeted geographically, and towards which conservation priorities, should be taken at the local level as far as possible. In line with this principle, local authorities in pilot areas, working with their partners, could decide to add conditions to the metric to reflect their particular circumstances and priorities." (DEFRA, 2011c: 5). As a result, planners were allowed to adapt and override the DEFRA metric, as explained by a planning officer in one of the pilot areas:

> At the end of the pilot they want a really good range of methods used and tried over the six pilot areas, and from that they are looking at developing a potentially national project. [*Interviewee U*]

The development of local adaptations to the calculative devices became common practice, as confirmed by planners and environmental managers in the six pilots. One particular adaptation involved provisions to include the distance between impact and offset area in the calculation mechanism, thus assuring that specific local natural park benefitted from potential payments. In another case, the changes went as far as shifting the focus of the calculation from ecosystems to species; this implied that impacts over a specific locally-occurring species could only be offset locally, due to its rarity elsewhere. Implicit in these changes was the assumption that the resulting set of calculative devices was for local use, and reflected a local understanding of what was better for local biodiversity. The reasons for the changes were not related to improving the metric, but about the maintenance of control over the governance of nature. In fact, one of the planning officers highlighted that maintaining local control over where offsetting for local damages takes place was the paramount objective of local constituents:

> [Biodiversity offsetting] has got to be within the district, definitely (...). We did a calculation on our carbon emissions, and how many trees would need to be planted to offset that. They were talking about planting trees in different part of the country, and I said "well, our members would not sign up to something that didn't see value improvements in this area". We are very localised, parochial on those things. That's elected members, probably wouldn't accept it further afield that the district itself. [*Interviewee O*]

The reference to carbon offsetting is indicative of the political reasons to oppose biodiversity offsetting. The market for carbon offsets has benefitted from the creation and acceptance of a unit which compares emissions in one location to emissions elsewhere (CO_2e). This has made calculation and the estimation of equivalence possible, making carbon emissions equivalent in different locations, and allowing exchange to take place across space (MacKenzie, 2009b) – the unit has made carbon dioxide (apparently) fungible. By expressing reservations about the acceptance of offsetting carbon emissions away from the district, the interviewee rejected both fungibility of biodiversity, and letting go of responsibility for decision-making. At a second pilot biodiversity offset council, another planning officer expressed similar views:

> Our steering group is very keen that the offset provision is done within the [local authority] area, smaller than the county. They want it to try to be as close to the development as they can. The approach we are taking is to tie it in as locally as possible. (…) One of the reason for that is local people are often concerned about the wildlife in their area, and if they see an area they know is quite good for wildlife being lost, it is important they also see the local benefits of the offsets. I think tying it geographically to where the damage is being done is crucial that will be needed to take local people and communities to support the project. [*Interviewee U*]

Biodiversity proved to be what Karen Bakker has described as an uncooperative commodity: an entity whose biophysical, spatial and sociocultural characteristics make it resistant to commodification (Bakker, 2003, 2005). The Actor Network Theory-derived work of Callon and colleagues (Callon, 1998c, 1999) helps describe and understand the agency of biodiversity itself: Its properties and actions are unruly elements, which cause the economic objects and models to become entangled with actually existing nature. It is not just that biodiversity is not easily measured and quantified, or that the knowledge-base to do so remains uncertain; rather, biodiversity becomes a political actant in its own governance, resisting being moved for the sake of the functioning of the market. In doing do, nature presides over a crucial power shift, from the promoters of the market approach to governing biodiversity to local planners, whose stated preference is for a more nuanced, locally embedded form of governance of nature.

A hybrid new governance regime?

The case of the biodiversity offsets pilot in England illustrates how, even in an economic experiment starting from first principles, the development of a metrological and calculative regime did not succeed in eliminating political resistance. The 'anti-politics machine' – deploying technical knowledge to subsume political disagreement (Barry, 2002) – proved ineffective in cooling down the situation, resulting in continuing political disagreement about how a new governance regime built around biodiversity offsets could take root. By the end of the running of the pilots, the new governance regime based around offsetting seemed to have failed to take root. In the aftermath of the process, the government made no attempts to draft regulation requiring offsetting in all of the UK. Whatever indirect indications have emerged suggest that the political momentum behind the idea of biodiversity offsetting has all but disappeared. For example, in their response to an EU consultation on the potential application of the concept of no net loss across Europe, DEFRA manifested reservations about the potential of biodiversity offsetting:

> There are also a number of detailed rules which would need to be settled before any offsetting system could be put in place and on which we suspect there is little consensus at present. For example: Who would operate the metric and how would consistency be ensured; how much trading up or down would be allowed; would there be restrictions on where an offset could be located; how would we ensure that offsets do not have unintended downsides (DEFRA, 2014: 2)

The reservations revolve around the lack of consensus around what constitutes an appropriate calculation mechanism to demonstrate no net loss of biodiversity (DEFRA, 2014). Due to lack of consensus around calculation, it has not been possible to successfully transform representations into standardised calculative devices, and thus create a new governance regime.

DEFRA was not the only agent attempting to develop calculative devices for the pilot biodiversity offsets market. One private company was involved in the pilot biodiversity offsets programme from its inception, with the objective of becoming an intermediary in this market, as explained by one of the company's senior executives:

> …we would like to see ourselves as the Google of the providers of these sites, or access to them. I just think that would be fantastic, if we could create a business around this [*biodiversity offsets*], and build [*the company*] into the organisation that provides all the trading infrastructure for this [*Interviewee A*]

The objective of this company was, as clearly stated, to establish itself as the *de-facto* broker for this market, but intermediating between buyers and sellers. Among the mechanisms the company pioneered in order to achieve this was the development of its own set of technologies and metrics, referred to by the interviewee as 'the trading infrastructure'. The company went about developing this by, first, adapting calculation procedures from the DEFRA metric, and, second, combining these with a suite of proprietary technologies which were designed as a calculative network. As explained by the same executive:

> ...what interests us is to convert that into a fully functioning market (…) we want the environmental consultancy community, or land audits, to be able to use a software application, which will enable them to calculate the conservation credits – or eco-credits – that a development or a land-use impact is having, and then it can automatically be uploaded to the trading platform, and then we can match it with what credits are required. [*Interviewee A*]

In developing these technologies during the pilots, the company set about creating an alternative form of making biodiversity calculable, similar in principle and execution to DEFRA's metric. Furthermore, these calculative devices were, in theory, capable of avoiding the entanglements between existing biodiversity and the politics of reforming planning: Rather than being involved in the adaptations implemented by local planners, the company sought to provide a complete service, estimating the credits biodiversity credits necessary to compensate for a developer's project, and suggesting locations where those credits could be acquired from. As of the second half of 2016, the company remained in operation, maintaining a registry of land which could be used to offset biodiversity losses elsewhere (Environment Bank, 2013b), and continuing to offer landowners the possibility of calculating the biodiversity credits their site might generate (Environment Bank, 2013a).

There is also evidence that, while biodiversity offsets appeared to have disappeared from public discussions about biodiversity governance, no net loss of biodiversity continues to be a valid policy concept. During the data collection for this research, not a single interviewee disagreed with the idea; all the objections raised were related to the specific details involved in translating the principle of no net loss of biodiversity into market practice. Furthermore, the idea of no net loss of continues to be invoked in practice: For example, National Rail built the environmental objectives for the upcoming HS2 railway around the objective of delivering no net loss of biodiversity (BBC News, 2015; Parliament UK, 2014), demonstrating the power of the idea as a driver for action. Likewise, local authorities looking to secure compensation in exchange for granting planning permission continue to be allowed to use the biodiversity metric to do so (Environment Bank, 2015). A hybrid governance regime, which protects the role of local authorities as the preeminent agents in deciding between conservation or development, but operate under the principles and calculative devices of offsetting, appears to be taking hold. While this is not the fully-fledged market for biodiversity offsets envisaged by promoters before the start of the pilots, the basic principles and market devices of offsetting

are recombining with the existing governance arrangements to produce a hybrid governance regime.

Concluding comments

The project to implement biodiversity offsetting in the UK sought nothing less than to fundamentally reorganise the relationship between the environment, the economy and society. In particular, it attempted to subordinate the governance of biodiversity to the economic imperative of efficiency, streamlining planning and helping deliver economic growth. In the event, the political project of market creation failed to account for the resistance posed by biodiversity itself: As an externality, the living, moving biodiversity proved resistant to attempts to commodify it. The most sophisticated standards of ecosystems accounting could only measure and quantify biodiversity, but failed to separate it from the restricted contexts of space and time which it depended on. These contexts are not only bio-physical – the irreplaceable habitats highlighted by critics of offsetting (Bull et al., 2013; Burgin, 2008; Devictor, 2015; Gordon et al., 2011); they refer also to the (local) political and cultural aspects which constitute important dimensions of biodiversity. The calculative devices developed proved incapable of accounting for those dimensions: They could calculate (some of) the biological components of a given ecosystem, but could not abstract or valuate the social, cultural and political dimensions of that ecosystem. Due to its complexity, biodiversity consistently resisted attempts to frame it as a commodity.

Another aspect which contributed to the failure to institute a reproducible market for biodiversity offsets in the UK was the uncertain knowledge base underpinning ecosystems accounting. Because there were no readily available ecosystems accounting standards available to policymakers, the choice was made to give local planners the opportunity to change and develop the DEFRA metric. This had an impact in terms of agency and the distribution of power among the agents involved, with local policymakers gaining the ability to change the metric to reflect local priorities and preferences, without reference to the wider market. As it became apparent that applying ecosystems accounting to the problem of conservation raised the prospect that damages to nature could be simply redistributed, making local communities worse off (Gibson, 1996; Milne, 1996a), local policymakers created alternative calculative devices, which preserved local biodiversity. Rather than hiding the possible consequences in a calculative ‘black box’, ecosystems accounting exposed the problem to local planners and environmental activists. Local policymakers used this information to avoid the ‘license to trash’ scenario.

Overall, the various aspects of market creation failed to mesh felicitously (Hébert, 2014) with the existing governance regime, as well as with each other in the economic experiment with biodiversity offsets in the UK. In their entanglements with the planning system they sought to reform and substitute, the politics, knowledge and materiality of biodiversity offsets consistently failed to gain traction. But just as importantly, the various aspects of the market project proved to be incompatible with each other: The politics demanded knowledge which did not exist in order to achieve its objectives, thus becoming irreversibly compromised; and the knowledge base and political project were at odds with biodiversity itself. Failure to align these various components into a functional assemblage impeded the development of an accepted metrological regime. However, this failure to perform economics should not be dismissed as the result of some vague historical, contextual or cultural aspects. Quite the opposite: The existing ecosystems accounting standards were not fit-for-purpose when tasked with disentangling biodiversity-as-a-commodity from physical, living nature. The ideal world of economic models and discourses could not hide the complexity of the material reality it purported to represent.

This does not mean that failure to institute a market signals the end of the project. The successful implementation of governance projects is dependent on the capacity of promoters to successfully bring together supporters and opponents of the market. These situations tend to happen in contexts where power – political as well as technical – is held by one side of the debate. But the case analysed in this paper shows a different situation, in which opposing camps all support marketisation, only disagreeing about the specifics of how it should be implemented. Because of their shared commitment to offsetting, all the groups involved hold the power and legitimacy to steer the debate in their preferred direction. In effect, because of the shared power and agency over the design of biodiversity offsetting, local planners were effectively capable of changing it to how it was implemented in practice. But conversely, this also means that the discourses and tools which were developed for the purposes of rolling out the market have a residual, continuing potential. There may be not market for biodiversity offsets in operation in the UK, and few prospects of developing one, but the principle of calculating impacts and securing compensation which results in no net loss of biodiversity according to those calculations has not disappeared. Planning in the UK is – slowly, out of the limelight of political debate – being reformed to include these principles. The impacts will, likely, be long-lasting.

The findings of this research suggest a number of avenues for future research. As markets continue to be promoted and deployed as governance mechanisms for economic life, equal attention should be paid to the reasons why they fail to take root. As argued in this paper, neither the neoliberalisation nor the performativity of economics theses present a satisfactory theory which might explain why marketisation succeeds in some situations and not in others. The answer does not appear to lie only in contestation about calculation (e.g. Callon, 1998) or in political opposition to markets (e.g. Prudham, 2004); a more deliberate focus on the assemblages of knowledge, political power and materiality – how they come together felicitously or not, and why – suggests a promising avenue for understanding how markets sometimes fail to become instituted. Likewise, the findings suggest that parts of a failed market assemblage have the capacity to continue to influence economic processes even after being dismissed as unsuitable or undesirable for governance. To understand the recombinant nature of assemblages – how ideas, devices, people and non-human entities – can circulate and impact the world is likewise a promising avenue for research. To address these issues seems likely to contribute to the understanding of marketisation and governance, as well as processes of economic transformation in general.

References

Apostolopoulou E and Adams WM (2015a) Biodiversity offsetting and conservation: reframing nature to save it. *Oryx*: 1–9.

Apostolopoulou E and Adams WM (2015b) Neoliberal Capitalism and Conservation in the Post-crisis Era: The Dialectics of 'Green' and 'Un-green' Grabbing in Greece and the UK: The Dialectics of 'Green' and 'Un-green' Grabbing. *Antipode* 47(1): 15–35.

Ascui F and Lovell H (2011) As frames collide: making sense of carbon accounting. Milne MJ (ed.), *Accounting, Auditing & Accountability Journal* 24(8): 978–999.

Bakker K (2003) *An Uncooperative Commodity: Privatising Water in England and Wales*. Oxford: Oxford University Press.

Bakker K (2005) Neoliberalizing nature? market environmentalism in water supply in England and Wales. *Annals of the Association of American Geographers* 95(3): 542–565.

Barnett C (2005) The consolations of 'neoliberalism'. *Geoforum* 36(1): 7–12.

Barry A (2002) The anti-political economy. *Economy and Society* 31(2): 268–284.

Barry A and Slater D (2002) Introduction: the technological economy. *Economy and Society* 31(2): 175–193.

Baumol W and Oates W (1988) *The Theory of Environmental Policy*. 2nd ed. Cambridge; New York: Cambridge University Press.

BBC News (2015) Battlefields, graveyards and forests in HS2's firing line. *BBC News - Regions*. Available from: http://www.bbc.co.uk/news/uk-england-34765616.

BBOP (2012a) *Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets*. Washington D.C.: Business and Biodiversity Offset Programme.

BBOP (2012b) *Standard on Biodiversity Offsets*. Washington D.C.: Business and Biodiversity Offset Programme.

Birch K and Siemiatycki M (2015) Neoliberalism and the geographies of marketization: The entangling of state and markets. *Progress in Human Geography*.

Bonnie R and Wilcove D (2008) Ecological considerations. In: Carroll N, Fox J, and Bayon R (eds), *Conservation & Biodiversity Banking, A Guide to Setting Up and Running Biodiversity Credit Trading Systems*, London: Earthscan, pp. 53–68.

Brenner N, Peck J and Theodore N (2010) Variegated neoliberalization: geographies, modalities, pathways. *Global Networks* 10(2): 182–222.

Breslau D (2013) Designing a market-like entity: Economics in the politics of market formation. *Social Studies of Science* 43(6): 829–851.

Bryman A and Bell E (2007) *Business Research Methods*. 2nd ed. Oxford: Oxford University Press.

Bull JW, Suttle KB, Gordon A, et al. (2013) Biodiversity offsets in theory and practice. *Oryx* 47(3): 369–380.

Burgin S (2008) BioBanking: an environmental scientist's view of the role of biodiversity banking offsets in conservation. *Biodiversity and Conservation* 17(4): 807–816.

Caldecott B and Dickie I (2011) *Habitat banking: scaling up private investment in the protection and restoration of our natural world*. eftec, Climate Change Capital ThinkTank.

Callon M (1998a) An essay on framing and overflowing: economic externalities revisited by sociology. In: Callon M (ed.), *The Laws of the Markets*, Oxford: Blackwell Publishers, pp. 244–269.

Callon M (1998b) Introduction: the embeddedness of economic markets in economics. In: Callon M (ed.), *The Laws of the Markets*, Oxford: Blackwell Publishers, pp. 1–57.

Callon M (1998c) *The Laws of the Markets*. Oxford: Blackwell Publishers.

Callon M (1999) Actor-network theory - the market test. In: Law J and Hassard J (eds), *Actor Network Theory and After*, Oxford: Blackwell Publishers, pp. 181–195.

Callon M (2007) What does it mean to say that economics is performative? In: MacKenzie D, Muniesa F, and Siu L (eds), *Do Economists Make Markets? On the Performativity of Economics*, Oxford: Princeton University Press, pp. 311–357.

Callon M and Muniesa F (2005) Economic markets as calculative collective devices. *Organization Studies* 26(8): 1229–1250.

Carrington D (2013) Biodiversity offsetting proposals 'a licence to trash nature'. *the Guardian*. Available from: http://www.theguardian.com/environment/2013/sep/05/biodiversity-offsetting-proposals-licence-to-trash (accessed 6 September 2013).

Castree N (2008) Neoliberalising nature: the logics of deregulation and reregulation. *Environment and Planning A* 40(1): 131–152.

Castree N (2011) Neoliberalism and the biophysical environment 3: putting theory into practice. *Geography Compass* 5(1): 35–49.

CEP (2013) *Evaluation of the Biodiversity Offsetting pilot phase - WC1051*. London: Collingwood Environmental Planning. Available from: http://randd.defra.gov.uk/Document.aspx?Document=11689_WC1051-SummaryEvaluationoftheBiodiversityOffsettingPilotInterimReport.doc.

Crowe M and ten Kate K (2010) *Biodiversity Offsets: Policy Options for Government*. Washington, D.C.: Business and Biodiversity Offset Programme.

DEFRA (2010) *An invitation to shape the Nature of England - Discussion Document*. London: Department for Environment, Food and Rural Affairs.

DEFRA (2011a) *Biodiversity offsetting. Guiding principles for biodiversity offsetting*. London: DEFRA. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/218681/110714offsetting-guiding-principles.pdf.

DEFRA (2011b) *Mainstreaming sustainable development – the Government's vision and what this means in practice*. London: DEFRA.

DEFRA (2011c) *Technical paper: proposed metric for the biodiversity offsetting pilot in England*. London: DEFRA.

DEFRA (2011d) *The Natural Choice: securing the value of nature*. London: DEFRA.

DEFRA (2012a) *Biodiversity Offsetting Pilots. Guidance for offset providers*. London: Department for Environment, Food and Rural Affairs. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69530/pb13742-bio-guide-offset-providers.pdf.

DEFRA (2012b) *Biodiversity Offsetting Pilots. Information note for Local Authorities*. London: Department for Environment, Food and Rural Affairs. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69529/pb13744-bio-local-authority-info-note.pdf.

DEFRA (2012c) Piloting biodiversity offsetting. Available from: http://www.defra.gov.uk/environment/natural/biodiversity/uk/offsetting/pilots/ (accessed 25 April 2012).

DEFRA (2013) Biodiversity offsetting in England - Consultations - GOV.UK. Available from: https://www.gov.uk/government/consultations/biodiversity-offsetting-in-england (accessed 10 September 2013).

DEFRA (2014) *Request for Information: EU Consultation on No Net Loss*. London: DEFRA. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/396937/RFI7004_20141203_No_Net_Loss_Redacted__2__amended.pdf.

DEFRA and ONS (2014) *Principles of ecosystems accounting*. DEFRA; ONS.

Devictor V (2015) When conservation challenges biodiversity offsetting. *Biological Conservation* 192: 483–484.

Doswald N, Barcellos Harris M, Jones M, et al. (2012) *Biodiversity offsets: voluntary and compliance regimes. A review of existing schemes, initiatives and guidance for financial institutions.* Cambridge, UK; Geneva, Switzerland: UNEP-WCMC; UNEP FI.

Ecosystem Marketplace (2014) Global Species Banking - Programs. Available from: http://global.speciesbanking.com/global.php (accessed 15 April 2015).

eftec and IEEP (2010) *The use of market-based instruments for biodiversity protection – the case of habitat banking*. Technical Report, eftec.

EMTF (2013) *Realising nature's value: The Final Report of the Ecosystem Markets Task Force*. London: EMTF-DEFRA.

Environment Bank (2013a) Gain calculator. *Environment Bank*. Available from: http://www.environmentbank.com/gain-calculator.php.

Environment Bank (2013b) Register Land. *Environment Bank*. Available from: http://www.environmentbank.com/register-land.php.

Environment Bank (2013c) The Environment Bank. Available from: http://www.environmentbank.com/.

Ferreira C (2014) *Biodiversity offset markets: current challenges and prospective developments*. Coventry: Coventry University. Available from: https://curve.coventry.ac.uk/open/items/95462227-6977-437d-afae-05150ecea809/1/.

Garcia-Perpet M-F (2007) The social construction of a perfect market: the strawberry auction at Fontaines-en-Sologne. In: MacKenzie D, Muniesa F, and Siu L (eds), *Do Economists Make Markets? On the Performativity of Economics*, Oxford: Princeton University Press, pp. 20–53.

Gibson K (1996) The problem with reporting pollution allowances: Reporting is not the problem. *Critical Perspectives on Accounting* 7(6): 655–665.

Glaser BG and Strauss AL (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine.

Gomez-Baggethun E and Perez MR (2011) Economic valuation and the commodification of ecosystem services. *Progress in Physical Geography* 35(5): 613–628.

Gordon A, Langford WT, Todd JA, et al. (2011) Assessing the impacts of biodiversity offset policies. *Environmental Modelling & Software* 26(12): 1481–1488.

Grams GD (2001) Rudiments In The Use of 'Grounded Theory': A Working Guide. Working paper, Vancouver.

Hanley N, Shogren J and White B (2007) *Environmental Economics in Theory and Practice*. 2nd ed. Hampshire: Palgrave Macmillan.

Hardin G (1968) The tragedy of the commons. *Science* 162(3859): 1243–1248.

Hardin G (1994) The tragedy of the unmanaged commons. *Trends in Ecology & Evolution* 9(5): 199–199.

Hébert K (2014) The matter of market devices: Economic transformation in a southwest Alaskan salmon fishery. *Geoforum* 53: 21–30.

Holm P and Nielsen KN (2007) Framing fish, making markets: the construction of Individual Trading Quotas (ITQs). In: Callon M, Millo Y, and Muniesa F (eds), *Market Devices*, Malden, MA: Blackwell Publishing, pp. 173–195.

Howarth L (2013) A license to trash? Why Biodiversity Offsetting (BO) will be a disaster for the environment. Available from: http://www.theecologist.org/News/news_analysis/2048513/a_license_to_trash_why_biodiversity_offsetting_bo_will_be_a_disaster_for_the_environment.html (accessed 27 August 2013).

IUCN (2015) New assessment highlights climate change as most serious threat to polar bear survival - IUCN Red List. *IUCN*. Available from: http://www.iucn.org/?22167/New-assessment-highlights-climate-change-as-most-serious-threat-to-polar-bear-survival---IUCN-Red-List.

Jones MJ and Solomon JF (2013) Problematising accounting for biodiversity. *Accounting, Auditing & Accountability Journal* 26(5): 668–687.

Kosoy N and Corbera E (2010) Payments for ecosystem services as commodity fetishism. *Ecological Economics* 69(6): 1228–1236.

Latimer W and Hill D (2007) Mitigation banking: securing no net loss to biodiversity? A UK perspective. *Planning Practice and Research* 22(2): 155–175.

Lawton J, Brown V, Elphick C, et al. (2010) *Making Space for Nature: a review of England's Wildlife Sites and Ecological Network*. DEFRA.

Lehman G (1996) Environmental accounting: Pollution permits or selling the environment. *Critical Perspectives on Accounting* 7(6): 667–676.

Liverman D (2004) Who governs, at what scale and at what price? Geography, environmental governance, and the commodification of nature. *Annals of the Association of American Geographers* 94(4): 734–738.

Lohmann L (2009) Toward a different debate in environmental accounting: The cases of carbon and cost–benefit. *Accounting, Organizations and Society* 34(3–4): 499–534.

MacKenzie D (2007) Is economics performative? Option theory and the construction of derivatives markets. In: MacKenzie D, Muniesa F, and Siu L (eds), *Do Economists Make Markets? On the Performativity of Economics*, Oxford: Princeton University Press, pp. 54–86.

MacKenzie D (2009a) Constructing Emissions Markets. In: MacKenzie D (ed.), *Material Markets: How Economic Agents Are Constructed*, Oxford: Oxford University Press, pp. 137–176.

MacKenzie D (2009b) Making things the same: gases, emission rights and the politics of carbon markets. *Accounting, Organizations and Society* 34(3–4): 440–455.

MacKenzie D (2009c) *Material Markets: How Economic Agents Are Constructed*. Oxford: Oxford University Press.

Madsen B, Carroll N and Moore Brands K (2010) *State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide*. Washington, D.C.: Forest Trends.

Madsen B, Carroll N, Kandy D, et al. (2011) *2011 Update: State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide*. Washington, D.C.: Forest Trends.

Maron M, Hobbs RJ, Moilanen A, et al. (2012) Faustian bargains? Restoration realities in the context of biodiversity offset policies. *Biological Conservation* 155: 141–148.

McAfee K (1999) Selling nature to save it? Biodiversity and green developmentalism. *Environment and Planning D: Society and Space* 17(2): 133–154.

McAfee K (2012) The Contradictory Logic of Global Ecosystem Services Markets. *Development and Change* 43(1): 105–131.

McGrath M (2013) 'Licence to trash' offsetting scheme set back until Autumn. *BBC News - Science and Environment*. Available from: http://www.bbc.co.uk/news/science-environment-23502362.

MEA (2005) *Millennium Ecosystem Assessment. Ecosystems and Human Well Being: Synthesis.* Washington, D.C.: Island Press.

Miller P (2008) Calculating Economic Life. *Journal of Cultural Economy* 1(1): 51–64.

Miller P and O'Leary T (2007) Mediating instruments and making markets: Capital budgeting, science and the economy. *Accounting, Organizations and Society* 32(7–8): 701–734.

Miller P and Rose N (1990) Governing economic life. *Economy and Society* 19(1): 1–31.

Milne MJ (1996a) Capitalizing and appropriating society's rights to clean air: A comment on Wambsganss & Sanford's accounting proposal. *Critical Perspectives on Accounting* 7(6): 681–695.

Milne MJ (1996b) On sustainability; the environment and management accounting. *Management Accounting Research* 7(1): 135–161.

Monbiot G (2012) Biodiversity offsetting will unleash a new spirit of destruction on the land. *The Guardian*, 7th December. Available from: http://www.theguardian.com/environment/georgemonbiot/2012/dec/07/biodiversity-offsetting-unleash-wildlife-destruction.

Muniesa F and Callon M (2007) Economic experiments and the construction of markets. In: MacKenzie D, Muniesa F, and Siu L (eds), *Do Economists Make Markets? On the Performativity of Economics*, Princeton: Princeton University Press, pp. 163–189.

Ostrom E (1990) *Governing the commons: the evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Parliament UK (2014) The environmental aim of HS2: no net biodiversity loss. Available from: http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvaud/1076/107605.htm.

Paterson O (2013) Biodiversity Offsetting/Ecosystems Markets Task Force: 5 Sep 2013: Hansard Written Answers and Statements - TheyWorkForYou. *They Work For You*. Available from: http://www.theyworkforyou.com/wms/?id=2013-09-05a.27WS.4 (accessed 10 September 2013).

Pawliczek J and Sullivan S (2011) Conservation and concealment in SpeciesBanking.com, USA: an analysis of neoliberal performance in the species offsetting industry. *Environmental Conservation* 38(4): 435–444.

Peck J (2012) Economic geography: Island life. *Dialogues in Human Geography* 2(2): 113–133.

Pimm SL, Jenkins CN, Abell R, et al. (2014) The biodiversity of species and their rates of extinction, distribution, and protection. *Science* 344(6187): 1246752–1246752.

Prudham S (2004) Poisoning the well: neoliberalism and the contamination of municipal water in Walkerton, Ontario. *Geoforum* 35(3): 343–359.

Quétier F and Lavorel S (2011) Assessing ecological equivalence in biodiversity offset schemes: Key issues and solutions. *Biological Conservation* 144(12): 2991–2999.

Rainey HJ, Pollard EHB, Dutson G, et al. (2015) A review of corporate goals of No Net Loss and Net Positive Impact on biodiversity. *Oryx* 49(2): 232–238.

Rayment M, White A, Dickie I, et al. (2011) *Costing potential actions to offset the impact of development on biodiversity*. London: GHK Consulting Limited; DEFRA.

Robertson M (2004) The neoliberalization of ecosystem services: wetland mitigation banking and problems in environmental governance. *Geoforum* 35(3): 361–373.

Robertson M (2006) The nature that capital can see: science, state, and market in the commodification of ecosystem services. *Environment and Planning D: Society and Space* 24(3): 367–387.

Robertson M (2007) Discovering price in all the wrong places: the work of commodity definition and price under neoliberal environmental policy. *Antipode* 39(3): 500–526.

Rose N and Miller P (1992) Political power beyond the State: problematics of government. *The British Journal of Sociology* 43(2): 173–205.

Sayer A (2000) *Realism and social science*. London: SAGE Publications Ltd.

Seto KC, Guneralp B and Hutyra LR (2012) Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences* 109(40): 16083–16088.

Smith RJ (1981) Resolving the tragedy of the commons by creating private property rights in wildlife. *CATO Journal* 1(2): 439–468.

Stake RE (1978) The case study method in social enquiry. *Educational Researcher* 7(2): 5–8.

Stake RE (2000) Case studies. 2nd ed. In: Denzin N and Lincoln Y (eds), *The Handbook of Qualitative Research*, London: Sage Publications, Inc, pp. 435–454.

Strauss AL and Corbin JM (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, California: SAGE Publications Ltd.

TEEB (2008) *The Economics of Ecosystems and Biodiversity. An Interim Report*. European Communities.

TEEB (2010) *The Economics of Ecosystems and Biodiversity. Mainstreaming the Economics of Nature: a synthesis of the approach, conclusions and recommendations of TEEB.* TEEB – The Economics of Ecosystems and Biodiversity.

ten Kate K and Inbar M (2008) Biodiversity Offsets. In: Carroll N, Fox J, and Bayon R (eds), *Conservation & biodiversity banking, a guide to setting up and running biodiversity credit trading systems*, London: Earthscan, pp. 189–204.

ten Kate K, Bishop J and Bayon R (2004) *Biodiversity offsets: views, experience, and the business case*. London: Insight Investment.

Tregidga H (2013) Biodiversity offsetting: problematisation of an emerging governance regime. *Accounting, Auditing & Accountability Journal* 26(5): 806–832.

Treweek J, ten Kate K, Butcher B, et al. (2009) *Scoping Study for the Design and Use of Biodiversity Offsets in an English Context*. London: DEFRA.

UN-Stats (2012) *System of Environmental-Economic Accounting - Central Framework*. European Commission; FAO; IMF; OECD; UN; World Bank. Available from: http://unstats.un.org/unsd/envaccounting/White_cover.pdf.

Van Hoyweghen I (2014) On the Politics of Calculative Devices: Performing life insurance markets. *Journal of Cultural Economy* 7(3): 334–352.

Vosselman E (2014) The 'performativity thesis' and its critics: Towards a relational ontology of management accounting. *Accounting and Business Research* 44(2): 181–203.

Walker S, Brower AL, Stephens RTT, et al. (2009) Why bartering biodiversity fails. *Conservation Letters* 2(4): 149–157.

Wambsganss JR and Sanford B (1996) The problem with reporting pollution allowances. *Critical Perspectives on Accounting* 7(6): 643–652.

Williams J (2012) Balancing Act. *Forest & Bird*. Available from: http://www.forestandbird.org.nz/what-we-do/publications/forest-bird-magazine-article/balancing-act.

Wissel S and Wätzold F (2010) A Conceptual Analysis of the Application of Tradable Permits to Biodiversity Conservation. *Conservation Biology* 24(2): 404–411.

Wotherspoon D and Burgin S (2009) The consultant ecologist's role in the New South Wales (Australia) approach to biodiversity offsets: 'BioBanking'. *Local Environment* 14(1): 61–71.

Yin RK (2009) *Case Study Research*. 4th ed. London: Sage Publications, Inc.

Yule J, Fournier R and Hindmarsh P (2013) Biodiversity, Extinction, and Humanity's Future: The Ecological and Evolutionary Consequences of Human Population and Resource Use. *Humanities* 2(2): 147–159.