



## City

analysis of urban trends, culture, theory, policy, action

ISSN: 1360-4813 (Print) 1470-3629 (Online) Journal homepage: <http://www.tandfonline.com/loi/ccit20>

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To cite this article: Matthew Gandy (2018) Cities in deep time, *City*, 22:1, 96-105, DOI: 10.1080/13604813.2018.1434289

To link to this article: <https://doi.org/10.1080/13604813.2018.1434289>



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Published online: 15 Mar 2018.



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# Cities in deep time

## Bio-diversity, metabolic rift, and the urban question

Matthew Gandy

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*How should we interpret the relationship between urbanization and the loss of bio-diversity? The discourse of bio-diversity serves as a critical lens through which the accelerating momentum of ‘metabolic rift’ can be explored in relation to contemporary mass extinction. But what is the precise role of cities within what has been referred to as the ‘sixth extinction’ facing the history of the earth? Are cities to be subsumed within a broader environmentalist critique of modernity or can they serve as the focal point for alternative cultural, political, and scientific interventions? This article suggests that the distinction between cities and broader processes of urbanization remains significant for a more critically engaged reading of the politics of the biosphere. Indeed, an overemphasis on ‘methodological globalism’ risks obscuring the differences that matter in the articulation of alternative modernities. In particular, we consider how the relationship between cities and ‘deep time’ can be conceptualized as a focal point for the interpretation of global environmental change.*

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**Key words:** bio-diversity, urban ecology, metabolic rift, the Anthropocene, deep time

### 1. Cities in the anthropocene

Emerging interest in the identification of a new geological epoch encompasses an array of critical perspectives, putative chronologies, and alternative terminologies. The recent coalescence around the term Anthropocene, a neologism that first passed almost unnoticed in the 1980s, signals a profound sense that a fundamentally different epoch is now superseding the Holocene that began some 11,700 years ago. Although the Holocene encompassed the origins of agriculture and the rise of the first cities, a series of more recent developments, including the emergence of capitalism during the ‘long sixteenth century’, and the dramatic spike in resource use since the

middle decades of the twentieth century, has focused attention on a radical and potentially irreversible discontinuity in the socio-ecological relations that have underpinned global modernity.

A focus on the Anthropocene transcends the restricted political and temporal terrain of the ‘sustainable development’ agenda that emerged in the 1980s by emphasizing patterns of environmental change over a much longer time period. The case for a new geological periodization draws on two inter-related sets of arguments: first, the accelerating momentum in human induced sources of environmental change; and second, a neo-catastrophist interpretation of the earth’s history that emphasizes not just the scale of previous geo-environmental

transitions but also their rapidity. The inter-related threats to the biosphere from biodiversity loss, climate change, and accumulating environmental ‘sinks’ connect with ‘deep time’ as a frame of reference that moves beyond the conventional scope of historical analysis to engage with forms of radical discontinuity.

A key contention of the Anthropocene is that we are now entering a sixth mass extinction event in which human survival is rendered uncertain (see, for example, Ceballos, Ehrlich, and Dirzo 2017; Kolbert 2014; Lovejoy 2012). Under previous mass extinctions, of which five have now been recognized, over 90 per cent of all life forms were wiped out. During the third mass extinction of the mid-Permian period, for instance, some 260 million years ago, warming temperatures released vast quantities of hydrogen sulphide from dead bacteria, turning the oceans purple, and releasing poisonous bubbles of gas into ‘a pale green sky’ (Zimmer cited in Kolbert 2014, 104). These imaginary accounts of past environmental dystopias located in deep time serve to emphasize the ephemeral and fragile nature of the ecological relations that have underpinned the possibilities for life let alone the intricate forms of socio-ecological interdependence that have allowed human capacities to flourish under modernity.

Our understanding of environmental transitions in the modern era needs to be tempered by evidence of past waves of human modification of the biosphere. Even the earliest hunter-gatherer cultures emerging in the Pleistocene epoch, over two hundred thousand years ago, had an extensive environmental impact through the use of fire to modify natural environments, along with the hunting of megafauna in which perhaps two-thirds of large mammal species were lost (see, for example, Brosimmer 2014). Subsequent episodes of environmental transformation during the Holocene have involved a steady expansion of the ‘human niche’ into existing ecosystems, marked by the rise of agriculture, new patterns of resource

utilization, and the gradual emergence of the ‘technosphere’ comprising ‘the sum total of all the earth’s physical infrastructure’ (see Otter 2017, 146). Under this conceptualization, which bears similarities with the ‘planetary urbanization’ thesis, cities are simply a historically and geographically specific manifestation of a broader set of processes and interdependencies (see Brenner 2014).

Several different starting points have been suggested for the Anthropocene including the megafauna extinctions, the emergence of agriculture, the discovery of the New World, the proto capitalist realm of seventeenth-century Holland, the switch from water to steam power in late eighteenth century England, the ‘mercurial signature’ within the global food chain, radioactive traces left by the detonation of the first nuclear weapons, and more recently, the extraction of rare earths under the transition to digital capitalism. Cities hold a growing presence within this panoply of historical developments as centres for trade, consumption, and the coordination of wider processes of state formation. Indeed, the growth of cities has even been referred to as a potential ‘golden spike’ within the future stratigraphic record marked by a distinctive *mélange* of burrowings and material traces (see Davies 2015).

The more incisive literature on the Anthropocene has sought to link causality with periodicity. The first use of steam power in 1784, for example, serves as a convenient marker within a broad history of increasing human impact on the biosphere. The switch from water to steam power increased the mobility of capital and enabled the transfer of production from predominantly rural areas to fast growing industrial towns such as Birmingham and Manchester (see Kunkel 2017; Malm 2016). Furthermore, the creation of large pools of (surplus) labor tilted the balance of power in favor of capital and freed production from the constraints of nature, location, and potential labor shortages. The concomitant reliance on fossil fuels also dramatically expanded the

potential scope, scale, and mobility of industrial production adding further impetus to capitalist urbanization.

It would be misleading, however, to argue that capitalism and urbanization are fully synonymous even though the built environment, and the secondary circuit of capital, has played a key role within the expansionary dynamics of global capital. As Ernest Mandel has pointed out, following Lefebvre, the problematic dimensions to urbanization are an outcome of the structural and political characteristics of capital rather than inherent features of the modern city:

‘The blatant deformation of urban development since the industrial revolution, has been the unequivocal product of social conditions: private ownership of land; real-estate speculation; systematic subordination of town planning to the development of ‘growth sectors’ of private industry; general underdevelopment of socialized services’ (Mandel 1978 [1972], 504).

For Mandel, the substitution of a capitalist logic with an ideological attachment to ‘technical rationality’ fails to address the destructive and alienating dimensions to urbanization:

‘These societal conditions, far from being suspended or neutralized by any technical logic, in their turn determined technological development—for example, the backwardness of industrial methods in the construction industry—and aberrant development (high-rise blocks, dormitory cities, and so on)’ (Mandel 1978 [1972], 504).

Urban form is thus a reflection of the political dynamics of urban space rather than an innate dimension to modernity. Mandel’s observations can be read as an indictment of a particular kind of twentieth-century technocratic modernity that reflects the structural parameters of political contestation in the urban arena. Rather than the biomorphic or generic city of avant-garde architectural theory we must contend with ‘actually existing cities’ in their precise historical and

political context (for a classic exposition of this argument see Tafuri 1987). In this sense the urban becomes a space of multiple possibilities driven not just by the logic of capital but emerging from a series of socio-ecological, technological, and ideological entanglements. What forms of agency, materiality, or imagination can co-exist or even flourish in spite of the functionalist imperative of capitalist urbanization? What kinds of alternative socio-ecological or technological pathways might serve as intimations of a different future?

From a somewhat different perspective these ambivalent dimensions to urbanization have also been considered within the burgeoning Anthropocene literature. ‘Cities have been centers of ingenuity, creativity, and wealth since their origins more than five thousand years ago,’ write J.R. McNeill and Peter Engelke (2014, 106), and ‘if well designed, they can require fewer resources per capita than rural areas’. Furthermore, as McNeill and Engelke point out, the greater gender equality fostered by urbanization leads to higher levels of education and lower levels of fertility so that the social, the environmental, and the demographic are inextricably entwined. In these types of assessments we are clearly moving away from the pervasive anti-urban sentiments that inhere in neo-Malthusian perspectives or anti-modern variants of ecocentrism yet the emphasis on socio-technical modes of innovation takes the fundamental parameters of the capitalist city as a given (in an echo of the Chicago School analysis of urban land use in the early twentieth century). What is lacking in McNeill and Engelke’s account, however, is a sense of the historicity of the Anthropocene debate itself in terms of its conceptual antecedents, emerging incongruities, and contemporary cultural resonance.

For the literary critic Jeremy Davies, in his incisive historiography of the Anthropocene, a richer reading of environmental change over the long term must encompass a history of what it means to be human, of the rights

and protections that have developed for individuals and communities, and of the distinctive forms of social inequality that are embedded within specific socio-ecological relations associated with fossil fuel extraction, the expansion of industrialized agriculture, and the destruction of vulnerable biotopes. A key concern for environmental justice under the Anthropocene will be countering the ‘simplifying tendencies of the Holocene’s final phase’ (Davies 2015, 6). These tensions between simplicity and complexity operate on a number of cultural and material levels including the protection of both social and ecological forms of difference: an emerging characteristic of the Anthropocene is the steady replacement of an array of intricate and inter-dependent socio-ecological systems with a series of ‘vulnerable saturated monocultures’ (Davies 2015, 6).

Urban complexity can serve as a critical leitmotif for disentangling different strands of environmental discourse. The diverse cultures of nature encountered in cities problematize the meaning of ‘ecological authenticity’ and attempts at landscape restoration: the rediscovery of urban rivers, for example, or the creation of ‘natural floodplains’ raises questions about the temporal specificity of socio-ecological relations. Similarly, the emerging interest in ‘cosmopolitan ecologies’ emphasizes the global interconnectedness of urban space which further underscores the innate hybridity of the human environment. In this sense, critical variants of urban ecological discourse hold wider implications for the interpretation of nature per se.

The Anthropocene literature is marked by a tension between an undifferentiated ‘we’, typical of more positivistic, technocratic, or neo-Malthusian accounts, and alternative readings of ‘deep time’ that are more alert to the development of different forms of human society (see Davies 2015; Demos 2017). The geo- or bio-engineering responses to the Anthropocene favour large-scale technological fixes such as nuclear-powered

desalination plants to enable the development of vast littoral agglomerations or the rapid development of bio-technologies to enable greater control over food production. These variants of the Anthropocene imaginary mark a radical elaboration of existing discourses within the sustainability literature where capitalist innovation takes precedence over structural forms of social and political change. In contrast, the term Capitalocene, as deployed by Jason Moore, emphasizes the inherent ecological characteristics of capitalist urbanization and the articulation between cities, the transformation of nature, and the emergence of an integrated global economy. Moore’s periodization is centred on the impact of capital rather than a more vaguely framed emphasis on the human impact (and by extension a Eurocentric conception of the human subject) (see Moore 2015). Yet an over extension of the temporal horizon for critical analysis can risk blurring the precise mechanisms that underlie historical change to produce a highly generalized focus on the human species (see Conrad 2016). In contrast to the limitations of ‘big history’, however, Moore’s critique of the Anthropocene rests on the emergence of capital as a sufficiently precise periodization under which an alternative theorization of global environmental change can be persuasively articulated in the face of the geosciences.

## 2. The urbanization of bio-diversity

Cities and bio-diversity are conventionally conceived to lie in antithetical relationship to one another. Indeed, ‘the city’ is widely portrayed as a powerful agent in environmental destruction through its concentrated demands for energy and resources. Yet we should be cautious in ascribing some form of urban agency to the ecological contradictions of capital (see Otter 2017). Manichean perspectives on the modern city can be contrasted with the emergence of more nuanced conceptualizations of the socio-ecological

relations that underpin the production of urban space. Furthermore, the specific ecological characteristics of cities, including cultural and scientific interest in the distinctive characteristics of urban biotopes, have opened up different angles of critical interpretation. But how should we conceptualize the relationship between biodiversity and urbanization? Can the socio-ecological complexity of cities influence global environmental discourse?

The term ‘bio-diversity’ first emerged in the mid-1980s as both a scientific concept and also a symbolic focus for environmental politics. The idea is rooted within the biological sciences, and in particular conservation biology, but also connects with wider domains of policy making, especially in the wake of the Rio summit of 1992. At its inception the term bio-diversity served as ‘a zealous defense of a particular social construction of nature that recognizes, analyses, and rues this furious destruction of life on Earth’ (Takacs 1996, 2). Over time, however, the emphasis of bio-diversity has extended from the protection of vulnerable biotopes at a global scale to a diversity of ordinary environments such as parks, gardens, or interstitial urban spaces. The idea of bio-diversity involves a distinction between those organisms, fragments of nature, or specific biotopes that should be prioritized: bio-diversity comprises an institutionally framed set of judgments about the relative worth of different components of nature. There is an implicit hierarchy of species or ecosystems that are considered worthy of protection yet at the same time the concept encompasses the functional integrity of the biosphere as a whole.

The concept of bio-diversity encompasses degrees of vulnerability as well as irreversible losses caused by the extinction of individual species. The rhetorical salience engendered by ‘ecologies of endangerment’, to use the anthropologist Tim Choy’s expression, has many possible manifestations in the urban arena. Choy’s study of Hong Kong examines how the question of ‘endangerment’ has

become a focal point for environmental politics:

‘It structures images of simultaneous tenuousness, rarity, and value. To speak of an endangered species is to speak of a form of life that threatens to become extinct in the near future; it is to raise the stakes in a controversy so that certain actions carry the consequences of destroying the possibility of life’s continued existence. Species can be endangered, as can ecosystems’ (Choy 2011, 26).

The question of value rests on various indices of uniqueness that are in turn related to the development of taxonomic knowledge: specific species may take on symbolic significance whilst other less showy organisms may have a much more complex or ill-defined relationship with public culture. The vulnerability of a particular species is partly context specific—many species of plants and animals are much rarer towards the edge of their range—and is also related to different definitions of irreplaceability since sub-species can also disappear and some life forms can be artificially sustained in artificial environments such as zoos or laboratories. Furthermore, the recognition of a ‘species complex’ can complicate the precise focus of conservation efforts, along with the implications of DNA barcoding for taxonomic science (a field that is under acute fiscal pressure within the neo-liberal academy and underfunded museum system) (see Waterton, Ellis, and Wynne 2013). It is of particular interest to conservation biology if a species (or sub-species) is endemic to a specific locality, which generally indicates ecosystems with greater degrees of geographical isolation such as islands or mountains. Forms of geographic isolation can also enable speciation to occur within urban space (in underground infrastructure systems, for example) along with epigenetic or behavioral adaptations to urban environments (as evidenced by the effects of noise, pollution, or artificial light) (see Gandy 2017).

It is within this context of cultural and scientific uncertainty that we must contend

with the specific characteristics of urban biodiversity and the limits to scientific knowledge. Studies of urban flora show that cities have high levels of bio-diversity—often higher than their monocultural hinterlands—comprising greater numbers of both native and non-native species (see, for example, Zerbe et al. 2003). Yet these high levels of urban bio-diversity have been criticized on the grounds of their ostensible ecological ‘inauthenticity’—in terms of novel biotopes or species assemblages—or their relative lack of endemism (i.e. the proportion of species that have a highly restricted geographical range). The conventional demarcation used in botanical studies between native and non-native species is based on the year 1500—a date that broadly corresponds with the ‘discovery’ of the New World—but this distinction becomes especially problematic in an urban context that comprises a socio-ecological palimpsest derived from successive traces of global history.

Cities can also serve as laboratories for the study of future ecological scenarios: urban biotopes have been recast as experimental zones to produce new constellations of ecological knowledge as evidenced in Berlin, Montréal, and other cities. Even individual gardens or marginal spaces such as pavements can play a role in this scientific transformation of urban space into a kind of multi-sited public research station. The increasingly urbanized landscapes of the Anthropocene now form a distinctive component of new approaches to nature conservation including urban forms of ‘re-wilding’ (see, for example, Lorimer and Driessen 2014).

The urban arena illustrates the ambiguity and malleability of ecological discourse, spanning concerns with unwanted nature such as pests, weeds, or disease vectors, as well as interest in the intrinsic value of spontaneous ecological assemblages explored by artists, scientists, and vernacular cultures of nature (see Biehler 2013). In the case of urban mammals, for instance, we find a tension between the cherished individual,

exemplified by pets, and the more abstract concept of a population, that may be subsumed within a bio-political framework of enumeration and control (see Srinivasan 2013). Animals also form part of the ‘mechanized zootechnosphere’ (Otter 2017, 152) as a key dimension to the dietary expansion of the human ecological niche.

The development of more systematic engagements with urban bio-diversity has emerged especially since the 1980s in response to more nuanced understandings of socio-ecological complexity, the shifting boundaries of what constitutes ‘the natural’ in the context of cultural landscapes, and the reorientation of conservation efforts towards expanded conceptions of ecological vulnerability and scientific interest. Yet the emergence of ‘biotope mapping regimes’, for instance, and other attempts to integrate biodiversity into land use planning since the 1980s, now lie in tension with the intensifying speculative dynamics of urban space (see, for example, Lachmund 2013).

It is striking that most of the significant theoretical work in relation to the Anthropocene has only engaged indirectly with the urban arena. There are parallels here with the first wave of political ecology literature in the 1980s that focused predominantly on a rural or global South context. The Anthropocene debate has an uncertain articulation with urbanization beyond the identification of specific empirical parameters or material traces.

An initial inventory of the direct environmental effects of cities might include phenomena such as concentrated levels of vehicle emissions, light pollution, or waste generation. The growth of cities has frequently been implicated in the wider dynamics of environmental destruction, either directly through habitat loss (both on the urban fringe and also within metropolitan regions), or indirectly through the production of food, energy, and other commodities. Yet it is the extractive realm of ‘cheap nature’, to use Moore’s term, and its associated environmental sinks, including the

atmosphere and oceans, that is pivotal to ecological destruction rather than the development of cities per se.

If we consider cities as hybrid technological entities we find that infrastructure systems produce distinctive environmental effects such as the linear ecologies of transport networks or interstitial spaces associated with ‘odd lots’ and other marginal zones that are only intermittently or tangentially incorporated into urban land markets. Other distinctive facets to urban bio-diversity include the varied substrates, diverse micro-climatological and hydrological gradations, and various forms of ‘ecological mimicry’ enabled by inaccessible ledges, rooftops, or other sites. Urban ecological assemblages provide a significant redoubt for many species in the face of wider processes of habitat fragmentation: a key argument emerging within conservation biology is that reduced and splintered populations may presage more catastrophic processes of decline and extinction in the future (see Cabello et al. 2017). If we look beyond the steady stream of individual species extinctions there are wider indicators for overall decline including insects needed for the pollination of plants (see Hallmann et al. 2017). The argument I wish to develop here is that cities can play a dual role in the protection of bio-diversity: first, through the provision of a kind of ecological sanctuary for flora and fauna; and second, by enabling the exploration of different socio-ecological interactions that might ultimately be ‘scaled up’ towards new forms of global environmental politics.

### 3. Metabolic rift and the circulatory dynamics of urban space

The swerve away from more abstract, constructivist, or idealist modes of theorization has rekindled interest in the phenomenon of ‘metabolic rift’, as originally elaborated by Marx, along with wider reflections on the metabolic dimensions to urban space. The idea of a radical break between a relatively

stable self-sustaining biosphere and the lurch towards irreversible environmental destruction is captured in Marx’s engagement with the contemporary work of the chemist Justus von Liebig, who explored damage to the soil cycle under the rise of modern agriculture. Marx notes how ‘progress’ in the field of capitalist agriculture ‘is a progress in the art, not only of robbing the labourer, but of robbing the soil’ in an early appreciation of the ecological contradictions of capitalist abstraction.<sup>1</sup> The term ‘rift’ is significant in this context because it emphasizes the longer-term dimensions to metabolic transformation rather than a more historically diffuse emphasis on perpetual re-combinations: there is a clear directionality to the metabolic process engendered by the expanding scope of global capital. The stratigraphic metaphor can be used in a double sense here to evoke both the fragility of the pedosphere and also the layers of human history carved into the surface of the earth.

Marx’s reading of Liebig has been elaborated by Georg Lukács and István Mészáros, along with more recent insights from John Bellamy Foster and Jason Moore, to provide a contemporary analytical tool for understanding destructive relations between society and nature. Moore, for example, emphasizes how the expanding ‘frontiers of appropriation’ that have shaped the ‘world-ecology of capital’ are based on a fundamental tension between a finite nature and a capitalist imperative that is ‘premised on the infinite’ (Moore 2015, 10, 87). A modified conception of metabolism, as developed under aegis of urban political ecology, emphasizes the interweaving between the circulation of capital and the production of the built environment. Neo-Marxian readings of urban metabolism have extended the analytical frame from the original emphasis on soil to a series of intersections between capital and nature encompassing infrastructure, technological networks, and other functional components of urban space (see Swygedouw 2006). The concept of metabolism shows how human labor transforms the raw



materials of nature into the built environment ranging from the specific infrastructure projects of the classic ‘spatial fix’ to the more generalized metabolic dynamics of a ‘socio-ecological fix’ (Ekers and Prudham 2017). This double dynamic between capital and space involves maintenance activities, depreciation of fixed assets, and a variety of cyclical interactions so that the built environment is in a constant state of entropy and flux.

An expanded reading of urban metabolism holds parallels with recent developments in critical theory that draw on a synthesis between neo-Lefebvrian analysis of urban space and the expanded field of neo-Marxian cultural analysis à la Fredric Jameson (see, for example, Ngai 2012). A renewed emphasis on the temporal and material parameters of metabolic rift also connects with an earlier phase of political economy before the rise of marginalist economics, the Kuznets cycle, and the ‘disembedding of the economy from natural constraints’ (Bonneuil and Fressoz 2016, 211). Emerging patterns of environmental destruction under ‘digital capitalism’ involve new kinds of material articulations between space, capital, and society. The idea of the ‘stack’, for instance, as elaborated by Benjamin H. Bratton, denotes a complex interplay between new digital infrastructures and multiple landscapes of resource extraction. Bratton’s use of the term ‘third nature’ does not denote a process of de-materialization but a new set of relationships emerging under the technological aegis of late capital. The ‘earth layer’ is simply the starting point for a ‘planetary-scale computation’ that ‘disembowels geological resources’ (Bratton 2015, 75–76). Similarly, media theorist Jussi Parikka’s exploration of the ‘anthroscene’ emphasizes ‘the unsustainable, politically dubious, and ethically suspicious practices that maintain technological culture and its corporate networks’ (Parikka 2014, 6). For Parikka, these concerns fold into a reading of ‘deep time’ that encapsulates not only the geological realm, and its associated non-human processes, but also the contemporary global ecological crisis.

#### 4. Conclusions

The blurring of nature-culture dualisms that developed in the wake of the post-structuralist debates of the 1980s does not provide a straightforward entry point into the cultural ambiguities or material interstices of urban nature. More recent theoretical contributions engaged with the post-colonial and post-human dimensions to urban space highlight the epistemological limits to existing conceptions of bio-diversity and the uncertain articulation between different conceptions of agency, materiality, and subjectivity. A focus on ‘deep time’ clearly places cities outside the conventional frame of historical analysis. But a temporal horizon derived from a geological perspective also highlights the historical specificity of capitalist urbanization even if many proponents of the Anthropocene do not recognize the epistemological implications of this observation for contemporary scientific discourse.

How can we characterize the place of cities within the putative emergence of the Anthropocene? It is useful to make a distinction between the city, as a particular kind of social and political arena, and urbanization, as a broader set of socio-ecological and socio-technical entanglements. The re-articulation of the metropolitan versus non-metropolitan political divide reinforces the significance of the urban arena as an experimental field within which new conceptualizations of nature, bio-diversity, and the human subject are taking shape. Cities can offer an alternative to dystopian stasis: we need an augmented conception of what the city is, what it can be, and how it relates to the wider political dynamics of the capitalist technosphere. An overemphasis on various forms of ‘methodological globalism’ elides the cultural and political distinctions between cities and urbanization and effectively overlooks the heterogeneous socio-ecological textures of urban space.

New socio-ecological articulations between nature and urban space pose questions about the ethical standing of non-

human life forms and the wider significance of the liveable city as an other-than-human terrain. Recent patterns of political turbulence have necessitated a partial reprise in the historical role of cities as sanctuaries for human and non-human nature alike. Growing threats to bio-diversity at a global scale have prompted calls to extend legal rights to nature as an elaboration of existing humanist doctrines. Yet there is a tension here between the extension of formal rights based on an elaboration of existing models of citizenship and the articulation of the post-human subject (see, for example, Braidotti 2013). An increasing number of philosophical interventions have sought to delineate how non-human nature might be conferred constitutional rights. Michel Serres, for instance, has sought to elaborate on the possibility of a ‘natural contract’ that reframes the political scope of the Enlightenment:

‘That means we must add to the exclusively social contract a natural contract of symbiosis and reciprocity in which our relationship to things would set aside mastery and possession in favor of admiring attention, reciprocity, contemplation, and respect; where knowledge would no longer imply property, nor action mastery, nor would property and mastery imply their excremental results and origins’ (Serres [1990] 1995, 38).

Whilst thus far viewed through the prism of an idealized nature threatened by the ‘new extractivism’ in the Andes and elsewhere (see Fitz-Henry 2012; Latta 2014) the idea of a ‘natural contract’ also has implications for a re-conceptualization of urban nature that extends beyond the utilitarian logic of ‘ecosystem services’. If the future of the biosphere is to be deliberated over in an increasingly urban context the question of what is worth protecting, on what grounds, and over what scale of metabolic interactions will be an inescapable dimension to public culture. Yet we should be cautious in terms of any geographical delineation for the emergence of distinctive forms of urban environmental consciousness and the extent of

potential engagement between a ‘natural contract’ and existing articulations of environmental justice. Strands of authoritarian or even militarized bio-diversity practice remain antithetical to progressive political ideals and connect with the development of environmental enclaves and other spaces of ecological exception. In this sense we can anticipate that the urban arena will remain a focus of contestation over the possible meanings of nature and future socio-ecological pathways into the unknown.

### Acknowledgements

I would like to thank Hyun Bang Shin and Louis Moreno for their comments on an earlier version of this article. The research forms part of my on-going project *Rethinking Urban Nature* funded by the European Research Council.

### Disclosure statement

No potential conflict of interest was reported by the author.

### Note

- 1 See Marx 1974 [1887], 474–75. Although Marx’s observations are primarily directed at the effects of capitalist agriculture on soil, his early recognition of irreversible forms of ecological destruction has served as a critical point of departure for a range of subsequent studies including contemporary critiques of the burgeoning Anthropocene literature.

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