

# What makes ecology 'political'? : Rethinking 'scale' in political ecology

Haripriya Rangan and Christian A. Kull\*

This is the author-archived version of a paper published in *Progress in Human Geography*. The final, definitive version is available from the Sage website (<http://phg.sagepub.com>) or this direct link: <http://dx.doi.org/10.1177/0309132508090215>

**Citation:** Rangan, H & CA Kull (2009) What makes ecology 'political'? : rethinking 'scale' in political ecology. *Progress in Human Geography* 33 (1):28-45.

## Abstract:

This essay explores the ways in which concepts of 'scale' are deployed in political ecology to explain the outcomes of ecological and social change. It argues that political ecologists need to pay closer attention to how scale is produced and used to interpret the experience of spatiotemporal difference and change so as to make ecology the object of politics, policy making and political action. It outlines an alternative approach that focuses on how three moments of action – operation, observation, and interpretation – work together to produce scale as a configuration and range of values that articulate differential sensibilities and political differences regarding changes to socialised landscapes. The essay uses examples from studies of plant movements to illustrate how scope and scale combine to 'enframe' and interpret ecological and related social change as 'disruption' to places, regional 'transformation', or as regionalised 'evolution'.

**Keywords:** political ecology, scale, regional change

## I Introduction

The question of scale has been a topic of considerable debate in political ecology since its development as a field of study over the past two or more decades. The most basic argument regarding scale in political ecology is that ecological and social change occurring in particular places need to be understood as outcomes emerging from the interactions of political and economic processes at local, national, and international levels (Blaikie and Brookfield 1987). Other arguments point to problems of conceptualising scale as 'pregiven sociospatial containers' and not recognising the varying time-space scales of environmental and social change (Zimmerer and Bassett 2003); the need to identify the most appropriate scale for analysis and figuring out how to move between scales (Paulson and Gezon 2005); and the need to move beyond static conceptions of scale by focusing instead on how social actors exercise power and authority by incorporating human and ecological subjects into scientific, economic, and political networks (Robbins 2004b). Despite numerous assertions about scale as a dynamic concept, a social construct, and as a subject or object of politics, the scopes of analysis used in political ecology studies offer little insight into the *different* experiences and perspectives regarding the outcomes of ecological change. What the arguments about

---

\* School of Geography and Environmental Science, Monash University, Melbourne, VIC 3800 Australia; Corresponding author: [Haripriya.Rangan@arts.monash.edu.au](mailto:Haripriya.Rangan@arts.monash.edu.au)

scale in political ecology do not question is *how* scale plays a role in *making* ecological change ‘political’.

The reason for proposing this argument arises from our current research on the political ecology of exchanges of *Acacia* species around the Indian Ocean. Our project attempts to understand the different experiences and perspectives regarding the presence of introduced acacias in four regions: southern Africa, Madagascar, southern India, and northern Australia. Australian acacias are widespread in the first three regions, while Indian and African varieties of acacia are widely distributed in northern Australia. Our research explores the different motives involved in the transfers, the diffusion and dispersal of the introduced varieties, and the differing sensibilities and knowledges that shape the reception of these transplanted species in their new locations (Kull and Rangan, in press).

Many environmental historians have focused on the drama of plant transfers by European colonial powers and how these activities transformed natures and societies in every part of the world. They show how European naturalists, scientific institutions, and explorers – Joseph Hooker, Aimé Bonpland, Henry Wickham, James Cook, Joseph Banks, La Condamine, Alexander von Humboldt, Alfred Wallace, and many others – moved plants between distant lands to botanical gardens and commercial plantations in the service of their imperial masters for purposes ranging from aesthetic enjoyment and scientific study to industrial production and monopoly profits (*e.g.*, Brockway 1979; Crosby 1986; Hecht and Cockburn 1989; Grove 1995; Browne 1996; Drayton 2000; Beinart and Middleton 2004). In contrast, biologists, particularly those working in the field of plant invasion ecology (see Henderson *et al.* 2006 for a review of this field) have focused their studies on introduced plants, examining how their seed dispersal strategies and competitive adaptations allow them to become ‘invasive’ in their host environments (see Richardson and Pyšek 2006 for a review of debates regarding the definitions of ‘invasive plants’; also Cronk and Fuller 1995). These two kinds of research have tended to represent plant introductions and movements in a predominantly negative light and paid little attention to the ways in which distinctive regional, social, and biogeographical landscapes have been shaped over time.

There are a limited number of political ecology studies of plant transfers, most of which follow the declensionist tropes offered by environmental history narratives (see Cronon 1992) of disruption to the prevailing socio-political and ecological order of places. Examples range from place-based politics and conflicts surrounding the introduction of exotic tree species for commercial or forestry purposes (Rocheleau and Ross 1995; Robbins 2001) and high-yielding food and vegetable crops for export (Schroeder 1999; Awanyo 2001; Freidberg 2001; Schroeder and Suryanata 2004), to those that highlight the political and economic disadvantages borne by particular place-based social groups drawn into the processes of commercialised transfer and privatisation of plant genetic diversity (Parry 2000, 2004). Although some studies have attempted to describe competing social perceptions regarding particular introduced plants (Robbins 2004a) or their commercial transfers (Freidberg 2004), the primary message of these narratives is of ecological and social change that disrupts the prevailing ecological balance and socio-economic order of particular places.

Plant transfers and movements have been going on from prehistory to the present. The inordinate emphasis on imperial institutions, colonial science, and contemporary profiteers in the age of globalisation deflects attention from the fact that for centuries before them, people have intentionally or otherwise moved plants from place to place: trading in plant products, acting as seed dispersal agents while walking, sharing knowledge of plant uses, transporting plant stock, seeds, and cultivation practices (Ridley 1930; Sauer 1969; Harlan 1992). Plant transfers, diffusions, and dispersals have

been part of the habitual rhythms of everyday life that – along with dramatic natural and social events and political-economic conjunctures of change – have created distinctive landscapes and regions (see Braudel 1972, 1981; Brockway 1979; Crosby 1972, 1986; Carney 2001; Drayton 2000; Mintz 1985). What we now celebrate as charming Mediterranean landscapes or vivid tropical environments have been produced through conscious and planned introductions and diffusions of plants from similar climatic regions to gardens, farms, groves, and also dispersed through the biological agency of the plants themselves and by the rhythm and pace of movements of their human and non-human transporters (Strauss *et al.* 2006; Cappuccino and Arnason 2006). All of these movements converge at different places and over different time periods to create distinctive regional economies and geographical identities.

What interests us is the question of *when* and *how* these quotidian movements and processes of ecological and attendant social change become the subject of political contention. What are the means by which ecological change is politicised? Political ecology studies usually describe how economic and political processes and networks operating at international, national and local levels interact to produce ecological outcomes at particular places. It is through these explanations that political ecologists refer to ‘scale’, or assert that scale is political, that there is a politics of scale, a politics about scale, and politics within and between scales (see for example Swyngedouw 2004; McCarthy 2005b; Paulson, Gezon and Watts 2005). In these studies, scale appears to represent the different levels of politics, policies, or political actions that converge to affect the ecologies of particular places. Scale, as a concept in itself, seems to remain an ‘apolitical’ entity without any agency.

In this essay, we propose a different way of thinking about the question of scale in political ecology. We argue that scale is the means through which ecological (and related social and economic) *change* is *made* political. Ecological change (indeed any kind of change) is a given, but it is made political by bringing together three moments of social action – operation, observation, and interpretation – to produce scales that represent ecological and attendant social change as disruptive, transformative, or evolutionary.

The following sections of the essay elaborate our argument. We begin by reviewing the main debates regarding scale in political ecological, geographical, and ecological literature. We then elaborate on what we mean by the ‘production of scale’, drawing on examples from our current research as well as other studies of plant movements to illustrate how the three moments of social action ‘enframe’ and interpret ecological and biophysical change as ‘disruption’ to places, regional ‘transformation’, or as regionally differentiated ‘evolution’.

## **II Scale in political ecology**

There is a large volume of literature on scale in geography and ecology that would be impossible to detail in this essay. The debates among ecologists and physical geographers often centre on the need to distinguish between the observational and operational aspects of scale (Turner *et al.* 1989; Lam 2004; Phillips 2004). Human geographers have long argued that scale is not simply a hierarchy of nested spatial ‘containers’, but rather an outcome of material processes and power (Taylor 1984; Smith 1984; Jonas 1994; Swyngedouw 1997; Herod and Wright 2002; Paasi 2004; Sheppard and McMaster 2004). They point out that scale is relational (Howitt 1998, 2002); socially constructed rather than given *a priori* (Marston 2000); shaped by networks (Leitner 2004; Taylor 2004); that there is both a politics *of* scale and a politics *about* scale (Delaney and Leitner 1997; Brenner 2001; Marston and Smith 2001; Swyngedouw 2004), and a politics within and among scales (McCarthy 2005b). Sayre (2005) and Lebel *et al.* (2005) argue

for the need to avoid conflation of the terms ‘scale’ and ‘level’, the former being a range and the latter being a position on that range.

The arguments regarding scale in political ecology are part of these ongoing debates, but also different in that discussions often centre on bridging the scales at which ecological and social processes occur. Political ecology was, in its early stages, described as an interdisciplinary approach that combined the “the concerns of ecology and a broadly defined political economy” for understanding the ways in which land degradation and social marginalisation were interlinked (Blaikie and Brookfield 1987: 17).

Blaikie and Brookfield argued that it was necessary to develop an approach that could

...encompass interactive effects, the contribution of different geographic scales and hierarchies of socio-economic organisations (e.g., person, household, village, region, state, world), and the contradictions between social and environmental changes through time.

Our approach can be described as *regional political ecology*. The adjective ‘regional’ is important because it is necessary to take account of environmental variability and the spatial variations in resilience and sensitivity of the land, as different demands are put on the land through time. The word ‘regional’ also implies the incorporation of environmental considerations into theories of regional growth and decline (*ibid*: 17).

In calling their approach ‘regional political ecology’, Blaikie and Brookfield aimed to draw attention to the spatial and temporal scales at which environmental variability, geographic variations, and social organisation operated to produce a constantly shifting relationship between nature and society. Yet Blaikie and Brookfield’s chosen method of analysis – the ‘chain of explanation’, which moved through ‘different geographic scales and socio-economic hierarchies’ extending out from the individual land manager to the world – effectively reduced ‘scale’ to a hierarchical order of spatial categories of socio-economic organisation: household, local, sub-national, national, international, and global. Despite their emphasis on ‘regional’ as a geographic scale for understanding environmental variability, land use, and economic activity over time, the ‘chain of explanation’ rendered the region as an intermediary – and often indeterminate – spatial category suspended somewhere between the village and the nation-state and offered little insight into the new or different spatiotemporal formations emerging from the interactions between environmental change and economic processes.

Blaikie and Brookfield’s ‘chain of explanation’ reflected a conscious attempt to integrate ‘politics’, *i.e.*, “questions of access and control over resources – relations of production as realms of possibility and constraint – into human ecology” (Peet and Watts 1996: 6), and thereby make it reflective of broader political and economic processes driving ecological change and resource degradation in particular places. Until then, most explanations of ecological change were based on functional-adaptation or systems approaches for explaining human-environment relations (Neumann 2005: 19). Human ecologists such as Vayda (1983) developed a ‘progressive contextualisation’ method that aimed to explain ecological change by analysing individual actions and interactions within ‘progressive’ levels of ecosystems or contexts representing expanding size and complexity. Vayda described progressive contextualisation as a method which starts “with the actions or interactions of individual living things and can proceed to put these into contexts that make actions or interactions intelligible by showing their place within complexes of causes and effects” (1983: 270).

Although Blaikie and Brookfield’s work established the foundation for the rapid development of political ecology as an approach for studying ecological and social change, their ‘chain of explanation’ has often been criticised for being an inadequate framework of analysis. In the first edition of *Liberation Ecologies* (1996), Peet and Watts observed that the ‘chain of explanation’ provided no sense of how or why some factors became causes. They argued that despite Blaikie and Brookfield’s emphasis on plurality, their analysis did not produce a theory that allowed for or explained complexity but rather:

...an extremely diluted, diffuse, and on occasion voluntarist series of explanations. Degradation can arise under falling, rising, or stable population pressures, under an upswing or downswing in the rural economy, under labor surplus and labor shortage; in sum, under virtually *any* set of conditions. The best that Blaikie and Brookfield provide is what they call a “conjunctural” explanation which seems to operate under all empirical circumstances... Rather than outlining an explicit theory of production or political economy and an arsenal of middle-level concepts, Blaikie and Brookfield only provide a plurality of disconnected linkages and levels (1996: 8).

Despite this trenchant critique, several subsequent texts on political ecology have broadly followed or adapted Blaikie and Brookfield’s ‘chain of explanation’ approach for analysing ecological and social change. Bryant and Bailey (1997) used it to establish the theoretical credentials of political ecology by identifying it as a specific research agenda in ‘Third World studies’ and emphasising its historical-materialist framework of analysis.<sup>1</sup> Forsyth (2003) has sought to expand the methodological toolkit of political ecology by incorporating poststructural discourse analysis and new models of non-equilibrium ecology. Neumann (2005) has argued that although the ‘chain of explanation’ approach is largely used to explain ecological and social change in agrarian societies and rural contexts, it can easily be applied to urban contexts and to exploring “the socio-ecological interconnections that operate at multiple scales and that link cities to each other and to rural regions” (2005: 157).

Other authors of recent political ecology texts have, however, taken up Peet and Watts’ criticisms of the ‘chain of explanation’ approach and called for alternative ways of understanding ecological and social change through ‘integrated analysis’ and ‘cross-scale’ linkages. We focus on the arguments and approaches presented in three recently published texts (Zimmerer and Bassett 2003; Robbins 2004b; Paulson and Gezon 2005).

## 1 Integration of ecological and social scales

Zimmerer and Bassett argue that the ‘chains of explanation’ method reinforces the conceptualisation of geographic scale as “pregiven sociospatial containers” (2003: 3), and offers little scope for recognising the “varying time-space scales” of environmental and social change. They note that:

One of the challenges facing political-ecological scholarship is to break out of these pregiven, scalar containers (local, regional, national, global) to examine human-environmental dynamics that occur at other socially produced and ecological scales. These challenges include being more attentive to the spatiality of social life, especially the politics of scale, and integrating ecological scale into analytical frameworks (*ibid.*: 288).

The authors point out that the spatiality of social life requires the recognition of space as not simply a container through which social processes flow, but “the product of social relationships that assume different configurations under changing conditions” (*ibid.*: 288); *i.e.*, scale is not simply an objective category representing a unit of spatial magnitude, but is socially produced. Zimmerer and Bassett argue that the central challenge for political ecologists is to integrate socially produced scales with those produced through ecological or biophysical processes. They point out that integration is complicated by the fact that the “scales of ecological processes are poorly understood by ecologists and conservation biologists. Too often, the spatial dynamics of species and ecosystems are arbitrarily defined to fit within human-designed management areas or researcher study plots rather than by their functional requirements” (*ibid.*: 289).

---

<sup>1</sup> More recently, some authors have discussed the possible advantages or otherwise of developing a ‘First World political ecology’ approach that focuses on a range of actors and contexts in urban and industrial contexts in rich countries, rather than on rural households and agrarian economies of the ‘Third World’. See Robbins 2002; McCarthy 2005a; Schroeder 2005.

Zimmerer and Bassett call on political ecologists “to integrate the scales of biophysical dynamics” into research frameworks and policy discussions. They note that future political ecological research,

...might consider how ecological scale interacts with socially constructed scales to produce distinctive environmental geographies. Four productive avenues of research are suggested here: (1) the scales of ecological dynamics; (2) functional conservations areas; (3) mismatches between ecological and social scales; and (4) fragmented scales (2003: 289).

## 2 Networks and scales

In his political ecology text, Robbins (2004b) notes that the problems associated with scale in the ‘chain of explanation’ can be overcome by using actor-network theory (see Callon 1986, Latour and Woolgar 1986; Latour 1987, 1993) to examine the ways in which various social actors exercise power and authority by incorporating human subjects and non-human objects and actors into scientific, economic, and political networks. He argues that actor-network theory is particularly useful for political ecology because it “paints a picture of a produced world, where politics hold sway, but which involves global migrants, both human and non-human, who produce and consume landscapes and knowledge, remaking the world as they go” (*ibid.*: 212). He observes that:

Networks organize and are organized by a range of human and non-human actors, through systems of accumulation, extraction, investment, growth, reproduction, exchange, cooperation, and coercion. While diverse, each network is by no means unique. Common patterns of exploitation and environmental change reflect common network morphologies and common processes. By explicating networks, therefore, we come to a better understanding of recurrent socio-natural situations, especially undesirable ones. Rather than manipulating or waiting for change in global political economy to trickle down a chain, a network allows us a range of places for progressive political action and normative change (*ibid.*: 212).

Robbins notes that the ecological characteristics of non-human nature and its objects interact with the socio-political world of human action and struggle, and that the characteristics and agents of both are transformed, consciously and otherwise, “to assume new roles, set new terms, and take on new importance. People, institutions, communities, and nations assemble and participate in the networks created in this interaction, leveraging power and influence, just as non-human organisms and communities do” (*ibid.*: 213). He proposes an alternative ‘hybridity thesis’ that combines the analytical strengths of actor-network theory with those of political ecology, which include the ability to bring historical depth and, “a highly flexible focal length, which crosses scale and frames its analysis as easily on global institutions and scientific labs, a focus typical of much work in critical science studies, as on peasants, hunters, and homemakers” (*ibid.*: 213).

## 3 Cross-scale linkages

Paulson and Gezon in their edited volume, *Political Ecology across Spaces, Scales, and Social Groups* (2005), note that political ecologists “have sought to expand the scale of analysis to address national and global processes that transcend geographically separable locales” (*ibid.*: 8). They point out that by locating “their environmental studies in the context of political economic systems and relations, political ecologists opened the possibility of bringing into the analysis social relations and places that are not necessarily proximal to the ecological phenomena of interest” (Paulson, Gezon, and Watts 2005: 25). This enlarged scope of analysis is not presented as a ‘chain of explanation’, but emphasises that local and global are always in dynamic interaction; that global flows are necessarily embedded in local processes; and that ‘place’ is not merely considered “as an isolatable physical space but as a dimension of historical and contemporary connections” (*ibid.*: 9).

Gezon expands on the discussion of scale in her individual contribution by arguing that, “scalar relationships between the global and the local do not exist in an *a priori* way. The global domain and local places are historically situated cultural constructions” (2005: 135-136). She goes on to describe ‘local’ as “geographic spaces and resident people”, and scale as “relationships between what is local and what is not” (*ibid.*: 136). Following her analysis of the global-local connections centred on a special nature reserve in northern Madagascar, Gezon asserts:

The term *scale* recognizes that there are multiple levels of analysis but appropriately leaves open the character of connections among people and places (if, indeed, there are any connections) and invites investigation into who influences whom. Many dictionary definitions of scale refer to relationships, in terms of distance or degree, between phenomena. Used in this sense, scale implies comparison and invokes a gradient. In the analysis of global connections, scale has two interrelated components: geographic scale and breadth of political legitimacy. In terms of the latter, the multiple forms of political power – those that derive from family or village leaders, from divine authority, from the state, and from international-globalist conservation agendas – do not interact as equal players. A concept of scale helps to place them analytically in a relationship based on the nature and extent (in terms of both geography and the number of people concerned) of their power in political discussions.... In terms of geography, scale also refers to the size and distance of the material implications of decisions made... Projects of scale making occur as people negotiate the extent of their political influence and material impact of the decisions they make (*ibid.*: 147-8).

Paulson and Gezon observe that one of the critical challenges for political ecologists is to identify the most appropriate scale for starting analysis and working out how to move between different scales, because all cognitive models of scale are based on deeply embedded assumptions about space, time, history, and causality. They note that there are practical and political implications to how different models of scale are used for organising and interpreting information, and emphasise that scale should not be seen as something ‘out there’ to be discovered, but as something that is “constantly made, negotiated, and transformed as people interact in specific times and places” (2005: 14).

The critiques of the ‘chain of explanation’ and related discussions of scale point to two recurring problems in political ecology: first, that instead of seeing scale and space as socially constructed, scale is often reduced to the notion of static, ‘pregiven socio-spatial containers’; and second, that political ecology does not provide a balanced integration of ecological and social processes across multiple scales for analysing landscape and socio-spatial outcomes. Walker (2005), for instance, emphasises the latter problem in his call for an integrative “modern political ecology – with all its important advances in understanding social and discursive struggles over resources – that retains biophysical ecology as a central research theme” (*ibid.*: 80).

### III Problems of scale in political ecology

The diverse propositions regarding the social construction and politics of scale are useful insofar as they draw attention to the ways in which scale is defined through politics and institutions, along with technologies and methods of measurement. However, as Lebel *et al.* (2005) argue, the scale metaphor has been stretched to cover a lot of different spatial relationships, confusing the analytical distinctions that need to be made between scale, position, and place. Sayre (2005) notes that, “scale is both a methodological issue inherent to observation (its epistemological moment) and an objective characteristic of complex interactions within and among social and natural processes (its ontological moment)” (*ibid.*: 276). The analytical confusion surrounding scale arises because, “Ecologists tend to keep scale’s two moments separate from each other, denying their dialectical relation; critical human geographers more often confound the two, collapsing the dialectic” (*ibid.*: 278).

Our view regarding the question of scale is that although many political ecologists and critical human geographers assert there is both a politics of scale and a politics about scale (see Brenner 2001; Swyngedouw 2004; McCarthy 2005b), few seem to recognise that scale is central to the production and representation of spatiotemporal *difference*, and the means by which *change* – be it ecological, social, or economic – is made ‘political’. Following on but extending Sayre’s argument, we argue that rather than existing as a pre-given dimension, position, or place through which politics occurs, scale is produced by three moments of action: operation (Sayre’s ontological moment), observation (Sayre’s epistemological moment), **and** interpretation (the moment of translation). Philosophers of science emphasise the distinction between epistemology and ontology, but often do not explain how scientists and researchers *make* the links between these two knowledge categories. We suggest that the connection between the two categories is made through a moment of translation. Translation involves narratives that use ‘models’, metaphors, or tropes to link the epistemological and ontological moments in ways that imbue significance and symbolic meaning to the relationships *and* differences between them (see Barthes 1972). The translational moment plays a crucial role in the production of scale because it provides the means by which spatiotemporal difference and change is articulated, challenged, or defended by using an order or range of values and sensibilities as the context for interpretation.

The problem of scale in political ecology arises from the persistent tendency to view it mainly in observational and operational terms, without recognising that the interpretive moment is crucial in producing scale to represent spatiotemporal difference or change. We would reframe Sayre’s view regarding the distinction between ‘biophysical’ and ‘political’ ecologists in that the former tend to explain spatiotemporal change by focusing on the differences between observational and operational scales without acknowledging that their models of nature and physical laws are translational tools that *make* ‘truths’ by linking and generalising particular experiences of biophysical change across a range of spatial categories. ‘Political’ ecologists (and critical human geographers) often tend to collapse the ontological, epistemological, and translational moments into an undifferentiated moment of ‘social construction’ in which scale represents little more than an order or range of political-spatial levels.<sup>2</sup>

The ‘post-chain’ approaches in political ecology reflect the problems that arise from either separating or confusing the three moments involved in the production of scale. Gezon’s explanation of cross-scale analysis collapses categories (or levels) of observation such as global, national, and local with the operational scales of different ecological and social processes and the interpretive scales used for assessing the outcomes of spatiotemporal change: ‘local’ is described as “geographic spaces and resident people”; ‘scale’ is described as “relationships between what is local and what is not”; and the ‘global scale’ is described as having two components, “geographic scale” and “breadth of political legitimacy”, with the former representing the “size and distance of the material implications of decisions made” (2005: 147-148; see quote in the previous section).

Zimmerer and Bassett’s problems with scale in political ecology are mainly about the mismatch between the scales of biophysical and social processes (2003: 289-290, see previous section), *i.e.*, the scale at which ‘ecological dynamics’ occur do not match the

---

<sup>2</sup> Most recently, Marston *et al.* (2005) have argued that despite the complex insights afforded by the literature on scale, there is still a foundational hierarchy, “a verticality that structures the nesting so central to the concept of scale” (419). Given the persistence use of scale as ‘nested hierarchical ordering of space’, they propose that the concept be entirely abandoned and replaced by a different ontology that flattens scale and thereby renders it unnecessary. See Collinge (2006) for a commentary on Marston *et al.*’s arguments.

scales at which socio-economic or political processes occur. Our view is that the mismatch of ecological and social scales is a basic recognition from which political ecology analysis should begin, not end. The operational scales of ecological and social processes do not and cannot (as a matter of logic) be made to coincide unless particular interpretive scales are used to translate across the spatiotemporal differences between them. What Zimmerer and Bassett call 'fragmented' scales are interpretations of mismatches in the operational scales of ecological and social processes.

Robbins' 'hybridity thesis' proposes to overcome the problems of cross-scale analysis in political ecology by combining actor-network theory with a deeper historical perspective. While this seems an innovative approach for understanding the ways in which social actors and biophysical agency interact, the hybrid approach remains vague about the observational scales used for explaining the spatiotemporal differences that emerge from the operations of actor-networks. Adding 'historical depth' to actor-networks is not a simple matter of adding a few decades or centuries and extending the time frame of analysis, but requires a change in the scale of observation so that it encompasses the different spatiotemporal forms and patterns produced by actors and their networks. Even if the notion of scale as vertically ordered spatial levels is abandoned in favour of horizontally organised actor-networks, there remains the need to define an interpretive scale for explaining differences in spatiotemporal forms or outcomes of ecological and social change.

Robbins' hybridity thesis provokes a number of questions regarding scale: what is the rationale or criteria for selecting a particular observational scale to analyse actor-network interactions? Is the operational scale of actor-networks defined primarily by institutions such as scientific laboratories, government agencies, nation-states, or 'communities' and delimited by their distinctive modes of 'enrolling' non-human actors? Or is it defined in terms of how particular non-human actors 'enrol' social institutions that operate across different spatiotemporal extents? What kinds of spatiotemporal orderings do horizontally organised actor-networks produce? Do these orderings produce interpretive scales based on the 'enrolling' power of actors or are they based on the differential power of networks?<sup>3</sup>

We believe that the question of scale in political ecology remains a problem because it is routinely reduced to a nominal representation of spatial ordering of politics or political authority. Despite assertions that scale is constructed and that there is a politics of/about/between/and within scales, most political ecology researchers reduce the concept of scale to an order or range of spatial levels, effectively rendering it apolitical. Most political ecologists (and critical geographers) fail to recognise or pay attention to the ways in which scale is produced, articulated, and used to interpret the outcomes of ecological change and spatiotemporal difference in socialised landscapes.

The critical challenge for political ecologists is to develop analytical frameworks that begin from the basic recognition that scale is *produced* to explain, or argue for or against, the processes and outcomes of ecological change in different realms of politics and policy discourse. Scale is the means by which ecology is *made* 'political'. If the aim of political ecology is to understand and illustrate the different ways in which ecological change occurs and becomes politicised, then it needs to develop analytical methods that not only focus on the spatial levels through which politics is articulated, but also on the meanings and metaphors of landscape that are produced and used to interpret the outcomes of ecological and social change (see Neumann 2005; Wainwright 2005).

---

<sup>3</sup> These questions also apply to the arguments for 'flat ontologies' presented by Marston *et al.* (2005).

#### IV Production of scale

The production of scale is a fundamental part of the activities and movements involved in what Henri Lefebvre (1991) calls the ‘production of space’, as well as in the production of time and power. Scale is produced by combining space, time, and power into different forms, functions, measures, symbols, and sensibilities, and is used to articulate relations, controls, and representations of social and biophysical landscapes.

Lefebvre argues that space is not something that exists as a geographical backdrop or container of populations, but is produced from physical, mental, and social activity. He sees the production of space embracing three kinds of actions, which he calls “three moments of social space” (*ibid.*: 40): spatial practice, representations of space, and representational spaces. These moments come together through activities and movements to produce space as practices of everyday life, as measures or categories of spatial difference, and the means for engaging in political action. Although Lefebvre does not directly engage with issues of scale in his discussions of space, his three moments in the production of space are equivalent to what we see as the operational, observational, and interpretive moments in the production of scale.

*Spatial practice*, according to Lefebvre, refers to the physical activities and patterns of interaction that people engage in as a matter of routine. They take this space for granted because it is what they ‘perceive’ and what they have to negotiate through the activities and movements of everyday life. The space produced from spatial practice is, as he says, “lived directly before it is conceptualised” (*ibid.*: 34). Lefebvre’s description of spatial practice is similar to what Braudel (1981) calls *la vie quotidienne*, or the structures of everyday life that encompass the routine and ongoing interactions, movements, and rhythms of social activities and biophysical processes. Spatial practice produces different kinds of operational scales that are reflected in distinctive socialised ecologies or landscapes.

*Representations of space* are produced by dominant social actors who, in order to exercise control, categorise and organise spatial practice according to what they think it *should* be. Lefebvre describes this kind of space as ‘conceptualised’ and different from the ‘perceived’ space of spatial practice; it is “the space of scientists, planners, urbanists, technocratic subdividers and social engineers, as of a certain type of artist with a scientific bent – all of whom identify what is lived and what is perceived with what is conceived. This is the dominant space in any society (or mode of production)” (*ibid.*: 38-39). Lefebvre notes that, “representations of space are shot through with a knowledge (*savoir*) – *i.e.*, a mixture of understanding (*connaissance*) and ideology – which is always relative and in the process of change” (*ibid.*: 41). We see ‘representations of space’ as equivalent to the observational scales that are produced by institutional actors involved in analysis, policymaking, administrative control or management of different kinds of spatiotemporal units. These institutional actors select various social and biophysical categories and spatiotemporal units for observation, identify their characteristics, define their prescribed behaviour, specify their order, and control their arrangement.

Lefebvre describes *representational space* as consciously performed by people “through its associated images and symbols” (*ibid.*: 39): these are spaces “redolent with imaginary and symbolic elements, they have their source in history – in the history of a people as well as in the history of each individual belonging to that people... It [representational space] embraces the loci of passion, of action and of lived situations...[and] may be directional, situational or relational, because it is essentially qualitative, fluid and dynamic” (*ibid.*: 41-42). We see Lefebvre’s ‘representational spaces’ as equivalent to the interpretive scales produced by institutions, groups, and individuals for representing the processes and outcomes of ecological and social change in particular ways. Their explanations or narratives may take the form of ‘models’, symbols, mythical

storylines and performances that interpret the experiences and outcomes of ecological and social change as disruption, transformation or evolution.

Lefebvre's theorisation of the production of space and mode of triadic analysis (1980 in Elden *et al.* 2003: 50-51; also Soja 1996) serve as the broad framework and method for the following elaborations on how each moment of scale is produced.

## 1 Production of operational scale

Operational scale is produced from combinations of **time**, **space**, and **power** that shape social activity and biophysical processes into particular forms or configurations. These forms are recognisable, but never completely determined. Braudel, for instance, describes three kinds of social historical forms: the *longue durée*, or the habitual rhythms of material life and practices that structure everyday life and seem to change at an almost imperceptible pace; *conjunctures*, or close-paced fluctuations that emerge from the coming together of demographic change, capital movements, and biophysical processes; and *events*, or amplified incidents that despite the intensity of their occurrence are short-lived (1972, 1981). Geologists and palaeontologists talk about natural historical forms in terms of eras, epochs, ages, phases, and moments (Gould 1989, 1997). Geographers refer to worlds, regions, and places (see Massey 2005 for an overview), while ecologists refer to biomes, watersheds, and niches. Social and cultural theorists may refer to culture, customs, and states; ideology, strategy, and tactic; or structural, covert, and overt power (see for example Foucault 1980; Peterson 2000). There are many more examples of these recognisable, but non-determined, forms of time, space, and power and their convergent configurations.

Most operational scales are distinguished in terms of their breadth, pace, and intensity of activity. For instance, Massey describes the operational scale of 'place' as a "spatiotemporal event" (2005: 130-142), a concentrated incidence of activities and movements that produces a node or moment in a network of interaction. Peterson describes overt power as "the direct wielding of power through force, incentives, or intimidation to influence people's decisions" (2000: 334), which operates in the present, over brief periods and specific locations; covert power involves the manipulation of institutions and occurs over slower and larger institutional scales, while "structural power involves manipulating culture, which is slow to change, and likely operates over a broader area than an individual institution" (*ibid*: 334). The title of Braudel's book, *The Mediterranean and the Mediterranean World in the Age of Philip II*, refers to an operational scale that is distinguished by a particular configuration of space, time, and power. Similarly, phrases such as the "black Atlantic" (Gilroy 1993), "Black Rice" (Carney 2001), or the "Columbian Exchange" (Crosby 1972) invoke operational scales configured by different activities, movements, and exercise of power across and around the Atlantic ocean over different time periods.

## 2 Production of observational scale

Observational scale is produced through measurement and control. It involves the setting of parameters and conditions within which social or biophysical phenomena are examined. Governments, policymakers, scientists and social researchers produce observational scale by focusing on particular social groups or biophysical entities, delimiting the spatiotemporal extent of their activities or movements, determining the resolution of the data for analysing their behaviour, and specifying the disposition, *i.e.*, the conditions, order, arrangement and rules of behaviour of the entities or phenomena chosen for surveillance, control or study.

Most empirical studies in geography and ecology focus on the spatial measure of observational scale in terms of 'extent' and 'resolution'. Extent refers to the

spatiotemporal area that is delimited for observing the activities and behaviour of selected biophysical and social agents in relation to a particular phenomenon. Resolution refers to the “smallest distinguishable parts of an object” (Lam 2004: 25), *i.e.*, the smallest interval at which data can be obtained. Resolution is also called ‘grain’, defined as “the area represented by each data unit” of the categories selected for observation (Turner *et al.* 1989: 154). Studies that focus on small areas can be fine-grained or of high resolution with data obtained at smaller intervals, while studies that focus on large extents are often coarse-grained or of low resolution with data obtained at larger intervals (Lam 2004: 26).<sup>4</sup> The processual measures defining observational scale relate to spread or distribution, speed, and frequency of occurrence. For example, plant invasion ecologists define invasive plants as “species that expand from the site of original arrival into intact or semi-intact vegetation (regardless of demonstrated impact)” (Henderson *et al.* 2006: 27), and as “a subset of naturalised plants that produce reproductive offspring, often in large numbers, at considerable distances from parent plants, and thus have the potential to spread over a large area” (Richardson and Pyšek 2006: 411).

The production of observational scale depends on knowing operational scales of the categories or phenomena chosen for study, control, or surveillance. Lam notes that identifying “the operational scale of any phenomenon is an important step, because it determines how large the spatial extent and the resolution of a study should be in order to capture the major variation or characteristics of the pattern, which ultimately affects the ability of the study in revealing the underlying processes” (2004: 26). For instance, the tree species *Acacia nilotica* is classified as an invasive ‘weed of national significance’ in Australia, but is found mainly in northern and central Queensland. Government departments at national and state levels, regional catchment management agencies, parks bodies, shire councils, and cattle station owners are required to either eradicate the species or control its spread within their jurisdictions. Given the vast land area of northern and central Queensland, land managers cannot gain a comprehensive sense of the operational scale of *A. nilotica*’s spread or its patterns and density of occurrence. Hence they have to rely on models that extrapolate relatively coarse data obtained from plant specimen collections maintained by herbaria, or which combine these with fine-grained data based on controlled observations of the plant’s behaviour under different grazing patterns and climatic conditions within small study areas.

Because observational scale depends on ‘objective’ measures, limits, and controls of the categories or phenomena selected for study or surveillance, it is often the subject of contention in scientific and policy debates. Policymakers and researchers may question the choice of categories, their resolution, the delimiting of extent and boundaries, and presumed order and disposition of relationships between them. Different institutions and actors may challenge the ‘models’ used for extrapolating the behaviour of categories and phenomena by pointing to the mismatch between operational and observational scale. The outcomes of debates regarding the objective characteristics of observational scale thus depend on how different models that represent the order and behaviour of categories are used to interpret spatiotemporal difference and ecological change as ‘problems’ (*e.g.*, plant invasions, deforestation, overstocking, and so on).

### 3 Production of interpretive scale

Interpretive scale is perhaps easier to recognise from lived experience than to describe in the language of scientific rationality. Researchers often use words such as ‘qualitative’ and ‘cultural’ to describe sensibilities or behaviours that cannot be easily measured and

---

<sup>4</sup> Lam points out that with contemporary advances in increased computing and data storage capacity, it is possible to have studies of large areas at finer resolution (2004: 26).

controlled. But such terms tend to obscure the ways in which interpretation is carried out in analysis or policymaking. Foucault's (1980) concept of discourse and discursive formation goes some way towards understanding how 'rational knowledge' is produced and interpreted as something called 'reality'. Discourse is not limited to analysing text, language, or conventions of conversation, but about how some statements and explanations emerge as knowledge or 'truths'. It involves the production of an interpretive realm that Foucault calls discursive formation, which establishes a regular or 'rational' relationship between "objects, types of statement, concepts or thematic choices" in the form of "an order, correlations, positions, functionings, and transformations" (*ibid*: 41). Hajer follows Foucault in describing discourse as "a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced and transformed in a particular set of practices and through which *meaning* is given to physical and social reality" (1995: 44, our emphasis). He points out that while the discourse surrounding a phenomenon may be diverse and complex, interpretation occurs through story lines or narratives that produce particular discursive forms or explanations that cohere and conform to a particular order of rationality.

The production of rational knowledge and rationality is, however, only part of the interpretive process. Excessive emphasis on deconstructing rational knowledge often obscures the ways in which sensibilities and emotions are evoked to imbue scientific or policy discourse with legitimacy and authority. As Bailey (1983) points out, the capacity of reason and rationality to help understand and manage the world is limited indeed. Despite repeated invocations and appeals to rationality and reasoned debate made by scientists and policymakers, neither of these are sufficient means to assert authority in the public realm or in the politics of governance. Hence the discourse of rationality needs to be made persuasive by using rhetoric that simplifies and generalises particular experiences and phenomena into universal symbols or 'truths' which invoke feelings of trust, reassurances of familiarity, or sensibilities of belonging. Bailey notes that truths are not made objectively true through rational consensus or agreement, but are made so by narratives that invoke emotions and appeal to feelings of trust and shared values. The appeal to 'values' introduces a normative hierarchy across which interpretation takes place in order to establish a broad form of agreement regarding particular statements. The normative hierarchy of values becomes the interpretive scale that serves as the device for political persuasion in the public realm, and plays a much larger role than rationality in the politics of governance. Interpretive scale enables both the exercise of power by institutions of governance and the performance of challenges and opposition to authority; it allows both to appeal to the emotions and sensibilities of the populace through the rhetorical shield of rationality and objectivity.

Interpretive scale is, therefore, distinct from operational and observational scale in that it is produced as a normative hierarchy or ordered range of values that serve as the context and means by which 'truth making' occurs in scientific and policy discourse. Generalisation and simplification are core activities of truth making, and are produced by using interpretive scale to extrapolate and translate across and between observational and operational scales (also see Howitt 1998). Extrapolation works on the logic that a phenomenon occurring at a particular spatiotemporal context can be projected across others, because its observational scale is positioned within and linked by a relational order of spatiotemporal values ranging from lesser to greater extents. But there are problems with this reasoning. Most researchers, be they biophysical or social scientists, are aware that "processes and controls and relationships at different scales may be independent of each other" (Phillips 2004: 93), and that "seamless representation across the whole range of relevant scales is impossible, and scale independence must be accounted for" (*ibid*: 97). Scale independence means that extrapolation across an ordered

range of spatial values can neither be accomplished by merely changing the ratio of representation (as in enlarging or reducing a map), nor by aggregating or disaggregating data to accommodate larger or smaller spatial values. Moving from one observational scale to another alters the behaviour of the categories chosen for studying the phenomenon. The differences in behaviour may arise for a variety of reasons: variations in intensity, new or unexpected elements, actors, or factors that appear at some observational scales but not others (Turner *et al.* 1989).

A good example of scale independence can be found in Matthew Turner's (2003) analysis of pastoral activities in the Sahelian regions of West Africa. He shows that categories such as numbers of livestock and amount of available forage, which are normally used for estimating carrying capacity of grazing areas, are significant only within narrow and controlled spatial and temporal extents of observation. When the observational scale is broadened to encompass longer-term patterns of cattle herding across rangelands, these categories become insignificant in relation to others such as land use composition, distribution of pastures, livestock demography, grazing management, trading and investment in cattle, and distribution of livestock wealth.

Scale independence means that extrapolation of a phenomenon across an order or range of spatiotemporal categories will not necessarily yield generalised truths about causes, behaviour, effects and outcomes. It presents a dilemma for researchers and policymakers who wish to draw on empirical data of a phenomenon obtained at one observational scale and present an 'objective' or 'realistic' generalisation of that phenomenon across a range of spatiotemporal extents. Scale independence reduces the interpretive power of extrapolation from the particular to the general and positions between them.

Truth making by generalisation or simplification therefore requires extrapolation to be aided by narratives that translate particular experiences into 'facts' in order to exercise power and authority in the realms of scientific debate and policymaking. Translation occurs through narratives that *abstract* particular objects, factors, or observational categories from their spatiotemporal contexts and represent these as archetypes whose logic of existence and behaviour is 'universal' in space and time (also see Callon 1986). The abstracted categories are invested with special meaning and significance as symbols or 'models' that transcend geographical boundaries and historical contexts (Barthes 1972; Geertz 1973). For example, one of the most widely used and politically persuasive explanations is Hardin's (1968) 'tragedy of commons', where interpretation occurs through a model based on the essential logics and relationships of a limited number of abstracted causal factors – rational self-interest, limited resources, population growth – to make generalisations that extend from 'the local' to 'the global'.

Interpretive scale is thus produced as a configuration of sensibilities and perspectives or 'scopes' that rework the measurements and boundaries used for observation into models and symbols that signify various ecological phenomena and entities as good, bad, useful, native, alien, benign, or invasive. It becomes the means by which ecological change and changes in socialised landscapes are made political in the public realm by invoking feelings of belonging, taste, beauty, usefulness, prejudice, fear or hope.

## V What makes ecology political?

Examining the production of scale through its three moments provides a clearer understanding of how these come together in explanations of ecological and attendant social change. Our analytical approach offers three insights: **first**, conventional references to scale as political or eco-spatial levels obscure the ways in which these serve as part of the interpretive scales used in political and policy discourses regarding

ecological and social change; **second**, the interpretive scales that are produced from prevailing political rhetoric and discourses of rational governance determine the observational scales used for studying ecological change; and **third**, the perspectives and sensibilities, *i.e.*, ‘scopes’, that researchers and policymakers bring to the delineation of operational scales of ecological and social processes play a critical role in ‘enframing’ outcomes of change as *disruption* to places, *transformation* of regions, or as differentiated regional *evolution*.

The third point is particularly relevant for political ecology. We began this essay by noting that the scopes of analysis used in political ecology offer little insight into the *different* experiences and perspectives regarding the outcomes of ecological and attendant social change. The predominant scope for political ecology studies (and environmental history) is of change as *disruption* to the presumed ecological and social order of places; the multiple levels and scales brought to enframe analyses of ecological change inevitably produce declensionist or tragic narratives about the *ecological politics of place*.

Robbins notes that there are some recent studies that show “peasant adaptations to changing markets and local environments, which are surprising since they show success stories, rather than the usual disasters that are more commonly the stuff of political ecology” (2004b: 214). We believe that scope is not just a matter of vision that sees success or failure, good or bad agents, or even combinations of good and bad outcomes of ecological and social change. What matters is whether political ecology studies can adopt scopes of analysis that encompass ecological change as an integral part of the human processes of regional transformation and differentiation, imbricated in daily life and livelihood practices, in development schemes and plans for improvement, and in emotional attachments to place (Kull and Rangan, *in press*).

Judith Carney’s *Black Rice* (2001) offers an example of how a political-ecological scope that views change as transformation rather than disruption can reveal new insights regarding the agency of African slaves in *making* and transforming the rice-producing regions of the southern United States. Her study is framed by the ‘Middle Passage’ of the trans-Atlantic trade, with its circuits of movement of slaves, plants, products, and capital between Europe, West Africa and the Americas. Carney combines archival information with past and present agro-ecological analyses of cultivation of African rice, *Oryza glaberrima*, to trace the similarities between the technics and infrastructure of rice producing landscapes of West Africa and the southern United States. Her analysis reveals an array of strategies used by West African slaves in the transfer and diffusion of African rice cultivation in the plantations and tidal swamps of South Carolina and Georgia between the 17<sup>th</sup> and 19<sup>th</sup> centuries. Slave men and women transformed the landscapes of these colonies by altering the conditions of work typical of chattel slavery to task-based labour arrangements, diversifying their livelihood activities, escaping to form rice-growing maroon communities, and abandoning rice plantations following the abolition of slavery. Carney’s analysis shows how the conjunctures emerging from the different work strategies of slaves, shifts in trans-Atlantic commerce, conflicts, and wars transformed regional landscapes and gave rise to new political identities and sensibilities of dignity and freedom among African populations in the southern United States.

A variation of this kind of political-ecological scope is found in Ian Tyrrell’s (1999) *True Gardens of the Gods*, which describes the transfers of biota and accompanying ideas of nature, aesthetics, moral values, social improvement, scientific knowledge and technological expertise that occurred between southeastern Australia and California from the mid-19<sup>th</sup> century to the 1930s. Tyrrell shows how the shared experience of frontier expansion and settlement across the Pacific Ocean combined with distinctive political, economic, ecological conditions and the biological agency of transplants gave rise to

different social priorities, new environmental sensibilities, conflicts of interest regarding introduced species and their place in these regionalised landscapes.

We believe that the different political-ecological scopes adopted in these examples provide a better understanding of the varied ways in which human activity, intentionality and control, and biophysical agency come together to transform landscapes and rework social relations. It is perhaps the need for this kind of scope and scale of analysis that motivated Blaikie and Brookfield to describe their approach as *regional* political ecology, one that would explore and explain how the convergences or *conjunctures* – of environmental variability, spatial variations in resilience and sensitivity of land under different kinds of uses, and of economic growth or decline – might produce differentiated regional landscapes of power, social fortunes, identities, and sensibilities of belonging. Political ecology may well benefit from readopting a ‘regional’ scope that extends understanding beyond the politics of ecological and social disruptions of place.

**Acknowledgements:** The research is part of a larger project funded by the Australian Research Council (DP 0666131). We are grateful to Craig Thorburn, Bruce Missingham, Elissa Sutherland, Michael Webber, John Friedmann, and three anonymous reviewers for their insightful comments and suggestions.

## REFERENCES

- Awanyo, L.** 2001: Labour, ecology and a failed agenda of market incentives: the political ecology of agrarian reforms in Ghana. *Annals of the Association of American Geographers* 91, 92-121.
- Bailey, F. G.** 1983: *The Tactical Uses of Passion*. Ithaca: Cornell University Press.
- Barthes, R.** 1972: *Mythologies*. New York: Noonday Press.
- Beinart, W. and Middleton, K.** 2004: Plant transfers in historical perspective: a review article. *Environment and History* 10: 3-29.
- Blaikie, P. and Brookfield, H.,** 1987: *Land degradation and society*. London: Methuen.
- Braudel, F.** 1972: *The Mediterranean and the Mediterranean world in the age of Philip II*. London: Harper Collins.
- Braudel, F.** 1981: *The structures of everyday life: Civilisation and capitalism 15<sup>th</sup> to 18<sup>th</sup> century*. New York: Collins.
- Brenner, N.** 2001: The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography* 25 (4), 591-614.
- Brockway, L.** 1979: *Science and Colonial Expansion: The role of the British Royal Botanic Gardens*. Reprinted 2002. New Haven: Yale University Press.
- Browne, J.** 1996: Biogeography and empire. in Jardine, N., Secord, J., and Spary, E, editors, *Cultures of natural history*. Cambridge: Cambridge University Press, 305-321.
- Bryant R. and Bailey, S.** 1997: *Third World political ecology*. London: Routledge.
- Callon, M.** 1986: Some elements of a sociology of translation domestication of the scallops and the fishermen of St. Brieux Bay. In Law, J. editor, *Power, Action and Belief: A new sociology of knowledge*. Keele: Sociological Review Monographs, 196-229.
- Cappuccino, N. and Arnason, J.** 2006: Novel chemistry of invasive exotic plants. *Biology Letters* 2 (2), 189-193.
- Carney, J.** 2001: *Black rice: The African origins of rice cultivation in the Americas*. Cambridge, MA: Harvard University Press.
- Collinge, C.** 2006: Flat ontology and the deconstruction of scale: a response to Marston, Jones and Woodward. *Transactions of the Institute of British Geographers* NS 31, 244-51.

- Cronk, Q.** and **Fuller, J.** 1995: *Plant Invaders*. London: Chapman and Hall.
- Cronon, W.** 1992: Nature, history, narrative: a place for stories. *The Journal of American History* 78 (4), 1347-1376.
- Crosby, A.** 1972: *The Columbian exchange: Biological and cultural consequences of 1492*. Westport, CT: Greenwood Press.
- Crosby, A.** 1986: *Ecological imperialism: The biological expansion of Europe, 900-1900*. Cambridge: Cambridge University Press.
- Delaney, D.** and **Leitner, H.** 1997: The political construction of scale. *Political Geography* 16, 93-97.
- Drayton, R.** 2000: *Nature's government: Science, imperial Britain, and the 'improvement' of the world*. London: Yale University Press.
- Elden, S., Lebas, E.** and **Kofman, E.**, editors 2003: *Henri Lefebvre: Key Writings*. London: Continuum.
- Forsyth, T.** 2003: *Critical political ecology: The politics of environmental science*. London: Routledge.
- Foucault, M.** 1980: Questions on geography. In Gordon, C. editor, *Power/Knowledge: Selected interviews and other writings, 1972-1977, Michel Foucault*. New York: Pantheon Books, 63-77.
- Freidberg, S.** 2001: To garden, to market: Gendered meanings of work on an African urban periphery. *Gender, Place and Culture* 8 (1), 5-24.
- Freidberg, S.** 2004: *French beans and food scares: Culture and commerce in an anxious age*. New York: Oxford University Press.
- Geertz, C.** 1973: *The interpretation of cultures*. New York: Basic Books.
- Gezon, L.** 2005: Finding the global in the local: Local struggles in northern Madagascar. In Paulson, S. and Gezon L., editors, *Political ecology across spaces, scales, and social groups*. New Brunswick, NJ: Rutgers University Press, 217-243.
- Gilroy, P.** 1993: *The black Atlantic: Modernity and double consciousness*. London: Verso.
- Gould, S.J.** 1989: *Wonderful life: The Burgess Shale and the nature of history*. New York: Norton.
- Gould, S.J.** 1997: An evolutionary perspective on strengths, fallacies, and confusions in the concept of native plants. In Wolschke-Buhlman, J., editor, *Nature and ideology: Natural garden design in the twentieth century*. Washington: Dumbarton Oaks, 11-20.
- Grove, R.** 1995: *Green imperialism: Colonial expansion, tropical island Edens and the origins of environmentalism 1600-1860*. Delhi: Oxford University Press.
- Hajer, M.** 1995: *The Politics of Environmental Discourse*. Oxford: Clarendon.
- Hardin, G.** 1968: The tragedy of the commons. *Science*. 164, 1243-1248.
- Harlan, J.** 1992: *Crops and man*, second edition. Madison: American Society of Agronomy.
- Hecht, S.**, and **Cockburn, A.** 1989: *The fate of the forest: Developers, destroyers, and defenders of the Amazon*. London: Verso.
- Henderson, S., Dawson, T.** and **Whittaker, R.** 2006: Progress in invasive plants research. *Progress in Physical Geography* 30 (1), 25-46.
- Herod, A.** and **Wright, M.**, editors 2002: *Geographies of power: placing scale*. Oxford: Basil Blackwell.
- Howitt, R.** 1998: Scale as relation: musical metaphors of geographical scale. *Area* 30 (1), 49-58.
- Howitt, R.** 2002: Scale and the other: Levinas and geography. *Geoforum* 33, 299-313.
- Jonas, A.** 1994: Editorial: the scale politics of spatiality. *Environment and Planning D: Society and Space* 12, 257-264.
- Kull, C.** and **Rangan, H.** in press: Acacia exchanges: Wattles, thorn trees, and the study of plant movements. *Geoforum*

- Lam, N.** 2004: Fractals and scale in environmental assessment and monitoring. In E. Sheppard, E. and McMaster, R., editors, *Scale and geographic enquiry: Nature, society, and method*, Oxford: Blackwell, 23-40.
- Latour, B.** 1987: *Science in action: How to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.
- Latour, B.** 1993: *We have never been modern*. Cambridge: Harvard University Press.
- Latour, B. and Woolgar, S.** 1986: *Laboratory life: the construction of scientific facts*, second edition. Princeton, NJ: Princeton University Press.
- Lebel, L., Garden, P. and Imamura, M.** 2005: The politics of scale, position, and place in the governance of water resources in the Mekong Region. *Ecology and Society* 10(2), 18.
- Lefebvre, H.** 1991: *The production of space*. Oxford: Basil Blackwell.
- Leitner, H.** 2004: The politics of scale and networks of spatial connectivity: Transnational interurban networks and the rescaling of political governance in Europe. In Sheppard, E. and McMaster, R., editors, *Scale and geographic enquiry: Nature, society, and method*, Oxford: Blackwell, 236-255.
- Marston, S.** 2000: The social construction of scale. *Progress in Human Geography* 24, 219-242.
- Marston, S. and Smith, N.** 2001: States, scale and households: limits to scale thinking? A response to Brenner. *Progress in Human Geography* 25, 615-619.
- Marston, S., Jones, JP, and Woodward, K.** 2005: Human geography without scale. *Transactions of the Institute of British Geographers* NS 30, 416-432.
- Massey, D.** 2005: *For space*. London: Sage Publications.
- McCarthy, J.** 2005a: Guest editorial. *Environment and Planning A* 37, 953-958.
- McCarthy, J.** 2005b: Scale, sovereignty, and strategy in environmental governance. *Antipode* 37(4), 731-753.
- Mintz, S.** 1985: *Sweetness and power: The place of sugar in modern history*. New York: Penguin Books.
- Neumann, R.** 2005: *Making political ecology*. New York: Hodder Arnold.
- Paasi, A.** 2004: Place and region: looking through the prism of scale. *Progress in Human Geography* 28 (4), 536-546.
- Parry, B.** 2000: The fate of collections: Social justice and the annexation of plant genetic resources. In Zerner, C., editor, *People, plants, and justice: The politics of nature conservation*. New York: Columbia University Press, 374-402.
- Parry, B.** 2004: *Trading the genome: Investigating the commodification of bio-information*. New York: Columbia University Press.
- Paulson, S. and Gezon, L.,** editors 2005: *Political ecology across spaces, scales, and social groups*. New Brunswick, NJ: Rutgers University Press.
- Paulson, S., Gezon, L., and Watts, M.** 2005: Politics, ecologies, genealogies. in Paulson, S. and Gezon L., editors, *Political ecology across spaces, scales, and social groups*. New Brunswick, NJ: Rutgers University Press, 28-64.
- Peet, R. and Watts, M.,** editors 1996: *Liberation ecologies: Environment, development, social movements*. London: Routledge.
- Peterson, G.** 2000: Political ecology and ecological resilience: an integration of human and ecological dynamics. *Ecological Economics* 35: 323-36.
- Phillips, J.** 2004: Independence, contingency, and scale linkage in physical geography. In E. Sheppard, E. and McMaster, R., editors, *Scale and geographic enquiry: Nature, society, and method*, Oxford: Blackwell, 86-100.
- Richardson, D. and Pyšek, P.** 2006: Plant invasions: merging the concepts of species invasiveness and community invasibility. *Progress in Physical Geography* 30 (3), 409-431.

- Ridley, H.** 1930: *The dispersal of plants throughout the world*. Ashford: Reeve.
- Robbins, P.** 2001: Tracking invasive covers in India, or, why our landscapes have never been modern. *Annals of the Association of American Geographers* 91 (4), 637-659.
- Robbins, P.** 2002: Obstacles to a First World political ecology? Looking *near* without looking *up*. *Environment and Planning A*: 34: 1509-13.
- Robbins, P.** 2004a: Comparing invasive networks: cultural and political biographies of invasive species. *The Geographical Review* 94 (2), 139-156.
- Robbins, P.** 2004b: *Political Ecology*. Oxford: Blackwell.
- Rocheleau, D. and Ross, L.** 1995: Trees as tools, trees as text: Struggles over resources in Zambrana-Chacuey, Dominican Republic. *Antipode* 27 (4), 407-425.
- Sauer, C.** 1969: *Agricultural origins and dispersals*, second edition. Cambridge, MA: MIT Press.
- Sayre, N.** 2005: Ecological and geographical scale: parallels and potential for integration. *Progress in Human Geography* 29 (3), 276-290.
- Schroeder, R.** 1999: *Shady practices: Agroforestry and gender politics in the Gambia*. Berkeley: University of California Press.
- Schroeder, R. and Suryanata, K.** 2004: Gender and class power in Agroforestry systems: case studies from Indonesia and West Africa. In Peet, R. and Watts, M. editors, *Liberation ecologies: Environment, development, social movements*. Second edition. London: Routledge, 299-315.
- Schroeder, R.** 2005: Debating the place of political ecology in the First World. *Environment and Planning A* 37, 1045-48.
- Sheppard, E. and McMaster, R.,** editors 2004: *Scale and geographic enquiry: Nature, society, and method*. Oxford: Blackwell.
- Smith, N.** 1984: *Uneven development: Nature, capital and the production of space*. Oxford: Basil Blackwell.
- Soja, E.** 1996: *Thirdspace: Journeys to Los Angeles and other real-and-imagined places*. Oxford: Blackwell.
- Strauss, S., Lau, J. and Carroll, S.** 2006: Evolutionary responses of natives to introduced species: what do introductions tell us about natural communities? *Ecology Letters* 9, 357-374.
- Swyngedouw, E.** 1997: Neither global nor local: 'glocalization' and the politics of scale. In Cox, K., editor, *Spaces of globalisation: reasserting the power of the local*, New York: Guilford, 137-166.
- Swyngedouw, E.** 2004: Scaled geographies: nature, place, and the politics of scale. In E. Sheppard, E. and McMaster, R., editors, *Scale and geographic enquiry: Nature, society, and method*. Oxford: Blackwell, 129-153.
- Taylor, P.** 1984: Introduction: geographical scale and political geography. In Taylor, P. and House, J., editors, *Political geography: recent advances and future directions*, London: Croon Helm, 1-7.
- Taylor, P.** 2004: Is there a Europe of cities? World cities and the limitations of geographical scale analyses, in E. Sheppard, E. and McMaster, R., editors, *Scale and geographic enquiry: Nature, society, and method*. Oxford: Blackwell, 213-235.
- Turner, M.D.** 2003: Environmental science and social causation in the analysis of Sahelian pastoralism. In Zimmerer, K. and Bassett, T., editors, *Political ecology: An integrative approach to geography and environment-development studies*. New York: Guilford, 159-180.
- Turner, M.G., O'Neill, R., Gardner, R., and Milne, B.** 1989: Effects of changing spatial scale on the analysis of landscape pattern. *Landscape Ecology* 3 (3/4), 153-162.
- Tyrrell, I.** 1999: *True gardens of the gods: Californian-Australian environmental reform, 1860-1930*. Berkeley: University of California Press.

- Vayda, A.** 1983: Progressive contextualisation: Methods for research in human ecology. *Human Ecology* 11 (3), 265-281.
- Wainwright, J.** 2005: The geographies of political ecology after Edward Said. *Environment and Planning A* 37, 1033-1043.
- Walker, P.** 2005: Political ecology: where is the ecology? *Progress in Human Geography* 29 (1), 73-82.
- Zimmerer, K. and Bassett, T.,** editors 2003: *Political ecology: An integrative approach to geography and environment-development studies*. New York: Guilford.