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Ecosystem services: Tensions, impurities, and points of engagement within neoliberalism

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Abstract
Across the world, governments, NGOs, scientists, policy-makers, and resource managers are learning to speak in the language of ecosystem services. It is a concept that seems to belong to what many geographers call neoliberal-style environmental policies. However, the policies and practices around the ecosystem service concept deviate considerably from neoliberal doctrine. Our primary aim is to open up space for informed conversation about ecosystem services in geography by exploring the internal heterogeneity and tensions within the world of ecosystem service policies. In describing these debates on their own terms, we find a diverse and wide-ranging set of actors and viewpoints.

Keywords
biodiversity, conservation, ecological economics, ecosystem services, environmental policy, market environmentalism, neoliberalism

I Introduction

The project of rendering the environment as a set of economically valuable 'ecosystem services' (ES) is now well into its second decade. While the term has a heritage of use (Costanza and Daly, 1992; de Groot, 1992; Ehrlich and Mooney, 1983), it was only just over 10 years ago that ecosystem services, defined most frequently as 'the benefits humans receive from ecosystems' (MEA, 2005: v), ascended boldly into environmental policy discussions. In 1997, ecological economist Robert Costanza and his team released their oft-cited estimate of $33 trillion as the US dollar value of the world's ecosystem services (Costanza et al., 1997), and ecologist Gretchen Daily (1997) published the edited collection titled *Nature's Services: Societal Dependence on Natural Ecosystems*. Together these publications carried the banner for a movement within policy and economics that has reached the highest levels of

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global environmental governance and development policy.

Ecosystem services is at least in the vanguard of the neoliberalization of nature, if not the flagship case, but few geographers are engaging with debates around ES. This is so even though there is an increasing portfolio of work on the commodification of nature and fieldwork in actually existing neoliberalisms, in all their hybrid and impure variety (Bakker, 2010; Castree, 2008a, 2008b; Heynen et al., 2007; Larner, 2003). While analysis has targeted the market-led transformation of management and accumulation in traditional resources such as fish, timber, ore, and crops, what is arguably most distinctive about the neoliberalization of nature is the way in which it deals in *non*-traditional resources. Nature is now found frequently represented as *credits*, *information*, or *services*, purportedly unbound from material essences and free to move through global circuits of credit and finance commodities.[1] Geographers and other social scientists are beginning to draw attention to this financialization of nature (Cooper, 2010; Pryke, 2007; Smith, 2007; Sullivan, 2010), but for the most part work on neoliberal natures remains in the sector of traditional resources, with 'scant attention' to ES (Bakker, 2010: 3).

Our concern here is not to adjust this state of affairs through theoretical argument – although such a call can be found in Smith (2007). Nor are we writing to offer normative or evaluative critique of the massive global project to manage the world as a set of ecosystem services – that is far beyond the scope of such a review as this. Rather, our goal is to provide an encounter with the ES literature on its own terms, as a rich and internally conflictual arena of debate that offers many points of entry for geographers, points which we attempt to indicate along the way.

In short, it is often more enlightening to listen to the agents and elaborators of neoliberalism talk about what an internally conflicted and polyvocal project it is than to read external critics charging the same thing. We believe that neoliberalism's internal incoherencies are more interesting than its apparent coherence, and specifically we would like geographers to recognize the many possible opportunities for engagement between work in political ecology, economic geography and ES. Work on ES can avoid the fate of caricature that has bedeviled some work on neoliberalism – whereby, for example, neoliberalism is equated with the reduction of state interventions (see Brenner et al., 2010), or in which mainstream economists are thought to speak in a unified orthodoxy. We outline major frictions and discontinuities within the mainstream ES policy literature in order to understand ES as an ongoing economic and political project with considerable variability. As we show, ES does not spring from a simple narrative of marketization, and critical evaluations of ES and neoliberal nature must avoid portrayals of neoliberalism in which capitalism rolls out coordinated and univocal state policy effecting a wholesale commodification of nature.

Below, we first outline key contributions made on ES by geographers and other critical social scientists. We then explore the active debates and frictions within the mainstream ecosystem services policy regarding how exactly to measure and commodify nature. These two aims intergrade – the distinction between 'internal' and 'external' critique is never so clean in life. But following Jamie Peck and Nik Theodore's (2010) work we distinguish between work that aims to measure the 'impact' of policies and ultimately to improve them on empirical grounds and work that is not 'confined to internalist and/or positivist evaluations of state[d] aims and objectives' (p. 169), that is, work that investigates underlying assumptions and epistemological framings. In outlining fundamental disagreements in the *internal* ES policy debates, we introduce them to geographers and suggest areas of linkages with existing geographical research approaches and tools. At a more general

thematic level, the interplay between environmental variability and economic pattern has historically been of central importance to geographic study. In this sense, debates over the creation of ES markets – that is, debates over the ways in which ecological difference can drive economic transactions – are a fascinating new venue in which fundamentally geographic debates are now unfolding.

We write in part to encourage participation in policy advocacy and action research. We are concerned about the shift to market-led environmental policy and the effects it may have on local and indigenous communities, on other species, and the implications for the commodification of nature and increasing uneven development. Can those of us researching the debates and practices of ES engage in useful solidarity with the desires and political concerns of people opposing business-as-usual resource development? Can the ecosystem services concept be deployed in ways that help people in such places achieve increased autonomy and well-being without imposing a commodity logic on their resources? The answer will depend more on the hands through which the concept and the policies pass than on axiomatic arguments, and we aim to encourage more hands to take up the work, particularly in the policy literature (Peck, 1999). In lifting our gaze from individual cases to refer to an entire whole class of commodity – services, after all, being an entire conventional sector – we are also responding to Castree's (2008a, 2008b) call for geographers working on neoliberal natures to temper the diversity of empirical settings with more consideration of underlying thematic unities, and Bakker's (2010) call to also move beyond case studies, to what she terms 'the translocal', to explain the variegation of neoliberal environmental policies and practices. We are not attempting to uncover the metanarratives underlying all ecosystem service projects, nor to make a new statement on the nature of neoliberalism, but rather to search for the Archimedean points where geographers might best exert effort.

It is perhaps more accurate to say that there are not so much thematic unities in ES as shared topics of discord. ES is not a dogmatically pure discourse of efficiency, utility, and market-clearing prices: even in its origins it is clearly heterodox from a neoclassical economic standpoint. In this paper we discuss five areas of disagreement or tension to support our argument: (1) debates over whether to define ES as a standard commodity or as a heuristically useful metaphor; (2) disagreements between price-theory marginalists and index theorists; (3) questions surrounding the use of ecological information in economic models; (4) schisms over value theory and valuation techniques; and (5) tensions over the place and role of ES policy in relation to equity, development, and markets. In each of these ongoing debates, there is significant room for geographers to contribute practically, but also to further broaden understandings about the operation of the value form, the production of nature, and neoliberalization more generally. In a world that has been recast as an immense collection of services (see Robertson, 2011), this is no small task.

Moreover, these debates are expressed or (temporarily) resolved in different ways in different places. The diversity and polyphony we have found in the ES world will be familiar to any reader of the neoliberal natures literature; Bakker (2004) and Mansfield (2007) have found similar complexity in the contexts of water and fisheries policy, respectively. Following Larner's (2003) concept of hybrid neoliberalisms – or the compatible concept of 'variegated neoliberalisms' (Brenner et al., 2010) – we see that market strategy clearly hybridizes well with state strategy in ES policy-making, but we find that it also hybridizes with scientific agendas, the strategies of civil society actors, and even with the distinctly non-market impulses of traditional state Keynesianism. If ES is a conception that is not folded entirely into a totalizing capital – if it can participate in non-capitalism as well as capitalism, as Gibson-Graham (1996) put it – then spaces for

resistance are not only sequestered in overlooked or embattled counterhegemonic enclaves. Dressed in the language of science and policy debate, narratives about ES that surpass capitalism-as-usual are everywhere we look.

II The rise of ecosystem services

The notion of an ecosystem service as a coherent economic object is rooted in the development of ecological economics as a heterodox branch of economics in the 1970s (Daly, 1973; Odum, 1981). Neoclassical economic theories had maintained for decades that technical change effectively de-couples economic growth from natural resources, through substituting industrially produced resources for the resources formerly harvested from the environment. Faced with the evident irreplaceability of lost or damaged environmental features, ecological economists attacked this notion of substitutability, a bedrock principle of Marshallian economics, by arguing on ecological grounds (and, more importantly, non-utilitarian grounds) that it violated the conservation of matter and the first law of thermodynamics (Daly, 1991; Georgescu-Roegen, 1971); in other words, that there are meaningful 'limits to growth'. Ecologists and economists advocating an ES approach (e.g. Daily, 1997) argue that substitution for many ecosystem services, such as pollination or climate regulation, is impossible or economically unfeasible. Thus, ecological economists insist on the persistence of environmental externalities which cannot be substituted-for and must be internalized by being explicitly valued. They agree with mainstream economists that the acme of valuation is to discover price in a clearing market.

Thus, ES policy is potentially enormous in scope. 'Ecologists should mount a massive awareness campaign to convince society of the importance of ecosystem services and to demand the resources for their study', writes ecologist Claire Kremen (2005); 'nothing less than our human future is at stake' (p. 477). This, she posits, 'may require an investment akin to that devoted to agriculture, medicine, space exploration, or defense' (Kremen and Ostfeld, 2005: 547). Practitioners of environmental policy and science have responded in droves. First, and massively, there was the Millennium Ecosystem Assessment Project (MEA, 2005), involving over 1300 experts worldwide and funded by the United Nations Environment Programme (UNEP), the Global Environmental Facility, and several private foundations and governments. Between 2001 and 2005, the MEA assessed the conditions and trends of the world's ecosystems through an ecosystem service framework, moving the concept from 'an academic backwater to the mainstream of conservation and environmental policy' (Adams and Redford, 2009: 785).[2] The US Department of Agriculture has established an Office of Environmental Markets, with a mandate to facilitate trade in ecosystem services, and in 2009 the US Environmental Protection Agency (EPA) released guidance on the valuation of ecological systems and services (EPA, 2009). In Europe a broad, multi-phase research effort called The Economics of Ecosystems and Biodiversity (TEEB), a project of UNEP conceived by the G-7 Environmental Ministers in 2007, recently concluded, drawing attention to the global economic benefits of biodiversity and the costs of biodiversity loss (e.g. TEEB, 2008, 2009, 2010a, 2010b).

Across the world supranational entities, governments, NGOs, regional administrations, scientists, policy-makers, and resource managers are learning to think about nature-society relations in the form of services, often valued in dollars and occasionally sold as commodities. It is a concept that seems evidently to belong to the turn to neoliberal environmental policies: the governance of a former public good external to capital is now performed in markets rather than managed through regulation by a Keynesian state. Ecosystem services can also be represented on a national accounting ledger and can thus be seen to augment a

developing nation's assets, or to play a role in conditioning international aid or loans.

III Critical approaches to ecosystem services

The rise of ES, and the creation of a world seen to be composed in its entirety of 'services', involves subjecting the conditions of biological existence to economic assessment: what Foucault (2008) describes as the making of a 'permanent economic tribunal for all matters of life' (p. 247). The objects addressed in neoliberal natures research are highly varied, but usually consist of nature in the form of a familiar primary resource: timber, water, fish, or minerals (see Bakker, 2009; Castree, 2008a, 2008b; Heynen and Robbins, 2005; Heynen et al., 2007; McCarthy and Prudham, 2004). Fewer geographers have tracked the turn in which nature confronts neoliberalism as a set of services or financial commodities, rather than as a set of resource commodities, although the work on the neoliberalization of fisheries using transferable quotas moves in this direction (e.g. Mansfield, 2007). Neil Smith (2007) captures the sense that something new is afoot, arguing that emerging environmental markets in ecosystem services like water purification or carbon sequestration accomplish the capitalization of the natural world more deeply and more intensely than either extractive resource capitalism or agricultural capital, engaging nature in a form that can be fully abstracted into exchange value and financialization.

Geographers and other social scientists studying ecosystem services have largely positioned themselves as critical of neoliberalism, and are generally guided by a commitment to a Marxian analysis of commodification, a Polanyian understanding of the state as a guarantor of the dynamic equilibrium of the 'double movement' between environmental destruction and protection, and a concern for the unequal social and environmental impacts of development. McAfee and Shapiro (2010) argue that ES policies and practices in Mexico have 'little to do with development beyond the short-term transfer of payments to poor landholders' (p. 595). Sullivan (2009) draws attention to the epistemological and ontological violence of characterizing nature as a service provider, and also to the way conservation is being drawn into financial logics (Sullivan, 2010). Dempsey (2010, 2011) highlights the intractable political problems in internalizing the services provided by ES, and focuses on the ways biological diversity and ecosystem services are becoming entities of financial risk management. Robertson (2004, 2006, 2007) has focused on issues of measurement and scientific practice in defining ES as commodities.

Esteve Corbera has been one of the most prolific writers on the use of ES policies in development (Corbera and Brown, 2008; Corbera et al., 2007a, 2007b). Kosoy and Corbera (2010) argue that ES should be understood as a case of commodity fetishism in that their definition as ecological objects masks the unequal social relations embedded in the process of buying and selling ES:

> When ES are commodified, they become the basis for new socio-economic hierarchies, characterised by the re-positioning of existing social actors, the emergence of others, and very likely, the reproduction of unequal power relations in access to wealth and ... resources. (Kosoy and Corbera, 2010: 1234)

Another theme in critical work related to ES focuses on the moral and ethical issues in the pricing of nature. Vatn (2000, 2010) argues that payments for ES may 'crowd out normative obligations' (2010: 1251) and collective obligations to environmental 'goods', and is counterproductive to conservation (see also McCauley, 2006; Martinez-Allier, 2002; Rees, 1998; Sydee and Beder, 2006). Burgess et al. (1998, 2000), while not addressing ES directly, draw out the methodological challenges of the valuation strategies used in ES policy (see section IV below; see also Gibbs, 2010; Spash, 2007).

Such critical observations are not solely the preserve of academics. While some NGOs are at the fore of ecosystem service advocacy (e.g. The Nature Conservancy, Forest Trends, Conservation International), other social movements and NGOs have launched their own critiques and analysis of the concept, arguing that market-based environmental policies 'exacerbate existing inequalities; undermine alternative regulatory systems; favor those with clear land tenure; and are exceedingly difficult to participate in or benefit from for those without the necessary investment capital, expertise, education or personal contacts' (Global Forest Coalition et al., 2008: 10–11). The People's Agreement produced by the World People's Conference on Climate Change and the Rights of Mother Earth held in Cochabamba, Bolivia (April 2010), condemns market mechanisms in ES, such as those trading in carbon sequestration in tropical forests, arguing that they violate 'the sovereignty of peoples and their right to prior free and informed consent as well as the sovereignty of national States, the customs of Peoples, and the Rights of Nature'.[3]

As one NGO states, ecosystem services are 'an expression of utilitarian attitude towards biodiversity that does not take into account its intrinsic value and holistic nature' (Global Forest Coalition et al., 2008: 3). Services, in this view, simply cannot be separated from their embodiment in beings and lives (note the parallel with a Marxian critique of labor-power; see Robertson, 2011). Other academics draw attention to the ethical question of placing the burden of environmental protection on the poor, when these are precisely the people with 'much lower impact degrading ecosystem services' (Muradian et al., 2010: 1204; see also Bumpus and Liverman, 2008).

The above authors actively question the economic axioms and often Euro-centric assumptions and northern economic interests that support the commodification of ES, and suggest a range of points of engagement or entry for geographers seeking to engage in the leading edge of capital's expansion in the natural world. While we cannot mark a sharp divide between critical and 'policy-relevant' literature, much of the critical scholarship takes place at least one step removed from the forums in which ES policies are built and deployed, the circuits of 'fast policy' (Peck and Theodore, 2010) within international development institutions, national environmental agencies, and other project/policy development spaces. In the following section, we turn to tensions within these policy circuits, many of which are heated but largely seek to measure or improve the 'impact' of ES policies rather than to examine their foundations.

IV Tensions within ecosystem service scholarship

As noted above, the antecedents of ES include a rejection of certain elements of mainstream economics; this spirit of heterodoxy still infuses ES writing and thinking. Writers such as Robert Costanza pride themselves on having broken with the axioms of neoclassical economics, and some of these schisms echo work within critical resource studies in geography. Within this tradition of seeking to elaborate ES, we find five principal areas in which there are major disagreements or debates.

1 Definitions

There is substantial variation and debate over the very definition of the term 'ecosystem services'. To some economists and development planners, it is a useful heuristic covering a range of externalities: non-monetized elements of nature from which humans draw comfort and utility but which should not necessarily be treated with a calculative approach that assesses monetary value (cf. MEA, 2005). To others, the term subjects nature to the strict logic of GDP and cost-benefit analyses that feed into policy

decisions (cf. Costanza et al., 1997). Still others believe that ecosystem services are the commodities for new markets in nature and its derivatives, which will stand independently of their policy or conservation value (cf. Boyd and Banzhaf, 2007; see McAfee and Shapiro, 2010).

Strictly speaking, the economic notion of a 'service' invokes the tertiary economy of non-consumptive exchange-values and a certain distance from manufacturing and primary resource exploitation.[4] Since the terminology suggests fungible commodities, one might expect that ecosystem services are defined with the same care and discrimination that apply to traditional service commodities such as medical service or administrative service: final products that are consumed directly to increase consumer utility. But as the widely used MEA definition, given below, suggests, there is a widespread tendency to use the term in a much broader fashion. The long form of the definition casts a wide net:

> Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. (MEA, 2005: v)

Here, at least, there appears to be no actual limit on the features of the environment that are called 'services' as long as they are connected in some way to an increase in human welfare.

Critics – often economists who are accustomed to a greater precision in their terms – say the MEA's definition has an 'everything but the kitchen sink' quality (Boyd and Banzhaf, 2006: 23). For economists James Boyd and Spencer Banzhaf (2006, 2007), a great deal of what gets counted as 'services' in the MEA may in the strict sense actually be either 'goods', 'benefits', or 'functions'. This worries them, predominantly because of the confusion it causes in accounting. 'Loose definitions', write Boyd and Banzhoff (2007), 'undermine accounting systems', they 'muddy measurement and lead to difficulties in interpretation' (p. 616). Banzhaf (2005) offers a more specific terminology: *services*, to be economically meaningful and avoid double-counting, must be final products – *not* processes – that input directly into a household production function. This results in a dramatically limited definition: 'Ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being' (Boyd and Banzhaf, 2006: 8).

Note that there is no place for ecosystem *processes* in this definition of services. Thus a lake's ability to cycle nutrients or the atmosphere's ability to reduce ground-level ozone concentrations are not ecosystem services 'because they are not consumed as inputs in a (household) production function' (Banzhaf, 2005: 279). They take this definition directly from welfare accounting, in which the 'distinction between end-products and intermediate product is fundamental': in the case of the lake, the end-product is good water quality, and the intermediate product is ecosystem functions and process such as the lake nutrients or nutrient cycling. It is identical to the distinction between counting *both* the steel in a car *and* the car itself in GDP. Clean water and cars are final products; nutrient cycling and steel are not. Kroeger and Casey (2007) argue that true markets cannot develop without such a restrictive definition.

Countering this, Robert Costanza (2008) argues that the MEA definition of ecosystem services is 'appropriately broad and appropriately vague' (p. 350). For Costanza, the entire point of the ES approach is precisely that the conventional economic approach is too narrow 'and tends to limit benefits only to those that people both perceive and are ''willing to pay for'' in some real or contingent sense' (p. 350). Costanza recognizes the potential for double counting, but does not see it as justification for a wholesale ejection of intermediate ecosystem processes from the domain of ES.

Costanza argues that the narrow approach would only work:

> if the world has consistently crisp boundaries, static linear processes with no feedbacks, clear distinctions between means and ends, little uncertainty, only one use for the classification system, and people who always know everything about the world and how it affects their welfare. (Costanza, 2008: 350; see also Tallis et al., 2008)

This vision, it must be said, strongly resembles the model-world of the neoclassical economist; note that Costanza, a leading light of ES thought, is unequivocal in his rejection of such a world. Costanza (2008) and Fisher et al. (2009) both suggest that a single definition may be inappropriate, and that different definitions may be necessary for use in the different policy settings in which ES is commonly found, such as (1) the heuristic recognition and naming of externalities in nature; (2) the reform of governance and decision-making structures (i.e. national accounting, cost benefit analysis) to recognize new kinds of assets; and (3) the formation of markets in new kinds of ecosystem commodities.[5]

There is enormous scope for geographers to become more vocal and engaged in this debate over what ES are and how they are defined. Definitions matter, and a yet-to-be-written critical geneaology of the ES concept would join geographic work on the power of other organizing environmental concepts such as the 'normal forest' (Demeritt, 2001) and carrying capacity (Sayre, 2008), and more broadly on 'nature' (i.e. Braun and Castree, 1998; Castree and Braun, 2001; Williams, 1976). Compared to conservation discourse and practice of the 1980s and 1990s (and much earlier), proponents of the ES approach foreground the 'social' nature of ecosystems that disrupts the 'prevailing view of *Homo sapiens* as somehow detached and insulated from ecosystem processes', which they say 'is outdated and dangerous' (Armsworth et al., 2007: 1384). Such a relational view of nature-society relations resonates with geographic critiques of 'pristine' nature, protected areas, and (racialized) national imaginaries (i.e. Braun, 2002; Cronon, 1995; Kosek, 2006; Neumann, 1998).

2 Enforcing marginalist principles

Economic geographers and political ecologists who study neoliberalism tend to overlook an entrenched internecine battle between price-theory marginalism and index theory in the rolling-out of neoliberal economic strategy. In ES debates, the 1997 article in *Nature* published by Costanza and his many co-authors is one of the principal battlegrounds. This article is remarkable for its scope and ambition: it used a variety of ES valuation methods in combination to arrive at a total value of $33 trillion for the Earth, which is described as a 'highly-efficient, least-cost provider of human life-support services' (Costanza et al., 1997: 255). The authors provided an abundance of caveats, and stated that this number is 'almost certainly an underestimate' (p. 259) even though it was 1.8 times the size of the global GNP. Despite these cautions, this number has become perhaps the single most widely cited figure in the ES literature, also appearing in popular articles and press. Prince Charles quoted the statistic in a May 2009 address to a Nobel Laureates symposium on climate change (Charles, 2009). Even with royal approbation, the figure has drawn a great deal of criticism; some on methodological grounds, but much also from economists who objected to Costanza's departure from marginalist principles.

Costanza's estimate of value came from summing the results of varied individual valuation exercises in a variety of global biomes, and multiplying each estimate by the global acreage of the biome. This multiplication of estimated price by quantity is a dramatic simplification of global ecosystemic complexity, and one can imagine ecologically grounded objections. But

the theoretical problem for economists is not ecological; rather it stems from Costanza et al.'s attempt to capture the entire value of the Earth as a whole, rather than capturing the marginal value of the next lost or gained unit of services provided by the Earth. Economists were merciless in a 1998 issue of *Ecological Economics* devoted to analyzing Costanza's argument. The aggregated price of an entire ecosystem, they claimed, was an economic impossibility: marginalist economics dictates that prices are only discoverable in a market with legible supply and demand curves – and who could buy the entire Earth as a unit? The question of price cannot be asked of an entire stock of goods, but rather of the last unit which sells to satisfy a consumer's demand. To sum the entire area under the supply curve and call it 'value' (understood as 'price') is to run a bulldozer through the marginalist revolution in economics.

Accusations flew (El Serafy, 1998; Toman, 1998) concerning whether or not Costanza had 'followed the rules' (*Nature*, 1998). Balmford et al. (2002) reattempted Costanza's global reach using strictly marginalist principles and failed to arrive at a global number due to data deficiencies, but did calculate annual costs of wildlife loss for particular biomes. However, Costanza's attempt to price the entire Earth was not really a departure from a certain kind of economic doctrine. In fact, it simply makes visible the different roles that economic analysis plays in the policy and market worlds. As Boyd and Banzhaf (2006) point out, there is a clear need for aggregated index values in a broad range of governmental and policy activity, and responding to such needs is the purview of accounting and index theory rather than price theory. The GDP itself is an aggregated figure that attempts to express a totality of value, and it is certainly widely used. Costanza's impulse was indexical, but when his result was read by marginalists as a statement of market value it was seen to violate principles held since the days of Jevons and Marshall. The dismissal of Costanza's figure has become de rigueur in the ES literature, and its citation is often now paired with Toman's (1998: 58) scathing indictment of it as 'a serious underestimate of infinity'.

This debate between price-theory marginalists and index theorists in the mainstream policy literature seems to have resulted in a strong presumption against comprehensive valuation. For example, the US National Research Council (NRC) report on valuing ecosystem services (2005), which among other things provided 'best practices' in reporting value, admonished its readers that '[c]omprehensive valuation of aquatic ecosystems should be viewed as a practical improbability' (p. 87) and that:

> in a policy context, economic valuation is not concerned with quantifying the value of an entire ecosystem ... rather, it is concerned with translating the physical changes in the ecosystem and the resulting change in ecosystem services into a common metric of associated changes in the welfare (utility or 'happiness') of members of the relevant population. (NRC, 2005: 42)

Yet such comprehensive valuation is what policy users and the general public *expect* out of a discipline like economics; Geoffrey Heal's (2000) admission in this regard sounds like something of a defeat, rather than an affirmation of the power of neoclassical principles:

> The conclusion that emerges from this analysis is that economics probably cannot really value the services of the Earth's life-support systems in any way other than by means of market prices, which only indicate the value of a small change in their availability. (Heal, 2000: 29)

Tracing these debates between the marginalists and the index theorists provides analytical foil for geographers interested in the polyvocality of capital and the limits of capital's ability to absorb ecological complexity. Indeed the marginalists' victory is brushing up against the very practical difficulty of measuring marginal changes in regards to ecosystem processes and

services, especially those that are poorly documented. Citing a case in which a small change in phosphate in a lake can cause it to change from very low to very high turbidity, Daily et al. (2000) note that:

> [m]easurement of incremental values works best when the increments are small, so that a change in one service will have minimal feedbacks through the rest of the system … Unfortunately, this condition is difficult to meet for ecosystem services, where the underlying systems tend to be highly interdependent, and seemingly small changes in one place cause large impacts on the overall system. (Daily et al., 2000: 396)

This non-linearity of ecosystem change is a critical tension in ongoing policy debates between index theorists and marginalists. Ring et al. (2010) confront this problem head on, noting that there are cases where the 'the basic theorems of welfare economics are not valid' (p. 17), and where such considerations 'may limit the range of valid cases for marginal valuation' (p. 20) (see also Rockström et al., 2009).

3 Ecosystem proxies, modelling, and measures

Human-environment geographers and political ecologists should be especially attentive to ES as an important venue in which new kinds of ecological information are integrated into economic and social relations. Many ecologists are enthusiastic about ES policy initiatives because of the newfound need for their expertise in defining and measuring new kinds of commodities, but many have also voiced concern over the simplicity of the models and the ecological naivety that economists bring to the measurement of ES. They insist that measurements must be attentive to complex issues of ecological scale, non-linearity in ecosystem processes, and the lack of settlement around the meaning of such concepts as biodiversity that are frequently represented as single-term proxy variables in economic valuation exercises (Carpenter et al., 2006; Goble, 2007; Kremen, 2005; Srivastava and Velland, 2005). Carpenter et al. (2006: 257) claim bluntly: 'We lack a robust theoretical basis for linking ecological diversity to ecosystem dynamics and, in turn, to ecosystem services underlying human well-being'.

The lack of extensive and established monitoring protocols for ES – or even basic agreement on *what* is to be monitored – means that the existence of an ecosystem service is often based on highly abstract models of global climate or regional hydrology and sediment transport (Brauman et al., 2007). These can say little about the actual provision of a service on a given site, and so the service itself becomes a stochastic and indeterminate entity. While this may not trouble economists, who are accustomed to dealing with risk and intangibility in the definition of, say, complex financial products, it is disconcerting to those who expect tangible ecological conservation to occur through the policy approach.

The models put forward, for example, do not typically include ecological thresholds, which would impose potentially unworkable uncertainties on ecosystem valuation and market development:

> A single wetland grass plant does not cycle enough nutrients to be of value to an upland cattle farmer. But how many plants are considered valuable? 100 plants? One hectare of wetland? And how does this answer change with the seasons, climate fluctuations and land use change in the watershed? (Tallis and Kareiva, 2005: 748)

Although individual services are often modeled separately from other services, ecologists claim they are clearly related, 'either positively or negatively, to other services' (Tallis et al., 2008: 9462). Ultimately, they say, 'interlocking production models of the full suite of ecosystem services are needed' (p. 9463). Such model complexity is daunting, but is precisely what ecologists and economists are trying to achieve within the Natural Capital project (NCP) – a

joint project funded by WWF, the Nature Conservancy, and Stanford University. The NCP has developed InVEST, a GIS model that uses land-use and land-cover patterns to estimate levels and economic values of multiple ES, biodiversity conservation, and the market value of the commodities provided by the landscape (Nelson et al., 2009). InVEST aims to model based on land-use and land-cover changes in:

> water quality, water provision for irrigation and hydropower, storm peak mitigation, soil conservation, carbon sequestration, pollination, cultural and spiritual values, recreation and tourism, timber and non-timber forest products, agricultural products, and residential property values. (Nelson et al., 2009: 5)

As is clear from this list, InVEST aims for panoptical synthesis of environmental and economic knowledge. We see at least two opportunities for geographers to wade into this area. First, while the development of critical work in GIS over the past decade has focused mainly on the use of GIS in planning and development (e.g. Elwood, 2010), the ability of GIS to align a diverse ecological world and economic principles in a common frame of analysis could be a fruitful area of critical GIS research. Second, we suggest that ecological-economic models like InVEST (and others) would be productively approached using the theoretical frameworks and methodologies of science and technology studies (STS) and those in the performativity of economics (i.e. Barnes, 2008; Callon, 1998; MacKenzie et al., 2007). In both cases, there is room to contribute to the already existing debates about these tools (see next paragraph) by examining what these 'calculative devices' (Latour, 1987) do, how they translate parts of nature into calculable beings, and the implications of this translation.

Economists in the ES literature recognize the need to ally themselves with reputable and defensible ecological assessment methodologies in order to ground the value of the services they wish to price or market. However, they are also aware that the drive for a more perfect ecological model of ecosystem functions may easily interfere with the task of establishing a value for ES. To economists, ecosystem modeling and assessment efforts must be aimed at producing *economically* legible data:

> Economists and ecologists should work together from the beginning to ensure that the ecological and economic models can be appropriately linked (i.e., the output from ecological modeling is in a form that can be used as an input into economic analysis). This requires that ecosystem impacts be expressed in terms of changes in ecosystem goods and services that people value. (NRC, 2005: 257)

This suggests that a cost of entering ES policy debates, for ecosystem scientists, is that they must accede to describing ecosystems as discrete units of service that retain a stable identity over space and time and can support the expression of a legible demand function. However the difficulty in doing so is widely recognized in the policy and science communities. Kroeger and Casey (2007) argue that both 'the lack of widely available, easily applicable, and low-cost approaches to quantifying ecosystem flows' and the difficulty of 'attaching these flows to reliable and low cost estimates of their economic value' are main obstacles for ES markets. Norgaard (2010) notes the diversity of ecological frameworks through which scientists understand complex systems, while ES models draw only on a limited few: the services describable under the paradigm of population biology, for example, will be dramatically different than those described under the paradigm of community ecology.

4 Measuring value

Ecosystem service models, debates and policies also provide an engagement with issues of *value* that are increasingly at the fore of economic geography (Gidwani, 2008; Huber, 2009; Mann, 2007; Robertson, 2011). Indeed, perhaps

the most pitched theoretical debate between economists in the ecosystem services literature has been over the *source* of the value that is carried by an ecosystem service. For 40 years there has been engagement, at times fruitful, at times tense, between ecological economists – who argue that the human economy is a subsystem within the larger energetic budgetary system of the biosphere – and neoclassical resource economists. In the early 1970s, ecological economists such as Herman Daly and the brothers Howard and Eugene Odum broke with neoclassical orthodoxy because of the evident and overwhelming challenges in representing the value of the environment through price, and the evident non-substitutability of certain environmental amenities. They explored using the embodied energy in an ecosystem (which they termed *emergy*) as the fundamental measure of value, instead of price (which neoclassical economists hold is the only measure of value). *Emergy* as a metric of value had the advantage of being grounded in then-cutting-edge systems ecology; it operated within the closed energetic system of the biosphere (in which the only source of energy is the sun), and could be converted to price through a multiplier such as the ratio of US GNP to the National Energy Consumption Index (in 1974, one US dollar was equivalent to 10,000 kcal) (Gosselink et al., 1974: 18). Their abandonment of the utility theory of value is a key moment in the development of ecological economics, and drew sharp criticism from natural resource economists such as Leonard Shabman, who vigorously took issue with the concept in a revealing back-and-forth debate with the Odum brothers in 1978 and 1979 (E.P. Odum, 1979; H.T. Odum, 1979; Shabman and Batie, 1978, 1979). The two groups of authors tossed incompatible axiomatic principles at each other and failed to agree on even the basic terms of the debate.[6]

This debate continues today. Proposals to quantify environmental impacts in units of *emergy* are routinely funded by US federal resource agencies.[7] On the other hand, those who continue to believe that price should not be used to reflect the value of ecosystems are described as being 'in deep denial' (Costanza et al., 1998: 68). But it is not only environmental ethicists and deep ecologists that Costanza is dismissing here: as widely accepted as the monetization of ES has become, there is an active counter-argument that monetization – even when indirectly applied through the notion of embodied energy – does not resolve the fundamental problems of valuation. Sharp critiques of capitalist valuation processes and value form are occurring *within* the ES literature. For example, Heal (2000), Ludwig et al. (2005), and TEEB (2008) have all commented on the problematic influence that discount and interest rates may have on ES values through monetization, and on the ethical implications for future generations of different discount rates. To employ the ES concept without calculating price or monetary value, Luck et al. (2009) instead prioritized watersheds where the human health value of an ecosystem service is great, where supply can easily be protected, where the service is threatened (but not completely disrupted), and there is limited potential to develop alternatives. The authors argue that their ranking of watersheds in terms of human need (captured through health and demographic statistics) rather than the money metric represents an appropriate non-monetary usage of the 'ecosystem services' concept (see also Gatto and DeLeo, 2000). There is thus a viable narrative within ES suggesting that values can be assessed without price (Wackernagel and Rees, 1997; see also Rees, 1998); there is room within ES policy dialogue for contributions which radically question the 'full' deployment of neoliberal and market-led strategy.

Debates over value theory may be unavoidably esoteric: many geographers will care more about the wide diversity of applied technologies and practices associated with the money-valuation of new ES commodities. There exists

a range of different possible measures, each with its institutional and spatial pattern of acceptance, but by axiom the best remains price in a clearing market. However, since the very problem which has stimulated five decades of work in environmental valuation is that public goods are non-rival and not traded in markets, economists have come up with valuation strategies, each less-than-perfect ways of determining the price of ES.

These include approaches like revealed preference,[8] stated preference, production function and benefits transfer approaches, techniques often covered in environmental economics undergraduate classes. Deep criticisms exist *within* the valuation literature itself, and Costanza et al.'s (1997) choice of benefits transfer as a valuation method in arriving at the value of the earth did not help their case. Dissatisfaction with valuation techniques has led several participants in the ES literature, economists and ecologists alike, to launch much more thoroughgoing reconsiderations of the goals of ES policy and the extent and limits of the beneficiaries of such policies (see Aldred, 2002; Fisher et al., 2009; Gatto and DeLeo, 2000).

The most recent 'consensus' text on economic valuation, *The Economics of Ecosystems and Biodiversity* (TEEB, 2010c), begins its chapter on valuation by dividing valuation techniques into two different streams of thought, or what they call 'valuation paradigms': *biophysical approaches* and *preference-based approaches.* Within the TEEB, preference-based approaches include those that assume that values 'arise from the subjective preferences of individuals' (TEEB, 2010c: 191). Biophysical approaches assume that values flow from non-human sources, as with 'emergy' discussed above, and assessment is based on 'measuring underlying physical parameters'. Critiques of these methods at the empirical level are far more common than at the theoretical level from which critical geographers often approach market environmentalism. But such technique-based concerns reach many of the same conclusions, and may be a more effective and practical entry into the debate over the basic efficacy and goals of market-based environmental policy.

5 Ecosystem services as development: crypto-Keynesian policies and the limits of markets

The mutability and hybridity of neoliberalism is on full display in ES, and it is perhaps this chimeric quality of ES policy that will be of most interest to economic geographers. While ES policy is often associated with market-based instruments, many ES policy tools with no connection to markets are being enacted. The very term 'market' appears to mean many things: the 'market environmentalism' label has been attached indiscriminately to almost any proposal that departs from the model of governmental fiat, or that involves a moment of structured negotiation between government and civil society over how environmental policy goals should be achieved. These can include ecosystem service markets, programs of subsidy-like payments for ES, the institutionalization of liability regimes or compensation for ES from which vulnerable populations have been dispossessed by development, and one-off trades (e.g. Kroeger and Casey, 2007; see also Corbera et al., 2007b; Vatn, 2010).

Programs establishing payments for ecosystem services and compensation for ecosystem services are often referred to by critics as PES and CES, respectively, precisely to distinguish them analytically from markets in ecosystem services (MES). This distinction is less frequently seen in policy discussions: we see, for example, a more or less Keynesian system of government handouts to farmers in South Africa, in the interest of achieving certain state-defined conservation goals, described as 'a precursor of markets' (Hawn, 2008; see also Goldstein, 2008). In Australia, the 'Bush-Broker' program in the state of Victoria is

described as a market-based approach, but involves a monopsony in which the state government sets resource conservation goals and invites private landholders to 'bid' by proposing conservation actions that the government will pay for. The government accepts the bids which achieve the goals at the least cost.[9] Clearly, to call such ES policies neoliberal in the conventional sense, or market-based, is misleading. In some cases ES policy invokes an inverted logic in which the *growth* of Keynesian policies is seen by market advocates as the surest indicator of the future hegemony of market relations (see Hawn, 2008). This is equivalent to saying that the Keynsianism of the New Deal in the USA during the 1930s functioned only as a necessary precursor to the US neoliberalism of the 1980s, and gives ES narratives a kind of proleptic effect in casting a whiggish history into the future (see Sparke, 1998). Some writers in ES seem to assume that where the neoliberal program does not have a decaying Keynesianism to feed off, a Keynesian policy must be created to provide one.

The fundamental goals of ES policies vary across time and space, particularly when it comes to projects involving international development. For some ES practitioners, the use of ES in development policy is meant to achieve efficient natural resource allocations rather than distributive justice (Engel et al., 2008; Pagiola et al., 2005: 239; Wunder, 2007). Proponents argue that in this approach the 'poor should be targeted … as long as their inclusion does not imply efficiency losses' (Muradian et al., 2010: 1203). But others, such as Dimas and Gabriel (2008), Landell-Mills and Porras (2002), and Muradian et al. (2010), reject development policy that uses ES concepts solely to achieve 'socially optimal levels of environmental externalities' (Muradian et al., 2010: 1203). They argue that in the Global South one cannot divide the concerns of distributive justice from environmental outcomes, and propose that PES 'should be considered explicitly as part of a portfolio of rural development programs and projects, instead of as an economic tool only used to guarantee environmental protection in the most efficient way' (Muradian et al., 2010: 1205; see also Pascual et al., 2010). However, the empirical outcomes of 'pro-poor' PES policies are decidedly mixed.[10] ES is therefore significant to the study of environmental geopolitics: internationally oriented PES schemes (those designed to transfer funds from developed to developing nations), such as payments for forest-carbon sequestration, cannot be separated from broader geopolitical struggles occurring over trade, development finance, and environmental degradation. The question of who will pay for the conservation of ecosystems and their services continues to occupy global politics as it has since the 1992 Rio Earth Summit.

The distinction between international development aid policy and ES policy is remarkably thin at times. The money to buy ES in most cases comes from Northern governments, a fortiori in places where there is little infrastructure and capital to make payments, and ES strategy often involves building state capacity to administer ES programs in developing countries.[11] It is precisely such a realization crisis in the ES economy that causes Tallis and Kareiva (2005) to warn that '[e]conomists and multilateral aid agencies will need to apply creative thinking in impoverished countries to help the value of ecosystem services be realized' (p. 749). Self-financing conservation remains like 'the legendary Holy Grail … elusive' (Ferraro and Kiss, 2002: 1719). The Keynesian (Northern) state continues to provide effective demand for ES, in many cases.

It is evident that a broad range of voices inside the ES debate are not convinced that markets in nature are desirable, and there are active attempts to redirect ES toward other uses. McCauley (2006) argues that a market-based approach on its own will not lead to conservation, and may obscure the moral imperatives of conservation. McCauley's letter, in *Nature*,

brought out the big guns of ES policy in response. But, significantly, the big guns did not line up in defense of the market concept; rather, they defended the more nuanced position that markets were not an essential component of ES policy deployment. The entire board of the Millennium Ecosystem Assessment responded (Reid et al., 2006) by saying that the MEA had never approached markets as a panacea and that there are limits to economic valuation. Costanza (2006) went further to suggest that most services, particularly public goods, cannot be commodified: 'Most ecosystem services are public goods (non-rival and non-excludable), which means that privatization and conventional markets work poorly, if at all' (p. 749). Responding to the same editorial, Marvier et al. (2006) made the point that economic valuation provides the data and tools supporting a simple way of 'getting everyone's moral imperatives on the same page' (p. 749). Dollars, in this formulation, are not important because they are the more perfect representation of value or because they allow the generation of a price signal, but rather because they are a way to express values in comparable terms, to weigh the 'moral imperative of saving nature ... against the moral imperative of saving people' (p. 749). This amounts to the belief that money's use as universal equivalent can be separated from the operation of capital to generate profit – a belief common among both scientists and policy-makers in ES (see Robertson, 2004), and something that critical researchers must regard as a key blindness.

Other conservationists openly suspect that money's role in valuation might not be fully separable from capitalism. Adams and Redford (2010) warn that ES practitioners need to be 'cautious about the power and applicability of economic metaphors' (p. 328), because of the ecologies that might be created: 'diverse ecosystems that produce economic returns will be well preserved, and those that do not will be converted or transformed to increase returns' (p. 329). This provides a direct and compelling link with the work on 'second nature' derived from Smith (1990) in critical geography. Likewise, geographic debates over scale (i.e. Marston et al., 2005) are directly salient to claims that the 'highly location-specific and spatially non-fungible' (Kroeger and Casey, 2007: 324) nature of many ES forces markets to be limited to the scale of ecological phenomena. This scale-based restriction would mean that markets 'lose much or all of the theoretical efficiency advantage competitive markets might have over alternative resource allocation strategies' (p. 324) (see also Muradian et al., 2010: 1203).

These critiques of markets have led some ES advocates to come full circle back to the advocacy of nakedly Keynesian or command-and-control policies which simply take ecosystem services as their object of regulation, without reference to markets. Kroeger and Casey (2007) argue that 'a regulatory framework is needed that addresses both the definition of service units and the monitoring of service provision to generate certainty over time by overcoming information asymmetry problems' (p. 328), and that 'only well-designed government programmes can achieve desired outcomes' (p. 329). Indeed, although they profess to be advocates for market-led policy, their argument reads as a convincing case for the increased state-directed allocation of ES. In the dizzying hybridity of neoliberalism, we find even dedicated practitioners unable to keep track of the supposedly cardinal points of orientation.

V Conclusion: geographic engagements

Are ecosystem services discourse and policy 'neoliberal'? This would seem to be an obvious conclusion, and similar maneuvers that commodify nature in new ways and expand the reach of capital into biological processes are often referred to in shorthand as 'the neoliberalization of nature'. Nevertheless, we have argued that it

is not clear what 'neoliberal nature' means when the internal dialogue of ES policy includes the schisms and debates reviewed above. ES is not unique in this respect. While ES is surely of singular interest as a major interface between capital and the environment, other examples of neoliberalisms fail the test of purity by many of these same tokens (Larner, 2003; Peck and Theodore, 2007); the practices around ES significantly exceed conventional versions of neoliberalism both in the diversity of their empirical forms and in the polyphony of theoretical justifications and foundational principles. Lohmann (2011) counts eight justifications for carbon trading markets alone in the mainstream policy literature, few of them conventionally neoliberal. Geographers have been at the fore in arguing that neoliberal concepts, born out of critiques of dirigiste government regulation, can yet embrace and extend government regulation (e.g. Brenner et al., 2010) – an outcome that still appears to be a contradiction or incoherency to many participants in ES policy dialogue. Geographic assessments of the intertwined processes of 'development' and the global extension of capital relations are so established in the discipline that we often forget that the connection between them is not obvious to all. Although mainstream ecosystem service policy and practice is often elaborated within a neoclassical or neoliberal frame (Gómez-Baggethun et al., 2010; TEEB, 2010c), there is significant room under the term for serious debates about value theory and value measurement, about the inherent worth of markets, about development strategy, and about the very definition of the concept of ES. As Mansfield (2007) finds in her exploration of the purportedly neoliberal design of transferable fishing quotas on the coast of Alaska, the concept 'contains within it much more than is expected and widely represented' (p. 496).

Specifically, there are at least six distinct ways that critical geographic research can contribute to debates ongoing on ES, beyond those outlined in the above section: first, research on the way that capitalist strategy and capital relations often or always overflow the formal relations of capital to create a more-than-capitalist world, following the pioneering work of Gibson-Graham (1996); second, the consideration of ES alongside other elements of global development strategy; third, work on value theory and 'the politics of measure' through which objects come to bear value and circulate as commodities in a capitalist economy (Mann, 2007); fourth, the development of empirical case counterweights to mainstream econometrics (e.g. Pattanayak et al., 2010) or the modeling of the behavior of rational actors; fifth, research on the geography of fast policy transfer (e.g. Peck, 2002). Lastly, there is a pressing need for geographers to study the emergence of financialized nature: the way that financial institutions like banks, investment firms and insurers are becoming involved in the provision of ecosystem services by creating new categories of financial risk (Dempsey, 2011), bankrolling new projects, or developing new projects, products and markets themselves (Sullivan, 2010).

Above all, we must understand whether the debates and fissures we have observed here constitute variegation within hegemonic capital, or if they are in fact a way toward non-capitalist outcomes. To take a cue from Mansfield (2007) and Blomley (2004, 2008) – themselves talking about property – ecosystem services 'might be both a tool of dispossession and a tool for challenging dispossession' (Mansfield, 2007: 496). But these debates and fissures are not simply there to be studied in order to answer the merely taxonomic question of whether something is, indeed, 'neoliberal'. We opened by asking whether critics of ES and neoliberal natures can find a useful solidarity with people engaged, through ES policy, in opposition to business-as-usual resource development, and whether ES can escape its own foundational commodity logic. A sensitivity to the internal productive disarray within all

neoliberalisms will surely help us find points of entry and change.

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Notes

1. The distinction between traditional 'resources' – things like forests, coal, minerals and fisheries – and non-traditional – services – is not often that easy to delineate. The former are resource commodities with markets, whereas the latter (depending on the definition) can be provided in traditional resource settings like forests or agriculture. However, importantly, ecosystem services also include aspects of the economy that are not always marketized, nor considered a 'resource', but play an important role in human well-being such as pollination services of bees, the actions of microorganisms in decomposing wastes and producing soil, etc.
2. A physical geographer, Ruth DeFries, took the lead for one MEA working group on conditions and trends in ecosystems.
3. See http://pwccc.wordpress.com/support.
4. Although orthodox economics treats services as a sectoral category, Marx dismisses the distinction itself: 'A service is nothing other than the useful effect of a use-value, be it that of a commodity, or that of the labour' (Marx, 1976, 299–300).
5. Policy consensus may be coalescing around a more narrow definition of ES. At first glance the definition offered by the recently concluded TEEB (2010c) is broad: ecosystem services are defined in TEEB as 'the direct and indirect contributions of ecosystems to human well-being' (p. 4). But their subsequent classification of services omits 'supporting services' such as nutrient cycling, 'which are seen in TEEB as a subset of ecological processes' (p. 19), a distinction which clearly delineates 'between functions, services and benefits', in order to 'make ecosystem assessments more accessible to economic valuation' (p. 3).
6. A more complete summary of this debate is included in a manuscript by Morgan Robertson and Joel Wainwright currently under review at the *Annals of the Association of American Geographers*.
7. We encourage anyone doubting the currency of emergy research to enter the terms 'emergy', 'grant', and 'EPA' into an internet search engine for an eye-opening experience.
8. Revealed preference, in which economists analyze data from real markets in commodities which proxy the ecosystem service (this is also known as 'hedonic valuation'). For example, the revealed difference in the price of houses near wetlands and distant from wetlands, as long as they are identical in every other respect, can be understood as the price value of the wetland's services (Lupi et al., 1991).
9. The range of market-based policies implemented by the State of Victoria is described here: http://www.dse.vic.gov.au/__data/assets/pdf_file/0017/102275/for_attach_library_5.pdf.
10. In Costa Rica and India, most ecosystem service providers were found to be relatively well-off landholders (see Kerr, 2002; Kosoy et al., 2007; Zbinden and Lee, 2005). Some initiatives discriminate against those without formal tenure, or with limited land endowments – thus increasing inequity (Corbera et al., 2007a; Grieg-Gran et al., 2005). While peasant land rights might be strengthened by PES, the titling that accompanies PES might also increase the value of land (through adding certainty to the definition of new values in property) and even create incentives for land grabbing (Vatn, 2010).
11. See a special issue of *Forests,* 2(1) (2011), devoted to this topic.

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