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Ecology-centred accounting for biodiversity in the production of a blanket bog

Purpose: This paper seeks to analyse the role of *ecology-centred* accounting for biodiversity in efforts to conserve biodiversity.

Design/methodology/approach: The paper examines a case study of biodiversity conservation efforts to restore a degraded blanket bog habitat. The analysis adopts a *social nature* perspective, which sees the social and the natural as inseparably intertwined in socio-ecological systems: complexes of relations between (human and non-human) actors, being perpetually produced by fluid interactions. Using a theoretical framework from the geography literature, consisting of four mutually constitutive dimensions of relations – territory, scale, network, and place (TSNP) – the analysis examines various forms of accounting for biodiversity that are centred on this blanket bog.

Findings: The analysis finds that various forms of *ecology-centred* accounting for biodiversity have rendered this blanket bog visible and comprehensible in multiple ways, so as to contribute towards making this biodiversity conservation thinkable and possible.

Originality/value: This paper brings theorising from geography, concerning the *social nature* perspective and the TSNP framework, into the study of accounting for biodiversity. This has enabled a novel analysis that reveals the productive force of *ecology-centred* accounting for biodiversity, and the role of such accounting in organising the world so as to produce socio-ecological systems that aid biodiversity conservation.

1. Introduction

The literature on accounting for biodiversity seeks to explain accounting's role in achieving biodiversity conservation (Jones, 2014a; Jones and Solomon, 2013). Studies of various forms of accounting for biodiversity have broadly conceptualised its role as being to somehow bring biodiversity into the processes of organisational decision-making, in the hope that this will encourage organisations to modify their behaviour in ways that will be conducive to conservation (Cuckston, 2013; Jones, 2014b; Rimmel and Jonall, 2013; Samkin, Schneider and Tappin, 2014).

However, accounting scholars are increasingly challenging the coherence of organisation-centred approaches to accounting for biodiversity and their potential for actually achieving

biodiversity conservation (Atkins, Atkins, Thomson and Maroun, 2015). Such approaches conceptualise biodiversity as a stock of resources upon which an organisation depends (cf. Milne, 1996; TEEB, 2010). Thus organisation-centred accounting seeks to make visible the opportunities and risks to the organisation, posed by biodiversity (Unerman and Chapman, 2014). But organisation-centred accounting encourages anthropocentric thinking so as to 'reinforce notions that businesses first not ecological systems must remain going-concerns' (Milne and Gray, 2013, p. 24). Furthermore, such thinking grossly oversimplifies the concept of biodiversity by failing to recognise the interconnectedness of human and non-human life (Christian, 2014; Gray, 2010; Hines, 1991; Lehman, 1996; Maunders and Burritt, 1991).

These concerns have led to suggestions that accounting scholars might usefully problematise the assumption that accounting must always place an organisation at its centre, as its "accounting entity" (Dey and Gibbon, 2014; Gray, Brennan and Malpas, 2014; Thomson, 2014b). Indeed, in a study of accounting for the biodiversity of a river and its surrounding catchments, Dey and Russell (2014, p. 249) explain that accounting which places the river itself at its centre represents 'a shift away from organisation-centred biodiversity accounting towards a more system-level conceptualisation of the accounting entity'. They suggest that by studying accounting that puts ecological systems at its centre (hereafter referred to as *ecology-centred* accounting), accounting scholars will more effectively be able to engage with the 'complexity and messiness' (p. 263) of biodiversity conservation efforts.

Dey and Russell's (2014) conceptualisation of *ecology-centred* accounting raises a question about the relationship between such *ecology-centred* accounts of biodiversity and the ecological system that is the accounting entity. That is, accounts of an ecological system will make this entity visible and comprehensible in particular ways, enabling particular forms of human action and intervention (cf. Hines, 1988, 1991; Miller and Power, 2013). So how do *ecology-centred* accounts of biodiversity contribute to shaping the reality of the ecological system at their centre? In terms of achieving conservation of biodiversity, then, how do *ecology-centred* accounts of biodiversity produce an accounting entity that can be acted upon in ways conducive to biodiversity conservation?

In order to answer these questions, this paper will examine a case study of a project in which conservation of biodiversity is the explicit objective. This case is a project to restore a degraded blanket bog habitat. This study will examine how *ecology-centred* accounting for biodiversity is deployed so as to make the blanket bog visible and comprehensible in ways conducive to its restoration. The conceptual shift towards understanding an ecological system as being the accounting entity requires a consequential shift in the theoretical

apparatus used to analyse the case. Thus this paper will turn to the geography literature, and to what Castree (2001) calls the *social nature* perspective, in which nature is understood to be made and shaped by human practices: that is, the social and the natural are seen to be inextricably intertwined, such that nature is understood as being comprised of socio-ecological systems (Eden, Tunstall and Tapsell, 2000; Whatmore, 2002). Specifically, the case study will be analysed using a framework, devised by Jessop, Brenner and Jones (2008), of four interconnected and mutually constitutive dimensions of socio-ecological systems. These are territory, scale, network, and place, which together comprise the TSNP framework. Thus this paper's principle contribution to the literature will be to bring the TSNP framework into the analysis of accounting for biodiversity, and to demonstrate how use of this framework can reveal the multiple roles of *ecology-centred* accounts of biodiversity in the production of socio-ecological systems in ways that conserve biodiversity.

The remainder of this paper will be structured as follows: the next section will review the literature on accounting for biodiversity; section 3 will set out a theoretical framework to guide the analysis; section 4 will outline the process of data collection and analysis, section 5 will report on this analysis; section 6 will then conclude the paper by discussing the implications of this analysis for accounting for biodiversity.

2. Accounting for biodiversity

A basic idea underpinning the study of accounting as a social practice (Hopwood and Miller, 1994) is that accounting does not simply passively record reality, but rather it actively constructs reality (Hines, 1988). Miller and Power (2013, p. 558) describe accounting as a 'productive force', playing an active role in organising economies and societies. They suggest that, despite the efforts of professional institutions to define accounting as a straightforward technical activity, 'the very idea of accounting is fluid, historically contingent, and constantly shifting … [such that] there are always pressures for new accountings' (p. 588). Accounting translates qualities into quantities so as to render phenomena comparable and calculable (Miller, 1992; Power, 2015). By making some things visible in particular ways, and keeping other things hidden, accounting creates conditions that shape how people perceive their own freedoms and possibilities (Espeland and Sauder, 2007). Thus Kornberger and Carter (2010, p. 340) offer a broad and inclusive conceptualisation:

> Accounting is the calculative practice that delineates the playing field and defines the rules of the game.

Jones and Solomon (2013) argue that it is this belief in the power of accounting to affect how people see and comprehend the world, so as to impact upon their decisions and actions, that has motivated the study of accounting for biodiversity. That is, accounts of biodiversity are not passive records of biodiversity, but rather they have an active role to play in making biodiversity conservation thinkable and possible.

A seminal effort to formulate an accounting for biodiversity, that can make visible organisations' responsibilities towards biodiversity, is Jones' (1996, 2003) natural inventory model, which requires organisations to record, value, and report on those species and habitats that are affected by their operations. That is, an organisation is expected to recognise the 'natural assets' (1996, p. 283) it controls. The expectation is that making these things visible to organisations will encourage stewardship. Jones sought to apply his natural inventory model in two case studies in which an organisation was responsible for managing an area of land with significant biodiversity values. The first (Jones, 1996) was a former limestone quarry in Wales now called Cosmeston Lakes Country Park, managed by Glamorgan County Council. The second (Jones, 2003) was a tract of land in Wales called the Ellan Valley, owned and managed by a water utility company. In both cases Jones compiled tables of information about areas of key habitats and populations of critical species. He also sought out possible ways to assign financial values to the natural assets. These included consideration of payments under agri-environmental schemes and market-use values based on revenues from farming activities and the supply of water to consumers. Jones argues 'if organisations have wider stewardship responsibility to the environment, then they should be aware of the environmental assets they own … [and] the maintenance of natural inventories represents one possible way in which they can discharge their social obligations' (p. 781). Building on Jones' work, Siddiqui (2013) has sought to compile a natural inventory of the Sundarbans mangrove forest in Bangladesh. He argues that recognition of its natural assets will aid the Bangladesh government in its duties of environmental stewardship.

Seeking to provide an exemplar for corporate biodiversity reporting, Samkin et al. (2014) study the annual reports of the New Zealand Department of Conservation. They find that the Department's reporting reflects its statutory duty to preserve the *intrinsic value* of its 8.6 million hectare estate of public conservation land. Samkin et al suggest that such a "deep-ecology" perspective, which is meant to 'guide human thought and actions towards a more harmonious coexistence with nature' (p. 556) could actually be 'equally applicable to corporations' (p. 556). However, van Liempd and Busch (2013) suggest that appeals to intrinsic value are unlikely to persuade policy-makers of the importance of biodiversity conservation and of the need to account for biodiversity. Instead, they argue that there is an

ethical imperative to recognise and measure the *instrumental value* of biodiversity. They suggest that failing to do so means that corporations are able to avoid responsibility for the harmful effects of their actions on biodiversity and, consequently, on the welfare of people in society who depend on the services provided by ecosystems. However, when van Liempd and Busch examine the biodiversity reporting of large corporations in Denmark they find that these corporations do not 'live up to this ethical need' (p. 865). Indeed, they find that such reporting 'is biased and focuses on PR-friendly positive examples … and ignores the measuring and reporting of any negative impacts of the company on eco-systems and biodiversity' (p. 858). Similarly, Rimmel and Jonall's (2013) study of biodiversity reporting by large Swedish corporations finds that such reporting is 'quite limited and rather general' (p. 771). To try to understand the motivations behind this, Rimmel and Jonall interview some preparers of these reports. They find that responses are consistent within Suchman's (1995) strategies of gaining, maintaining and repairing legitimacy. Another study of corporate biodiversity reporting, this time in large corporations in the UK and Germany, conducted by Atkins, Grabsch and Jones (2014), also found that a 'majority [of corporations] are reporting very little or no [biodiversity] information' (p. 237). Furthermore, what reporting there is, 'is not systematic but is dictated by … an anthropocentric approach which seeks to manage impressions' (p. 238).

Recognising that the mining industry has historically been a very significant source of harm to biodiversity, Boiral (2016) studies the biodiversity reporting of large mining corporations. He finds that such reporting is consistent with 'impression management and symbolic rather than substantive commitment on the part of organisations' (p. 756). Specifically, Boiral identifies four techniques of neutralisation used by corporations to 'rationalise, through socially acceptable arguments, the occurrence of unethical behaviour or negative impacts' (p. 752). These techniques are (i) claiming (on the basis of offsetting practices) to have a neutral or positive impact on biodiversity, (ii) denying (on the basis of an absence of identified endangered species or protected habitats) that their operations have a significant impact on biodiversity, (iii) distancing themselves from negative impacts on biodiversity (e.g. by stressing that their operations are conducted in compliance with environmental regulations), and (iv) diluting their responsibilities (e.g. by citing rising demand for mined resources as the root cause of biodiversity impacts). These neutralising techniques, argues Boiral, enable corporations to present a narrative of responsibility and accountability that is largely disconnected from their real impacts on biodiversity.

In a case study of a New Zealand mining company that has adopted Boiral's (2016) first technique of neutralisation – claiming neutral or positive biodiversity impacts – Tregidga (2013) examines the offsetting calculations that the corporation uses to arrive at its claim

that its operations result in 'no net loss of biodiversity' (p. 809). Comparing these calculations to three threatened species impacted by the company's coal-mining (including one species of snail whose entire known habitat was to become an open-cast mine), Tregidga argues that despite the company presenting the quantification and measurement of biodiversity impacts, used in its offsetting calculations, as 'straightforward and unproblematic' (p. 827), such techniques may instead be understood as mechanisms 'through which particular species and habitat destruction can be justified, or at least hidden in its accounting' (p. 827).

The inadequacies of corporate reporting to address system-level concerns like biodiversity loss (cf. Milne, 2007; Milne and Gray, 2007) lead Dey and Russell (2014) to suggest that 'organisation-centred disclosures may perpetuate, rather than reform, unsustainable organisational and societal behaviour' (p. 245). As such, they argue there is a 'need to widen the lens through which we examine accounting for biodiversity, and to situate organisation-centred [reporting] alongside other potential sources of biodiversity accounting' (p. 246). Thus Dey and Russell seek out and examine accounts that represent the biodiversity of the River Garry in Scotland in ways that advocate various possibilities for organising and regulating the use of the river within a hydro-electric scheme. Dey and Russell find that such accounts 'shift away from organisation-centred biodiversity reporting towards a more system-level conceptualisation of the accounting entity' (p. 249). That is, the river is seen to be conceptualised as the accounting entity in a way that highlights contestations over the management of this ecological system. Dey and Russell's work suggests that researchers who are interested in engaging with what they call the 'complexity and messiness' (p. 263) of efforts to address the challenges of biodiversity loss might usefully seek to study accounts of biodiversity that are centred, not on organisations, but on ecological systems.

One such study of *ecology-centred* accounting for biodiversity is Thomson's (2014a) examination of the various biodiversity indicators used by the UK government to assess its progress against commitments made under the United Nations Convention on Biological Diversity. Thomson finds that these indicators have co-evolved with national and international strategies for biodiversity governance. Aware of the dangers of over-simplifying the complexity of biodiversity, the UK Government appears to be utilising a growing basket of indicators, which 'incorporates more dimensions of biodiversity into biodiversity governance and accountability practices' (p. 167). Thomson suggests that corporations can draw on this approach to biodiversity accounting, so as to develop robust and credible systems for managing the risks and opportunities arising from corporate impacts on biodiversity.

Another, very different, *ecology-centred* approach to accounting for biodiversity is examined in Cuckston's (2013) study of a project to conserve a tropical forest ecosystem in Kenya called the Kasigau Corridor. An accounting for the forest in terms of its biomass, and the consequent carbon content, enabled the project to be financed through the voluntary carbon emissions trading markets by selling carbon offsets to companies wishing to claim they are "carbon neutral". Cuckston suggests that accounting for the world's tropical forests in this way, so as to be able to finance their conservation, could help stem devastating biodiversity loss, including the extinction of forest-dwelling species.

In stark contrast to the reductionism of biodiversity indicators or accounting for forests in terms of biomass, Christian (2014) offers what he calls a "deep-ecology" perspective that recognises people's interconnectedness with nature. Christian traces the efforts of volunteer conservationists as they record and report the health of particular populations of species in their local environment. He suggests that Jones' (1996, 2003) natural inventory model could be adapted to compile accounts of biodiversity at a community level. However, rather than seek out monetary valuations of biodiversity, Christian argues that such accounts should reflect communities' lived experiences of biodiversity and could 'include poems, photographs, pictures and stories from local individuals' (p. 141). The idea is to connect people with the biodiversity around them, so as to encourage them to speak up for it and to try to protect it. That is, to create a 'sense that these [habitats and species] are community assets and thereby build a discourse that accepts nature, in all its diverse forms, as part of everyone's life' (p. 142).

How are we to make sense of these (and presumably numerous other) varying forms of accounting for biodiversity? If, as suggested by Dey and Russell (2014), researchers should seek out *ecology-centred* accounts of biodiversity, and study their role in real conservation efforts, then how can we bring structure and sense to such an enquiry? How can we understand *ecology-centred* accounting for biodiversity as being a productive force (cf. Miller and Power, 2013) that acts upon ecological systems? What does it mean for an ecological system to be an accounting entity? This is the subject of the next section.

3. Social nature

Twenty years ago, Milne (1996) set out what he called a 'framework of analytical approaches to environmental resources within which to view existing and future accounting developments' (p. 135). Four approaches to what is, basically, *accounting for nature* were identified. These were (i) no accounting for nature, (ii) accounting for externalities, (iii)

accounting for sustainability, and (iv) non-accounting for nature. Each of these approaches sees nature, and the challenges it presents for organisations, in different ways.

The “no accounting for nature” approach sees nature as a source of abundant raw materials. For example, a forest may be seen to be an abundant source of lumber for producing construction materials. Nature itself is not accounted for until it is combined with human labour to make valuable goods. This is the dominant approach to nature prevalent in most financial accounting and management accounting practice. At the other end of the spectrum, the “non-accounting for nature” approach also stipulates that nature is not accounted for, but for very different reasons. That is, this approach emphasises nature’s intrinsic value, which is said to be the value of nature in and of itself, independent of human preferences. Any accounting for nature is, therefore, ‘a demeaning exercise’ (p. 153) that will necessarily fail to capture nature’s essence and will likely undermine humanity’s deep connection with nature (see also Cooper, 1992; Hines, 1991). Milne (1996), however, suggests that a non-accounting approach presents little in the way of potential for actually addressing environmental problems: ‘there is always a danger that such a posture may in fact lead to no action at all’ (p. 153).

Between these two extremes lie two approaches that advocate some form of *accounting for nature*. “Accounting for externalities” recognises that organisations are dependent on the limited resources of their natural environment. Thus organisations should be encouraged to account for their impacts upon these environmental resources, either descriptively or using non-market valuation techniques to ascertain the costs of these impacts in terms of the loss of what has been termed ‘natural capital’ (p. 146). Milne suggests that this approach aims for a more efficient use of environmental resources, but that the actions encouraged by this approach ‘are not necessarily sustainable solutions’ (p. 146). Conversely, an “accounting for sustainability” approach, Milne argues, recognises the stress placed on ecosystems by ‘unrestrained economic exploitation’ (p. 146), such that constraints are needed in order to ensure that future generations are not deprived of environmental resources. An accounting is therefore required that modifies economic thinking such that it is ‘constrained directly by ecological values’ (p. 149). However, translating this idea to the organisational level is highly problematic (cf. Gray, 1992). The stresses on ecological systems are likely to be aggregated as numerous organisations exploit a common source of environmental resources. Thus, ‘businesses alone are not capable of providing the necessary information systems to implement sustainability’ (Milne, 1996, p. 151).

> Sustainable outcomes require the rationing of scarce ecosystem capacities, and the presumption of such an approach is that the ecosystems are the going concerns, not the economic project' (p. 152).

Developments in the practice of *accounting for nature* in the twenty years since Milne (1996) specified this framework have borne out the fundamental difficulties with trying to devise an "accounting for sustainability". The notion of sustainability is claimed for projects such as the Global Reporting Initiative (GRI) and Integrated Reporting. These, however, much more closely resemble "accounting for externalities" as they are concerned with recording the impacts of organisations upon environmental resources. Indeed, Milne and Gray (2013) forcefully argue that such efforts present the concept of sustainability in ways that suggest it is 'a myopic and inwardly focussed concern largely bereft of ecological understanding' (p. 24). Thus, 'concern for ecology has become sidelined' (p. 13), so as to 'reinforce notions that businesses first not ecological systems must remain going concerns' (p. 24). Furthermore, Gray (2010) suggests that what we now call "accounting for sustainability" is a misnomer:

> It is increasingly well established in the literature that most business reporting on sustainability and much business representative activity around sustainability actually have little, if anything to do with sustainability … Sustainability is a systems-based concept and, environmentally at least, only begins to make any sense at the level of eco-systems and is probably difficult to really conceptualise at anything below planetary and species level. So whatever else organisational 'accounts of sustainability' are, they are probably not accounts of sustainability (p. 48).

Understanding nature as a source of environmental resources for human exploitation leads to a focus on the needs of humans and human organisations, rather than the implications of exploitation upon ecological systems. This "accounting for externalities" approach, which seems to dominate contemporary efforts to account for nature, reflects what the geographer Noel Castree (2001) calls a "people and environment" perspective. That is, nature is seen as being something separate from, and external to, human society. A "people and environment" perspective is unlikely ever to be able to foster accounting for sustainability because ecological systems are seen as important only in terms of the resources they provide to humans. Ecological systems themselves are understood as being "natural" phenomena that lie outside the concern of human organising and accounting. But, in a world of agriculture, aquaculture, forestry, and landscape management, it is becoming increasingly difficult to draw a clear line between the human world of society and the non-human world of nature. In geography – a discipline that has made the study of the society-

nature nexus its essential fulcrum (Ginn and Demeritt, 2009) – this recognition of the interconnectedness of society and nature has led researchers to adopt what Castree (2001) calls a *social nature* perspective. This is the idea that nature is inescapably social:

> … the social and the natural are seen to intertwine in ways that make their separation – in either thought or practice – impossible (Castree, 2001, p. 3).

The *social nature* perspective comprises two distinct but related ideas: firstly, that our concepts of nature – the ways that we know and understand nature – are socially constructed and, secondly, that we humans play a very significant role in actually producing nature in a material and physical sense (Demeritt, 2002). This second, material and physical sense, in which nature is produced, in large part, by human actors, is linked to an idea from the Earth sciences: that is, the immense impact of humanity upon Earth's biosphere has led researchers to suggest that our current epoch might be termed the *Anthropocene* (Crutzen, 2002). This understanding that human society and non-human nature are inseparably entwined has important implications for how we can think about the possibilities of a role for accounting in sustaining ecological systems. This is because, within a *social nature* perspective, nature is comprised of socio-ecological systems: hybrid systems that exist as co-productions of human and non-human actors (Whatmore, 2002; Whatmore and Thorne, 2000). Thus human actions are understood as being integral to sustaining socio-ecological systems (Bakker and Bridge, 2006). Furthermore, accounts of nature, which construct human understandings of nature, will make particular kinds of human action within socio-ecological systems thinkable and possible. As such, socio-ecological systems may be understood as being within the realm of human organising. Within a *social nature* perspective, therefore, *ecology-centred* accounting for biodiversity may be seen to construct its accounting entity in particular ways, rendering a socio-ecological system visible and comprehensible in particular ways, which in turn enables particular forms of action: particular forms of organising. Whilst the accounting literature has examined and theorised accounting's role in organising people (Miller and Power, 2013), the extant literature has not theorised how accounting can organise non-human life within socio-ecological systems. For a theoretical framework that can explain this productive force of *ecology-centred* accounting for biodiversity, we can look again to geography and, in particular, to the ways that the production of socio-ecological systems has been theorised using an ontology of spatial relations.

Relational ontology: TSNP

A *social nature* perspective demands an ontology that can cope with the dynamic, fluid character of a reality that is being perpetually produced by interacting human and non-human actors (Anderson, 2009). Geography has long been understood to be the study of space, in much the same way that history is the study of time (Massey, 2005). But a lack of a clear delineation between social and natural realms throws into doubt conventional notions of space as a kind of fixed container in which things happen. Space, it seems, in a world of *social nature*, is not something that just passively exists but rather it is something that is actively produced:

> This thinking marks a rejection of a static ontology of 'being-in-the-world' … and an embracing of a more emergent and emerging ontology of 'becoming-in-the-world' (Anderson, 2012, p. 573).

Geographers refer to this as their *relational turn*, whereby space – the fundamental stuff of geography (Thrift, 2009) – has become understood to be a product of dynamic *relations* between things in the world:

> Space does not exist as an entity in and of itself, over and above material objects and their spatiotemporal relations and extensions. In short, objects *are* space, space *is* objects, and moreover objects can be understood *only* in relation to other objects – with all this being a perpetual becoming (Jones, 2009, p. 491, emphasis in original).

Thus socio-ecological systems are studied as complexes of spatial relations, being always created and reinvented as humans and non-humans interact in myriad ways. The relational turn has spawned diverse streams of theorising as researchers have sought to understand the character of spatial relations. In an effort to stem the fragmentation of relational theorising, Jessop et al. (2008) devised what has become an influential framework comprising four interconnected and mutually constitutive dimensions of spatial relations. These are: *territory*, *scale*, *network* and *place*. These are not different kinds of relations, but rather they are complementary ways of thinking about the spatial relations constituting any specific socio-ecological system.[4] These dimensions, collectively comprising the TSNP

[4] This is analogous to the way that physicists think about light. Sometimes it is useful to think of light as a wave, and sometimes as a particle. These two ways of thinking about light help us to comprehend its reality.

framework[5], encourage the adoption of a multi-dimensional perspective in analyses of socio-ecological systems.

The TSNP framework offers a way to structure an enquiry into how *ecology-centred* accounting for biodiversity produces an accounting entity that makes socio-ecological systems visible and comprehensible in ways that can enable action to conserve biodiversity. That is, TSNP can guide an analysis of the different kinds of relations between human and non-human actors that are produced by different forms of *ecology-centred* accounting for biodiversity. The following four subsections will explain the four dimensions of TSNP and connect them to work in the accounting literature, including accounting for biodiversity. The aim is to show how each of the four dimensions of TSNP raises questions concerning the role of *ecology-centred* accounting for biodiversity in making biodiversity conservation thinkable and possible.

Territory

The relational turn represents a movement from a fixed, static ontology, whereby spatial configurations provide the setting in which things and practices occur, towards a fluid, dynamic ontology whereby things and practices are understood to actively produce the spatial relations comprising reality. Within a static ontology, a territory has been understood to be a bounded area of the Earth's surface that is controlled by some sovereign authority, such as a nation state (Clark, 2003). With this understanding, geographers have concerned themselves with the causes and implications of particular territorial configurations in terms of resources and strategic advantages that derive from territorial control (Sack, 1983). The relational turn has seen a movement from the study of particular territorial configurations towards processes and practices of territorialisation (Murphy, 2012). Taking inspiration from animal ethology, in which animals are seen to perpetually act to set out and reinforce their territories (e.g. scenting, displaying, calling, fighting), and in which the territories being produced are frequently overlapping and shifting over time, geographers have turned their attention to all manner of human territorialising practices (Delaney, 2005). Jessop et al. (2008) describe territorialising practices as the making of 'inside/outside divides' (p. 393): practices that differentiate those things that constitute the "*inside*" of a territorial space from those things that constitute the "*outside*" (that is, a territory's environment).

[5] The order is arbitrary. Jessop et al (2008) refer to TPSN.

> Territoriality as a system of relations is also a system of exchanges and consequently a system of flux of all sorts between exteriority (the physical environment) and alterity (the social environment) (Raffestin, 2012, p. 129).

Territorialising practices may be seen to be central to efforts to conserve biodiversity in a world of socio-ecological systems (Lorimer, 2012). An example is Atchison and Head's (2013) study of invasive plant management in northwestern Australia. Atchison and Head examine the practices of "weed managers" in their efforts to fight what they call their 'war against weeds' (p. 964). Such practices, including quarantine procedures for livestock (to try to prevent the spread of seeds in their fur, hooves and dung), vehicle inspections and wash stations, and herbicide spraying, perpetually produce a 'front line' (p. 954): a border between those apparently native plants that constitute northwestern Australian ecology and those invasive species that do not belong there.

Another example is Frediksen's (2016) study of efforts to conserve wildcats in Scotland. The biggest threat to the wildcat species is interbreeding with feral domestic cats. Observing the practices of identifying and neutering feral and "hybrid" cats, Fredriksen sees these as ways of 'separating out valued lives to be fostered from unvalued ones to be left to die or even actively eliminated' (p. 691). He notes that wildcats and feral cats fill the same ecological niche, but that feral cats are 'seen as out of place in the 'wild' and thus framed as threats to the preservation of 'pure' Scottish wildcats and the 'native' Scottish landscape' (p. 694). When asked to explain their hostility to feral and hybrid cats in the Scottish Highlands, conservationists simply argued that 'they're not *supposed* to be in that environment' (p. 694, emphasis in original).

> In the case of Scottish wildcat conservation, the pursuit of 'native' Scottish biodiversity involves the attempt to stamp out 'non-native' feral cats and the hybrids that muddle these categories (p. 701).

Both Atchison and Head (2013) and Fredriksen (2016) illuminate ways that conservation in the Anthropocene – the era of socio-ecological systems – means making choices about the desirable composition of these socio-ecological systems and deploying various kinds of practices to create inside/outside divides that define these socio-ecological systems as the particular forms of "nature" that are valued and that must be conserved.

Within the accounting literature, accounting has been conceptualised as a territorialising practice that delineates economic entities (Miller, 1992; Miller and Power, 2013). That is, accounting practices can be seen to divide up complex arrangements of human activities into discrete observable units, such as companies, groups of companies, divisions,

departments, production lines, service centres and such like. In doing so, accounting defines boundaries around spaces in which some things are included and others excluded from an entity's economic decision-making processes (Hopwood, 1992; Miller and O'Leary, 1987). Indeed, organisation-centred accounting for biodiversity, such as biodiversity-related corporate reporting, can be seen as a way of shifting the territorial boundaries of organisations so as to bring things inside economic decision-making that were previously excluded. Certainly, Jones' (1996, 2003) natural inventory model can be seen as a way of using accounting as a territorialising practice to define new boundaries around an organisation so as to include so-called "natural assets" that would normally be excluded and seen as simply part of an organisation's environment. However, if the accounting entity is not a human organisation, but a socio-ecological system, then what does it mean for accounting to act as a territorialising practice? In a world of *social nature*, how does *ecology-centred* accounting for biodiversity produce an accounting entity with inside/outside boundaries? And how might such territorialising of socio-ecological systems contribute to making biodiversity conservation thinkable and possible?

Scale

Within a static ontology, scale has been understood to be a level of representation of reality (Clark, 2003). Thus geographers could analyse reality by unproblematically referring to the "global", "national", "regional", or "local" scales. The relational turn has seen a movement whereby geographers have gone from assuming the existence of various fixed hierarchical levels of reality towards seeking out the practices that actually produce scalar hierarchies (Marston, 2000; Moore, 2008). An example might be to investigate those practices that enable a corporation to claim that it is a global corporation or, indeed, a local one (Herod, 2009). Like with territorialisation, the relational approach to scale has drawn inspiration from ecology (Neumann, 2009). Here, scale has been conceptualised in terms of the kinds of interactions between actors that are possible: so, for example, a pond-skater and an elephant interact with a puddle very differently and can be said to operate at different scales (Sayre, 2005). This overlapping, changeable, messy conceptualisation of scale, whereby 'scales are conceived of in terms of a process rather than fixed entities' (Herod, 2009, p. 221), has led to claims that scale has become too slippery a concept to be useful (e.g. Brenner, 2001). Perhaps most notably, Marston, Jones and Woodward (2005) argue that 'scholarly positions on scale are divergent in the extreme' (p. 416), such that the concept of scale carries too much conceptual baggage and should be removed from the geographical lexicon. Instead, they suggest that geographers can achieve greater clarity if they simply

speak of practices that ‘function as an ordering force’ (p. 425). Whilst Jessop et al. (2008) acknowledge the controversy over the terminology of scale, they include the notion of scale in their TSNP framework to denote what they call practices of ‘hierarchization’ and ‘vertical differentiation’ (p. 393).

Within the accounting literature, accounting has been studied as a practice that creates various forms of hierarchical ordering. That is, the quantification and commensuration of qualities creates hierarchical relations between entities that may previously have been unrelated (Espeland and Lom, 2015; Espeland and Sauder, 2007). In a study of city ranking devices, Kornberger and Carter (2010), for example, examine the ways that the quantification of various qualities, by such devices, creates a hierarchical ordering whereby cities have become related in terms of certain measures of their performance. Furthermore, this hierarchisation, and the consequent ‘dynamics of improving or declining’ (p. 332) in the rankings, has created conditions that have shaped the strategising and the possibilities for action of city managers as they seek to compete in the rankings game.

Similarly, the accounting for tropical forest conservation, studied by Cuckston (2013), can be seen to be an ordering practice that has created possibilities for action. The quantification of tropical forest conservation in terms of carbon emissions reductions has made the conservation project commensurable with numerous other kinds of carbon trading projects. This forest conservation project has thus become hierarchically related to these carbon trading projects, in the sense that these projects can be differentiated in quantitative terms (that is, in terms of the number of tonnes of carbon emissions reductions they achieve). Accounting for the tropical forest in this way, therefore, has enabled the conservation project to access carbon trading finance, which has provided an economic impetus for the conservation work and, indeed, has made the conservation work financially feasible. That is, this particular ecology-centred accounting has produced an accounting entity – the tropical forest – that is related to other entities (carbon trading projects) in a hierarchically ordered way, and this has opened up an opportunity for driving biodiversity conservation.

Are there other ways that *ecology-centred* accounting for biodiversity can act as a hierarchical ordering practice? In a world of *social nature*, how does *ecology-centred* accounting for biodiversity produce an accounting entity that is hierarchically related to other such entities? And how might hierarchical ordering of socio-ecological systems contribute to making biodiversity conservation thinkable and possible?

Network

Within a static ontology, the concept of network has been understood in the geography literature to be a set of nodes that are linked together by some kind of connecting medium (Clark, 2003). Examples of such networks are railway networks, road networks, telecommunications networks and so forth. Geographers have concerned themselves with studying the characteristics of such networks and their social, political and economic effects (Taaffe, Gauthier and O'Kelly, 1996). The relational turn in geography has seen a shift whereby researchers have been importing ideas from Callon (1986, 1998) and Latour's (1987, 2005) actor-network theory: seeing networks more as emergent assemblages of interconnected entities that collectively acquire new capacities – new agency – to act upon the world. Callon's (1986) concept of free association, which stipulates that an 'observer must abandon all a priori distinctions between natural and social events' (p. 199) has inspired researchers to conceptualise socio-ecological systems as assemblages of interacting human and non-human actors. Whatmore (2002) describes these as hybrid realities, collectively co-produced by the perpetual interactions of human and non-human actors. A seminal example of this was provided by Eden, Tunstall and Tapsell's (2000) analysis of efforts to return the river Cole in the UK to a "natural" state. Eden et al 'tell a story about river restoration as the intertwining of social, scientific, technological, and natural actors' (p. 257). Using Latour's (1987) concept of a centre of calculation[7], their analysis focuses on the role of a design document for the restoration project – a "vision plan" – which 'translated the diversity of actors – natural, social, political, technological – into the centre' (Eden et al., 2000, p. 267) such that the interests of these diverse actors, including the interests of the river itself (understood in terms of patterns of water flow, erosion, vegetation colonisation and such like), were aligned to bring about a new 'complex hybrid of nature and society' (p. 258). The vision plan made the river visible in specific ways to the human restorers and informed their interventions to transform this socio-ecological system.

Within the accounting literature, accounting has been extensively studied as a way to enable what Latour (1987) called *action at a distance* (see Justesen and Mouritsen, 2011). That is, accounting is seen as a method of extracting stable, mobile and combinable inscriptions from distant locations and transporting them to a centre of calculation (Robson, 1992). Thus distant sites become visible and comprehensible to people at this centre in ways that enable them to devise and implement ways of acting upon multiple distant sites simultaneously

[7] A centre of calculation is defined by Latour (1987) as a site where inscriptions are collected, combined and manipulated so as to produce abstract representations of reality.

(Miller, 1990; Neu, Gomez, Graham and Heincke, 2006). Within accounting for biodiversity, we might see the UK government's development of numerous biodiversity indicators, examined by Thomson (2014a), as an example of this network-making role of accounting. The collection of myriad inscriptions from across the country, which are accumulated centrally so as to be able to calculate these indicators, enables actors in government to see and comprehend the state and trends of UK biodiversity. That is, UK biodiversity is produced as an accounting entity that can be seen and understood in terms of a set of indicators representing various aspects of an overall picture. This constructed picture of the country's biodiversity can then be used to inform policy formation concerning the kinds of interventions needed to improve this picture.

How else might *ecology-centred* accounting for biodiversity function as a network-making practice? In a world of *social nature*, how does *ecology-centred* accounting for biodiversity produce an accounting entity that can be acted upon, *at a distance*, from a *centre of calculation*? And how might such a role contribute to making biodiversity conservation thinkable and possible?

Place

Within a static ontology, place has been understood to denote an area in space which has distinct characteristics that distinguish it from other areas of space (Clark, 2003). For example, a particular town will have characteristics that distinguish it from other settlements. Places, within this static ontology, are essentially settings that geographers can study in detail to ascertain, for example, distinct cultural practices that occur within a particular place (Castree, 2009). The relational turn in geography has seen a shift in thinking about place from this idea of a fixed location towards a notion of place as a temporary coming together of heterogeneous things and practices to form a transient convergence: 'the notion of place has changed from one that is sedentary and stable to one that is provisional and emergent' (Anderson, 2012, p. 573).

> Relational places are made up of material objects, living things, and natural processes, alongside the practices, cognitive responses, and emotions that produce and are produced by this intersection (Anderson, 2012, p. 574).

A place is thus understood as a kind of lived experience of the world. To illustrate the intrinsically fluid and transient character of relational place, Anderson (2012) analyses the *surfed wave* as a place that is produced for the lifetime of the ride. The surfed wave is a

coming together of surfer, surfboard and the sea, alongside the surfer's life history, surf culture, weather systems, swell, reef, and much more besides, all converging for a brief time to produce what one surfer describes as a 'way of being in the world' (Duane, 1996, p. 14, quoted in Anderson, 2012). That is, the surfer experiences this convergence as a feeling of being 'one with [the] sea' and thus 'intimately connected to nature' (Anderson, 2012, p. 580).

The extant accounting literature has not studied accounting's role in the production of relational place (cf. Samiolo, 2012). However, a constant feature of the study of accounting as a social practice is that accounting can act upon people in ways that affect how they experience and feel about the world (Walker, 2016). It is recognition of this aspect of accounting's power over people that seems to motivate Christian's (2014) proposal for community-level accounting for biodiversity as a way of encouraging people to document the ways that they experience biodiversity in their own lives. We might see Christian's proposal as a way of producing an accounting entity that contributes to creating a sense of place within a community: a way of making visible and comprehensible people's lived experiences of the biodiversity around them.

Might *ecology-centred* accounting for biodiversity have such a place-making role? In a world of *social nature*, how does *ecology-centred* accounting for biodiversity produce an accounting entity that facilitates the lived experience of socio-ecological systems? And how might such production of relational place contribute to making biodiversity conservation thinkable and possible?

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The TSNP framework is described by Jessop et al. (2008) as a 'starting point for theorising polymorphy' (p. 392). That is, rather than focus on only a single dimension of spatial relations, Jessop et al hope that using TSNP as a guiding heuristic will encourage researchers to recognise and study multiple ways that spatial relations are produced, so as to develop 'more concrete-complex explanations for given research objects' (p. 394). Each of the dimensions of TSNP is itself a contested concept, being interpreted by different geographers in different ways (Jones, 2009). Thus there has been no single cohesive way that TSNP has been used in the geography literature. Rather, there has been a plurality of approaches, united by a desire to investigate polymorphy in the production of spatial relations (Chettiparamb, 2013).

Whilst no previous research has used TSNP to investigate accounting, Shelton, Poorthuis, Graham and Zook (2014) applied TSNP to their investigation of 'Twitter activity in the wake of Hurricane Sandy' (p. 168)[9]. Whereas previous studies on geotagged social media postings had adopted a one-dimensional (territorial) spatiality, by simply analysing the concentration of such postings by latitude and longitude, Shelton et al sought to use TSNP to 'highlight the polymorphous and complex spatialities of user-generated content' (p. 168). They describe TSNP as 'a kind of metatheory … [that] offers a useful heuristic for thinking about the multiple spatialities of social media data' (p. 170). They argued, for example, that the patterns of concentration of social media postings regarding Hurricane Sandy were qualitatively distinct at different resolutions, implying that various *scales* of reality were emerging from the data. They also sought to identify the emergence of *place* – the 'lived dimension expressed in the qualitative information contained within these datasets' (p. 170). Furthermore, Shelton et al sought out concentrations of social media postings on Hurricane Sandy in localities other than New York City as a way to identify the *network* interconnections that have created impacts at sites that are physically distant from the immediate effects. Overall, Shelton et al. (2014) claimed that use of the TSNP framework enabled them to develop a deeper understanding of the multiple forms of spatial relations produced by social media data.

When it was first formulated, the TSNP framework encountered some criticism. Casey (2008) questions the prescription of four dimensions, no more no less. Whilst these four might represent relational thinking and theorising in geography research over the past twenty years or so, it might be that future theorists come up with other dimensions with equal or greater explanatory power as these four. Casey also challenges the apparent equivalence in status of the four dimensions, suggesting that place should, in his view, be regarded as 'more primal' (p. 403) than the other three. Conversely, Paasi (2008) takes issue with how the authors of the TSNP framework 'leave place, territory, scale, and networks open and do not conceptualize them in any specific way' (p. 408). This lack of detailed conceptualisation means that others are left with the task of figuring out how to operationalise TSNP for any particular research object: that is, the 'challenge is to make these categories perpetually useful for analysing the dynamism of the social world' (p. 409). In a similar critique, Shapiro (2008) characterises the TSNP framework as a 'more-is-better suggestion' (p. 413) that does not in itself advance understanding of specific issues and problems in geography. However, despite this initial uneasiness, geographers have broadly welcomed TSNP as a useful

[9] Hurricane Sandy hit the United States eastern seaboard in October 2012, causing a great deal of damage to the infrastructure of New York City.

catalyst for encouraging multi-dimensional thinking (Chettiparamb, 2013; Mayer, 2008; Shelton et al., 2014).

Adopting a *social nature* perspective, the present paper will use the TSNP framework as a guiding heuristic for studying the ways that *ecology-centred* accounting for biodiversity produces accounting entities that make various dimensions of relations comprising socio-ecological systems visible and comprehensible in ways that make biodiversity conservation thinkable and possible. The next section will briefly describe the process of data collection and analysis used in this study.

4. Data and analysis

In order to study the role of *ecology-centred* accounting for biodiversity in efforts to conserve biodiversity, this paper examines a case study of a conservation project which aims to restore a degraded blanket bog habitat that is situated in the Peak District National Park in the north of England. This particular conservation project was chosen as a case study that is representative of the challenges of biodiversity conservation in a world of *social nature* because the organisations managing the project – a large water company, which owns the land, and a national conservation charity[10] – explicitly recognise that biodiversity conservation in this case requires prolonged active intervention so as to 'restore the natural habitat and the plants and animals that rely on it' (United Utilities, 2016). Following Dey and Russell's (2014) challenge to researchers to seek out *ecology-centred* accounts of biodiversity used in conservation efforts, this research has sought to identify such accounts and to seek to understand their role in this conservation project, using Jessop et al's (2008) TSNP framework as a guide.

The first *ecology-centred* accounts that were identified were ecological monitoring reports produced by a consultant ecologist for the water company. These reports, available on the water company's corporate responsibility website, detail the results of ecological restoration work across a large area of the northern Peak District in England, covering various habitats. In order to refine the scope of the case study, it was decided that this case study would focus on one part of this large conservation project: the restoration of a degraded blanket bog habitat. Two monitoring reports related specifically to the blanket bog: one covering the

[10] These are United Utilities PLC and the Royal Society for the Protection of Birds respectively.

period 2006-10 (Anderson, Worrall, Ross, Hammond and Keen, 2011), and another covering the period 2006-12 (Anderson and Ross, 2013).

A close reading of these monitoring reports indicated that they were playing a network-making role: creating a *centre of calculation* from which the water company could act *at a distance* upon the landscape. A one-dimensional approach could have focussed the analysis entirely on this network-making role of this *ecology-centred* accounting for biodiversity. However, the use of the TSNP framework demands the seeking out of further dimensions. The monitoring reports referred explicitly to a classification scheme for sites of special scientific interest (SSSI) as one of the main driving forces behind the conservation project. This led to an examination of this scheme, which is part of the UK Government's Common Standards Monitoring regime, using documentation obtained from the website of the Joint Nature Conservation Committee (JNCC). This documentation comprised a descriptive account of the defining characteristics of a blanket bog habitat (JNCC, 2015a), an explanation of the Common Standards Monitoring regime (JNCC, 2015b), a UK national report on the operation of Common Standards Monitoring for habitats (Williams, 2006), and a document setting out detailed guidance on the identification and measurement of the defining attributes of upland habitats under Common Standards Monitoring (JNCC, 2009). Close reading of these documents revealed two forms of accounting for biodiversity within the Common Standards Monitoring regime – classification of habitats based on defining attributes, and a hierarchical ranking of habitat condition – that were found to play territorialising and scale-making roles respectively. Furthermore, the water company's project website referred to work being undertaken, by their partner conservation charity, on bird monitoring. Through correspondence with the water company, the (unpublished) 2015 report on this monitoring was obtained (Wilkinson and Douglas, 2015). The company also provided some (published) promotional materials that were created for public consumption and which drew on the findings of the bird monitoring report (RSPB, 2015b, 2015c). In addition, a search of the conservation charity's own website identified some further documents drawing on this bird monitoring work at the blanket bog restoration site (RSPB, 2015a, 2015d, 2016a, 2016b). A close reading of the bird monitoring report and the related promotional materials revealed these to be forms of accounting for biodiversity that were playing a place-making role.

Whilst each of the forms of accounting for biodiversity, centred on the ecology of a blanket bog habitat, could be seen to play multiple roles, the choice was made to associate each form with what was understood to be its predominant role. Thus the analysis sought to extract and synthesise coherent narratives under each of the four dimensions of TSNP, linking the identified forms of *ecology-centred* accounting for biodiversity to the theoretical

themes associated with the relevant dimension (cf. Humphrey and Scapens, 1996; Scapens, 2004). This was an iterative process, going back and forth between the empirical material and the geography literature relating to the relevant dimension of spatial relations, so as to develop theoretical explanations of the accounting, rooted in the relational ontology of TSNP. The aim was to construct a multi-dimensional picture to explain how *ecology-centred* accounting for biodiversity has been involved in this particular conservation project to restore a degraded blanket bog habitat.

5. Producing a blanket bog

Ecological restoration of a degraded blanket bog habitat is having a transformational effect on the landscape and its biodiversity. But what role has *ecology-centred* accounting for biodiversity played in these conservation efforts? The following four sub-sections will use the dimensions of Jessop et al's (2008) TSNP framework to analyse how such accounting has made the blanket bog visible and comprehensible in ways that make this biodiversity conservation thinkable and possible.

Territory

The landscape in question here is a designated site of special scientific interest (SSSI) called the Dark Peaks. Large SSSIs, like this one, are divided into smaller units that are each classified as containing a particular scientifically important feature. A feature may be a type of habitat, a particular species, or a geological formation. The characteristics of each of these features are described by a public body called the *Joint Nature Conservation Committee* (JNCC).

The Dark Peaks landscape includes three SSSI units whose scientifically important feature is that they are examples of blanket bog habitat. The degradation of this blanket bog began about 230 years ago as a result of sharp increases in air pollution (most notably sulphur dioxide – a cause of acid rain) resulting from the industrial revolution in the UK. The pollution caused a decline in bog-building vegetation species, which exposed the peat. This resulted in increased erosion, including the formation of drainage gullies, which lowered the water table, drying the peat, thus making it even more inhospitable for bog-building vegetation species. The following is an extract from the JNCC's habitat type description for blanket bog:

> Blanket bog is a wet peatland habitat that dominates much of upland Britain ... It is characteristically underlain by an expansive 'blanket' layer of peat. This develops because the climate is sufficiently cool and damp to allow peat-forming plants to grow – the litter of which decomposes very slowly under permanently water-logged conditions and gradually accumulates into a layer of peat. The peat depth and time over which it has accumulated are very variable – usually it is between 0.5 - 3m thick and dates 5 - 6000 years. (JNCC, 2015a).

For all types of SSSI, the JNCC specifies a number of specific attributes that define the scientifically important features. These attributes 'must be quantifiable and measurable' (JNCC, 2015b). That is, a good quality blanket bog habitat should have, according to the JNCC, these quantified and measurable attributes.

The quantified and measurable attributes defining blanket bog include specifications concerning the habitat's extent (i.e. there should be no decline over time in its overall area), physical structure (i.e. less than 10% of the area should be bare ground or show active signs of drainage), and the composition of vegetation. The attributes concerning composition of vegetation include specifications that there should be, in any $4m^2$ sample plot, at least six indicator species[12] present, and at least 50% of vegetation cover should consist of at least 3 indicator species. Also, less than 1% of the vegetation cover in these $4m^2$ sample plots should consist of undesirable species[13]. In addition, based on a visual estimate of as much of the feature as can be seen at a sample location, less than 1% of vegetation cover should be made up of non-native species and less than 10% of vegetation cover should be made up of scattered native trees and scrub.

The JNCC's specification of the attributes of a blanket bog habitat thus produces territorial relations of what Raffestin (2012) calls exteriority and alterity by specifying those desirable vegetative species that belong inside such a habitat, and those undesirable species that specifically belong outside it. By classifying the Dark Peaks landscape as a blanket bog, the JNCC's quantified and measurable attributes act as standards for this landscape: a set of

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[12] Indicator species for blanket bog habitat are listed by the JNCC as: andromeda polifolia, arctostaphylos spp, betula nana, carex bigelowii, calluna vulgaris, cornus suecica, drosera spp, erica spp, empetrum nigrum, eriophorum angustifolium, eriophorum vaginatum, menyanthes trifoliate, myrica gale, narthecium ossifrafum, non-custose lichens, pleurocapous mosses, racomitrium lanuginosum, rubus chamaemorus, rhynchospora alba, sphagnum spp, trichophorum cespitosum, vaccinium spp. Note that the spp abbreviation means that all species of the stated genus are included.

[13] Undesirable species for blanket bog habitat are listed by the JNCC as: agrostis capillaris, holcus lanatus, phragmites australis, pteridium aquilinum, ramunculus repens.

norms against which the landscape can be compared and evaluated. By making such a comparison, a judgement can be made to determine that this particular blanket bog is degraded, because it does not meet the quantitative standards set down for it. Ecological restoration of this landscape, then, means coaxing the landscape towards these specified norms.

Interestingly, the blanket bog habitat in the Dark Peaks landscape is a relatively recent socio-ecological system. Just 5000 years ago the area was dominated by forest. There is evidence to suggest that blanket bog began to form after these forests were cleared by humans. So the blanket bog may itself have been (in part) a product of human activity. But rather than seeking to return the landscape to the forest state it was in 5000 years ago, the JNCC's standards specify a desired state from more recent history: a blanket bog habitat, before the influence of air pollution caused it to degrade. This is a judgement: which socio-ecological norms should this landscape be evaluated against? The choice of blanket bog is not arbitrary, but it is not inevitable either.

With respect to the territory dimension of TSNP, this paper has asked how *ecology-centred* accounting for biodiversity acts as a territorialising practice that produces an accounting entity with inside/outside boundaries, and how this contributes towards making biodiversity conservation thinkable and possible. In a similar way to the practices of the weed managers studied by Atchison and Head (2013) and those of the Scottish Highlands conservationists studied by Fredriksen (2016), the JNCC standards define borders that delineate the desired forms of "nature" that are to be valued and conserved. Territorial relations are established between desirable vegetation that belongs within a blanket bog habitat and undesirable vegetation that does not belong and needs to be kept out. Organisation-centred financial and management accounting can be understood as a territorialising practice by defining what is to be included and what is to be excluded from economic decision-making (Hopwood, 1992; Miller and O'Leary, 1987). Indeed, organisation-centred accounting for biodiversity might be seen to be an attempt to extend the boundaries of organisations, such that so-called "natural assets" are brought into account in decision-making (cf. Jones, 1996, 2003). However, the *ecology-centred* accounting for biodiversity seen here defines what is to be included and what is to be excluded from a particular socio-ecological system. It produces an accounting entity that represents the specified norm for a blanket bog. In this way, the JNCC standards define what it means to restore and conserve the biodiversity of a blanket bog habitat. By making the norms for this habitat, explicit and specific, the JNCC makes clear the stewardship responsibilities of the water company, which owns the land. In a world of *social nature*, *ecology-centred* accounting for biodiversity has thus been seen here to be a territorialising practice that contributes towards making biodiversity conservation

thinkable and possible by producing an accounting entity that makes the standards for conservation visible and comprehensible.

Scale

The JNCC regularly monitors the condition of SSSI units. Each unit is assessed in terms of whether the JNCC's specified standards – the quantified and measurable attributes – for that unit's scientifically important feature are being met. With each assessment, SSSI units are classified into one of five conditions:

1. Favourable
2. Unfavourable, recovering
3. Unfavourable, no change
4. Unfavourable, declining
5. Destroyed

In order to be considered to be in favourable condition, a SSSI unit must meet all the specified standards for its scientifically important feature. Where one or more standard has not been met, meaning the condition is classified as unfavourable, a judgement is made about whether the SSSI unit is moving towards a favourable condition (recovering), is making no movement towards or away from a favourable condition (no change), or is moving away from a favourable condition (declining). Where there is no conceivable possibility of the scientifically important feature recovering to a favourable condition it is classified as destroyed.

The JNCC has powers to initiate prosecutions if it deems that land is being inappropriately managed, such that a 'SSSI isn't being cared for or is being damaged' (Natural England, 2015). In the Dark Peaks SSSI, the three units designated as blanket bog habitats were all previously classified by the JNCC as being in unfavourable condition (two were declining, one was no change). In launching the ecological restoration project, the water company that owns the land stated their intention to restore all the Dark Peaks SSSI units to a favourable condition. Whilst by 2013 none of the vegetation composition standards for SSSI condition had been achieved, the water company's monitoring reports claimed that the observed increases in coverage and diversity of vegetation clearly indicated that these units would, if assessed by the JNCC, be classified as being in an unfavourable but recovering condition.

By classifying habitats in terms of their achievement of the JNCC's standards for their type, different kinds of socio-ecological systems are rendered commensurable in terms of their

condition. This commensuration means that classifications of condition can be meaningfully accumulated and aggregated to produce accounts of the state of nature on a larger scale. So, for example, in 2006 the JNCC published its first report on the state of nature conservation areas in the UK, following its introduction of SSSI condition assessments. This report aggregated the condition assessments of 7720 SSSI habitats to present a national picture. It found that 42.0% of habitats were in a favourable condition, 23.6% were unfavourable recovering, 33.3% were unfavourable no change or declining, and 1.1% were destroyed. This national account of nature has formed the basis of a quantitative target set at a national level. The UK government has set a target that, by 2020, 95% of SSSIs will be in either favourable or recovering condition and 50% will be in favourable condition. The water company explains that 'the key driver [of the ecological restoration project] was the enhancement of SSSI condition' and suggests this will enable the company 'to meet the Government's Key Performance Indicator (KPI) target of having 95% of SSSIs in favourable or unfavourable recovering condition' (Anderson and Ross, 2011, p. 2).

With respect to the scale dimension of TSNP, this paper has asked how *ecology-centred* accounting for biodiversity acts as a hierarchical ordering practice that produces an accounting entity that is hierarchically related to other entities, and how this contributes towards making biodiversity conservation thinkable and possible. The JNCC's classification of SSSI habitats on the basis of their ecological condition acts as what Marston et al. (2005, p. 425) call an 'ordering force' that creates what Jessop et al. (2008, p. 393) refer to as 'hierarchization'. That is, socio-ecological systems are being differentiated quantitatively such that they become related by virtue of their common metric (cf. Espeland and Lom, 2015; Espeland and Sauder, 2007). This hierarchical ordering of SSSI sites creates a dynamic akin to that studied by Kornberger and Carter (2010) resulting from the ranking of cities. Although SSSI sites are not actually ranked here, they can be directly compared as being in better or worse (or equal) ecological condition. The water company, like other owners of SSSI sites, becomes subject to a kind of what Espeland and Sauder (2007, p. 3) call 'quantitative accountability', whereby someone is held accountable for their performance on the basis of a quantitative measure. The practice of classifying SSSI habitats on the basis of ecological condition produces an accounting entity that is related to other SSSI habitats in a hierarchically ordered way, such that an improvement or decline in ecological condition is made explicit and the results (or lack thereof) of conservation efforts are made starkly visible. This visibility creates an impetus for biodiversity conservation – one that appears to have motivated the efforts of the water company in this case. In a world of *social nature*, *ecology-centred* accounting for biodiversity has been seen here to be a hierarchical ordering practice that contributes towards making biodiversity conservation thinkable and

possible by producing an accounting entity that makes the performance of conservation efforts visible and comprehensible.

Network

To restore the blanket bog habitat in the Dark Peaks, the water company and conservation charity designed and implemented a number of interventions in the landscape. These interventions included:

- removal of sheep grazing, with a stock-proof fence placed around the whole area;
- application of coir rolls[14] to aid water retention;
- application of geojute[15] to stabilise steep slopes in gullies;
- application of lime, fertiliser, nurse grass seed[16], and heather brash[17].

With the exception of the removal of sheep grazing (which occurred in 2003), the interventions occurred over the winter of 2007-8.

In order to evaluate the success of these interventions in restoring a blanket bog ecology, the project set up a monitoring programme to take measurements in 2007, 2008, 2009, 2010, and 2012. A reference area was also defined, in which there would be no interventions (except for the removal of sheep grazing), so as to provide assurance that changes in the measurements could be attributed to the interventions. The monitoring programme covered measurements of hydrology, such as the water table level, and measurements of the development of vegetation in sample plots across the sites. The water company has published reports on the corporate responsibility section of its website, which tell the story of the ecological restoration through an interpretation of the hydrology and vegetation monitoring results.

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[14] Coir rolls are cylinders of compacted organic material (the fibres from the husks of coconuts) that can be placed in bodies of water to help prevent erosion and to encourage the establishment of plant-life.

[15] Geojute is a net woven from organic fibres that is used to help prevent erosion and encourage the establishment of plant-life on steep slopes

[16] Nurse grass is a mixture of grass species that are able to germinate and establish on bare peat, thus stabilising the peat so that other vegetation species can move in.

[17] Heather brash is harvested heather plants, with the seeds still attached. It is spread across bare peat to encourage the seeds to germinate and for new heather plants to establish. Using brash (rather than seeds alone) aids the germination of seeds by providing them with some protection whilst they become established.

The measurements, when aggregated across the sites (excluding the reference area), have shown a steady increase in vegetation cover and a corresponding decline in bare peat. Overall vegetation coverage went from less than 10% to nearly 90%. However, this dramatic increase in coverage is only part of a complicated story. The nurse grass accounted for more than 50% of the vegetation cover through 2008-10, but it then declined to less than 20% in 2012. This pattern was interpreted in the monitoring reports as the nurse grass performing its intended function:

> The nurse species are acting exactly as required in that they stabilise the peat quickly and then give way to locally native species (Anderson and Ross, 2013, p. 32)

Of the nurse grass, two species were found to have played a significant role in peat stabilisation. Highland Bent, a non-native species, had established early on and contributed 25% of nurse grass coverage up to 2009, but then declined rapidly to very low levels. Wavy hair-grass also increased rapidly but then persisted alongside the expansion of other bog species. This is explained in the monitoring reports as being desirable behaviour because wavy hair-grass is 'native and a normal component of dry blanket bog vegetation' (Anderson and Ross, 2013, p. 17). The monitoring also shows steady increases (up to around 20% in 2012) in heather coverage following the application of brash.

In addition to the nurse grass and heather, other species were seen to colonise the developing vegetative community. These include cottongrasses, dwarf shrubs, and bryophytes (mosses). However, dwarf shrubs consisted of only two species – crowberry and bilberry – and bryophytes were almost entirely campylopus species, which typically colonise dry bare peat. Notably, there was no colonisation of bog-building sphagnum species of bryophytes. The monitoring reports suggest that the peat was still too dry for these species and that '[o]ver time the bryophyte layer should continue to increase and diversify' (p. 34). In light of the small number of colonising bog species, the monitoring report concluded that the ecology was not yet approaching a 'blanket bog vegetation community' (p. 32).

> It will take time for a more representative blanket bog vegetation to develop more fully and it is dependent on increasing the wetness of the peat over the long term as well as stabilising the peat surface (p. 34).

The hydrological monitoring had shown an increase in the water table level in the peat such that, with continuous vegetation cover, the water table was 'recovering to a more natural position and pattern of behaviour' (Anderson et al., 2011, p. 39). However, the water table was still not high enough to support bog species and was showing volatile fluctuations in level 'which are not typical of good quality blanket bog' (Anderson and Ross, 2013, p. 35).

Overall the water table had risen in response to the vegetation cover, but not yet to the point where it could support wet blanket bog development.

The monitoring programme was acting here to create a centre of calculation: a site 'at which information is accumulated about other places, processes, entities and activities that are distant' (Miller, 1990, p. 318). Across the Dark Peaks landscape, measurements were being taken of the hydrological response (height of the water table, turbidity and colour of the water), the vegetation response (counts of different species and estimates of ground coverage), as well as of the prevailing conditions (temperature, rainfall). Thousands of individual measurements were made and recorded on a central computer system. These records were then combined in various ways to produce representations of the reality out there in the field. These representations were brought together to produce reports that tell a story of the ecological restoration. That is, meanings were being assigned to representations so as to construct a narrative concerning how the landscape was responding to human interventions. For example, counts of vegetation coverage and species composition in sample plots across the landscape, and in each of five years, were accumulated and aggregated to produce bar charts showing changes in the percentage of peat surface with vegetation cover, and the percentage of surface cover made up of individual types of vegetation: nurse grasses, dwarf shrubs, heather, cottongrass, and bryophytes. These graphs together presented a comprehensible picture of how the vegetative composition of this landscape was changing over time. This was then interpreted within the report, providing an overall narrative of the vegetation response to the project:

> The monitoring has shown that the restoration measures have largely been successful in establishing vegetation on the treated areas and in reducing the area of exposed, bare, eroding peat. Although not approaching a dry blanket bog vegetation community yet, community development is evident with more typical species beginning to colonise … A key objective of the restoration is for other blanket bog species to colonise over time into the nurse grass and heather mixture that have been sown … To date, no *Sphagnum* species have colonised in any plot during the monitoring period, the areas still being too dry for these species (Anderson and Ross, 2013, pp. 32-34).

The production of a comprehensible narrative thus made sense of the human interventions, and created the rationale for further such interventions to encourage development in the desired direction. The expectation was that increases in the level and stability of the water table and increases in the coverage and diversity of vegetation would co-develop over time to form a blanket bog ecology. However, in order to aid this process, in 2011, a decision

was made to subject some sample plots to two further interventions to try to speed up restoration. These were (i) the blocking of gullies within the peat using stones and heather bales to reduce drainage and thus aid re-wetting of the peat; and (ii) some small clumps of bog-building sphagnum mosses were reintroduced in some areas where the water table was considered sufficiently high for them to survive and spread.

With respect to the network dimension of TSNP, this paper has asked how *ecology-centred* accounting for biodiversity acts as a network-making practice that produces an accounting entity that can be acted upon *at a distance* from a *centre of calculation*, and how this contributes towards making biodiversity conservation thinkable and possible. In a way that is similar to the "vision plan" in the river restoration project studied by Eden et al. (2000), the ecological monitoring of the hydrology and vegetation here produced network relations between humans at the centre and the non-human elements of the landscape that enabled the co-production of what Eden et al call a 'hybrid world' (p. 261). The flows of information from this landscape, generated by a large assemblage of measurement devices, enabled humans to create representations of the ecological reality of the landscape, which informed their interventions and allowed them to interpret the landscape's reaction to these interventions. The restoration of the degraded blanket bog habitat is made possible by the visibilities produced by these network relations. Whilst organisation-centred accounting is used to govern organisations on the basis of accounting numbers (Miller, 2001), *ecology-centred* accounting is seen here to be used in a similar way for governing socio-ecological systems: seeing such systems through the accounting and acting on that basis. That is, this ecological monitoring of hydrology and vegetation produces an accounting entity that humans can see and understand as a system that is governable through informed interventions. In a world of *social nature*, *ecology-centred* accounting for biodiversity has thus been seen here to be a network-making practice that contributes towards making biodiversity conservation thinkable and possible by producing an accounting entity that makes the relations between actions and reactions of human and non-human components of socio-ecological systems visible and comprehensible.

Place

The conservation charity involved in the ecological restoration project conducted a series of surveys to monitor the response of moorland bird populations to the ecological restoration project. Surveys were conducted in 2005, 2007, 2009, and 2014. In each survey, 41 square plots, each 1km^2, were identified across the Dark Peaks. A surveyor walked in parallel transects, spaced 200m apart such that all points in the square were covered to within

100m. A record was made each time the surveyor identified, by sight or sound, an instance of a moorland bird species. Similar surveys were carried out at comparable sites in northern England where no ecological restoration had taken place, so as to provide a reference for comparison of trends over time. The charity's report (Wilkinson and Douglas, 2015) tells the story of birdlife in the Dark Peaks over the period of the ecological restoration.

The bird monitoring found that, of 17 species for which there was sufficient data for comparisons, abundance trends for 10 species were more positive on the Dark Peaks restoration sites than on reference sites; abundance trends for 5 species showed no significant difference compared to reference; and 2 species showed more negative abundance trends than reference. Within these numbers, the monitoring report picked out two particular cases that the charity claimed represented the success of the ecological restoration project. These were Dunlin and Golden Plover. Both species are wading birds associated with blanket bog habitats. The Dunlin increased in abundance by 775% (from a very low baseline) on the restored sites and was effectively rescued from extinction in the Peak District. The Golden Plover – an iconic moorland species with a stunning gold and black summer plumage – increased in abundance by 138%. The increases in both these species were attributed largely to the increases in insect food as a result of re-wetting and re-vegetating the dry and eroded peat. The bird monitoring was described by the water company as providing 'a useful indicator of the progress in returning the environment to a more *natural* state' (United Utilities, 2015, emphasis added).

Figure 1: Images of the golden plover (pictured) and other wading birds dominate promotional literature for the Dove Stone Nature Reserve. This particular image occupies the front page of a leaflet explaining the benefits of restoring blanket bog habitats (RSPB, 2015c). Photo credit: iStock.com/dgwildlife

This accounting for bird life within the landscape is instrumental in the production of what Anderson (2012, p. 575) calls 'relational place': a coming together of constituent parts into an assemblage and a convergence. That is, the bird monitoring provides a measure of an emergent property of this landscape – the abundance of native wading birds – arising out of the coming together of the developing vegetation and hydrology to form a single

assemblage: a blanket bog habitat. Indeed, the success of the ecological restoration, in terms of creating a viable habitat for birds, has led the conservation charity to designate the site the Dove Stone Nature Reserve (RSPB, 2012, 2015d). The charity describes its reserves as 'core areas for nature to thrive' (RSPB, 2016b). Indeed, its mission statement reads:

> Our birds and wildlife are increasingly vulnerable in a rapidly-changing world. Together, we will create bigger, better, more joined-up spaces for nature to save our wildlife, and our shared home (RSPB, 2016c).

The establishment of nature reserves is understood to be 'at the heart' (RSPB, 2015d, p. 1) of the charity's work. The charity represents these as places people can visit to connect with nature:

> As the human population continues to grow, nature reserves are becoming ever more important, both for wildlife and people. It's in these green places that everyone has the opportunity to get in touch with nature (RSPB, 2015d, p. 6).

The Dove Stone Nature Reserve is promoted by the charity as a place to see particular species of birds. Images of the golden plover, in particular, dominate the reserve website and promotional literature (see figure 1). Prospective visitors are advised as to the bird species they might encounter:

> See ravens and peregrine squabbling on the quarry cliffs. Curlews and lapwings breed on the in-bye fields, wheatears and ring ouzels on the moorland edge with golden plovers on the open moor. Dunlin may also make an appearance (RSPB, 2016a).

The bird monitoring here has enabled the conservation charity to represent the ecological restoration of the blanket bog, not only as a successful construction of an assemblage of blanket bog vegetation and hydrology, such that increased abundance of bird life is able to emerge, but also as the production of what Anderson (2012) calls convergence: it is a site at which "nature" becomes something tangible, that can be seen and felt by human beings. The representation of this ecological restoration work, therefore, as a production of a "natural" place – a place where nature can be experienced – is used to underpin and promote ongoing conservation efforts:

> Active blanket bog with Sphagnum mosses forming new peat is our long-term aim. Innovative methods for the introduction of Sphagnum are being trialled currently.

> Detailed monitoring will allow us to understand how … key bird populations respond to this recovery in the moorland ecosystem (RSPB, 2012, p. 58).
>
> This work has transformed the eroding peatlands into wetter, more diverse habitats. We are re-introducing sphagnum moss, a key feature of blanket bog, which is slowly re-colonising naturally. It will take many years to fully restore the area, but we're moving towards a natural blanket bog once more (RSPB, 2015c, p. 3).
>
> The work transformed the peatlands, and has resulted in increases in breeding waders … Although restoration is long term and much remains to be done, the blanket bogs are now moving towards a natural sphagnum-rich community once again … The experience at Dove Stone provides evidence of the potential to transform damaged upland ecosystems to improve biodiversity, … developing a more natural and diverse landscape (RSPB, 2015b, p. 4).

The charity's annual review suggests that the observed success in increasing abundances of moorland wading birds 'demonstrates how quickly nature can respond when we create the right space for it' (RSPB, 2015a, p. 8). These accounts of the biodiversity of the blanket bog, in terms of the emergence of wading birds that make the bog their home, make sense of these conservation efforts in a way that is comprehensible on an emotional, human level. "Nature" – the nature that Hines (1991) declares is her friend and a source of pleasure and peace, and the nature that Christian (2014) describes as being fundamentally interconnected with humanity – is made visible in the bird monitoring and in the accounts that are derived from it. Nature becomes something concrete: something we *feel* we must protect.

With respect to the place dimension of TSNP this paper has asked how *ecology-centred* accounting for biodiversity acts as a place-making practice that produces an accounting entity that facilitates the lived experience of socio-ecological systems, and how this contributes towards making biodiversity conservation thinkable and possible. The notion of place, as a convergence of component parts, reveals a tension at the heart of the *social nature* perspective: that nature is understood to be produced by human practices but, at the same time, nature is understood to have an agency of its own. Castree (2014, p. 707) suggests that 'nature is defined by the absence of human agency or by what remains (or endures) once human agents have altered natural processes and phenomena.' This tension is evident in the hybridity of the term *socio-ecological system*, which has here become the accounting entity. The "socio-" and the "ecological" have to come together in particular ways. But this coming together will always be transient and provisional (cf. Anderson, 2012). Within a *social nature* perspective, humans can never know nature in and of itself, but rather can come to comprehend nature through particular representations that embody its elusive

existence (Castree, 2014). *Ecology-centred* accounting for biodiversity, therefore, has a role in capturing this fleeting convergence and thus in representing, and making sense of, a nature that exists beyond human agency: a nature that humans cannot entirely grasp or control, but a nature that humans can experience and a nature that is seen and understood as precious and worthy of continued efforts to protect it. Biodiversity conservation is represented here, not as an abstract improvement in ecological condition, but rather as a concrete production of this particular *place* – the Dove Stone Nature Reserve – where people are able to witness the birdlife of a blanket bog habitat and thus experience "nature" for themselves. Indeed, the emergence of nature in this blanket bog habitat is seen and understood as being embodied in the improvements in the measures of birdlife. That is, this bird monitoring, and the accounts derived from it, have produced an accounting entity that is seen and understood in terms of a coming together of conservation efforts – a convergence of component parts of the blanket bog – such that nature, in the form of these native wading bird populations, could emerge. In a world of *social nature*, *ecology-centred* accounting for biodiversity has been seen here to be a place-making practice that contributes towards making biodiversity conservation thinkable and possible by producing an accounting entity that makes the emergence of a nature that is beyond human agency (cf. Castree, 2014) visible and comprehensible.

6. Conclusion

The accounting literature has long been troubled by the basic dilemma of how organisation-centred accounting can possibly play a role in sustaining life-supporting ecological systems (Milne, 1996; Milne and Gray, 2013). At the heart of this paper is a concern with what it means to take up Dey and Russell's (2014) challenge to shift our conceptualisation of the accounting entity away from organisations and towards ecological systems. This paper has proposed that to make sense of this conceptualisation, and thus to understand *ecology-centred* accounting for biodiversity as what Miller and Power (2013, p. 558) call a 'productive force', we need to accept a view of the world as being comprised of what Castree (2001) calls *social nature*. This is a world comprised of socio-ecological systems: hybrid realities co-produced by humans and non-humans (Whatmore, 2002). It is a world grounded in a relational ontology: an ontology whereby socio-ecological systems are dynamic, fluid becomings that are being perpetually produced by the interactions of their (human and non-human) components. This paper has adopted this relational ontology and used Jessop et al's (2008) TSNP framework as a way to guide an analysis of the ways that *ecology-centred*

accounting for biodiversity produces accounting entities that make visible and comprehensible various dimensions of the relations comprising socio-ecological systems.

In this paper, the TSNP framework has been deployed in the analysis of *ecology-centred* accounting for biodiversity used in a conservation project to restore a degraded blanket bog habitat. Using TSNP as a guiding heuristic aided the pursuit of Dey and Russell's (2014) challenge to seek out *ecology-centred* accounts of biodiversity used in conservation efforts, and facilitated the analysis of these accounts in terms of how they produce accounting entities that make various forms of relations visible and comprehensible in ways that contribute towards making biodiversity conservation thinkable and possible. The territory dimension revealed how the specification of quantified and measurable attributes for a blanket bog habitat produced a visible and comprehensible standard for biodiversity conservation. The scale dimension revealed how the classification of this blanket bog in terms of its ecological condition produced a visible and comprehensible measure of performance of biodiversity conservation. The network dimension revealed how ecological monitoring of hydrology and vegetation produced a centre of calculation from which the blanket bog could be seen and understood as a governable entity. The place dimension revealed how bird monitoring, and accounts derived from this, made the emergence of nature – in the form of wading birds native to a blanket bog habitat – visible and comprehensible, so as to underpin and promote continuing biodiversity conservation efforts.

In their problematisation of organisation-centred accounting, and their reconceptualisation of the accounting entity towards an *ecology-centred* accounting, Dey and Russell (2014) describe the accounting in their case study as "external": as being produced by actors who are outside the accounting entity (cf. Georgakopoulos and Thomson, 2008; Thomson, Dey and Russell, 2015). However, adopting a *social nature* perspective enables a different view of *ecology-centred* accounting. In a world comprised of socio-ecological systems – of hybrid productions of human and non-human actors – the actors doing *ecology-centred* accounting are very much inside the accounting entity. Such accounting is integral to the perpetual interactions between human and non-human actors that comprise socio-ecological systems. Just as a human organisation (like a company or a market) is constituted, in part, by its accounting, which creates the conditions in which its component parts act in ways that perpetuate the organisation (Hopwood, 1992; Kornberger and Carter, 2010; Skaerbaek and Tryggestad, 2010), so is a socio-ecological system constituted, in part, by the accounting of its human components.

This analysis of the *ecology-centred* accounting in the blanket bog case study can, therefore, be seen to extend the understanding of what Miller and Power (2013, p. 558) called

accounting's 'productive force'. That is, (organisation-centred) accounting has been conceptualised in the literature as a calculative practice that creates conditions in which forms of organising are made thinkable and possible (Miller, 1992; Power, 2015). But, adopting a *social nature* perspective means understanding nature as being internal to human organising (Castree, 2001). Thus *ecology-centred* accounting for biodiversity can be conceptualised as a calculative practice that creates conditions in which forms of organising of human and non-human actors into socio-ecological systems become thinkable and possible.

This conceptualisation leaves open the matter of whether any particular *ecology-centred* accounting is or is not a "good thing" in terms of conserving biodiversity. Socio-ecological systems can be more or less biologically diverse and contribute more or less to maintaining the integrity of the biosphere: a monoculture palm oil plantation is a socio-ecological system, as is a city, but then so is a garden or a national park (Franklin, 2006; Lulka, 2012; Mels, 2002). *Ecology-centred* accounting forms part of the equipment available to humans that grants them power over non-humans. This power can be used to further the economic interests of one or more humans, perhaps by seeking to produce a socio-ecological system that maximises agricultural output. However, if – as in the case analysed here – *ecology-centred* accounting is designed and deployed by people whose interests lie in conserving biodiversity (such as a government environmental agency or conservation charity), then this power can also be used to seek to produce socio-ecological systems that aid biodiversity conservation.

Some people understandably baulk at the premise of the *social nature* perspective, that nature is something internal to human society: to human organising. It stands in stark contrast to the conventional view of nature as a domain that is "out there" somewhere beyond the bounds of human civilisation. The conservation of nature tends to be understood in terms of protecting this domain from human encroachment (Gray, 2010). Within this view of conservation, there is no role for accounting: nature must be safeguarded against human organising (Cooper, 1992; Hines, 1991). And yet, on a planet that is increasingly understood to be entering an epoch – the *Anthropocene* – in which humanity has a profound and pervasive impact on the biosphere (Crutzen, 2002), it seems that nowhere on Earth can escape human influence. Left unchecked, this reality is highly damaging to biodiversity. Perhaps, then, the cause of conservation is best served by seeking to organise the world in ways that enable biodiversity to be maintained and enhanced. The case analysed here suggests that accounting has a role in such organising. But that role is not just to try to encourage organisations to bring biodiversity into their decision-making (Jones, 2014a; Jones and Solomon, 2013). Rather, an *ecology-centred* accounting is able, to borrow

Kornberger and Carter's (2010, p. 340) phraseology, to set the 'rules of the game' so as to make it possible for society to organise itself in ways conducive to biodiversity conservation. Indeed, if the *social nature* perspective has a normative dimension, it is that it is explicitly and specifically the responsibility of humans to seek to organise the world so as to conserve its biodiversity. Jessop et al's (2008) TSNP framework can be used to help us consider the various dimensions of this responsibility. Choices must be made about the specific socio-ecological systems to be produced (territory), about the mechanisms of accountability that will drive such production (scale), about the methods of coordination and control that enable production (network), and about the ways that nature is represented and experienced in such production (place). Humans must perpetually act to produce a world in which non-human life can thrive.

Adopting a *social nature* perspective, therefore, has fundamental implications for the study of accounting for biodiversity. The conservation of biodiversity is seen to be a dynamic, perpetual production of socio-ecological systems: an outcome of actions that seek to organise human and non-human actors in particular ways. Thus the study of accounting for biodiversity becomes the study of accounting's role in this organising. This paper has demonstrated how Jessop et al's (2008) TSNP framework can be used as a starting point for analysing the productive force of *ecology-centred* accounting for biodiversity: a heuristic for guiding thinking about how such accounting is used in the production of socio-ecological systems. That is, this paper suggests that researchers studying accounting for biodiversity might usefully import theorising from the relational turn in geography – theorising regarding territorialising, scale-making, network-making, and place-making practices – in their investigations of the visibilities and understandings of the world produced by different forms of accounting for biodiversity. Such an approach could open up myriad opportunities for crossing disciplinary boundaries between accounting and geography by using the dimensions of TSNP as common conceptual tools, thereby encouraging synergistic collaboration on issues at the heart of biodiversity conservation policy and practice. The study of accounting as a social practice and productive force offers great insight into the power of calculative practices to make and shape our lived reality (Hopwood and Miller, 1994; Miller and Power, 2013). If such insight can be turned towards efforts in biodiversity conservation, then new and beneficial ways to organise Earth's socio-ecological systems might become thinkable and possible.

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