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## **Time, Temporality and Environmental Change**

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The advent of global warming, increased flooding, the decline in biological and species diversity, deforestation and the depletion of natural resources require rigorous and engaged reconceptualizations that challenge orthodox geographical thinking. Accordingly, this special issue explores how variously scaled temporalities are integral to the emergent ecological crises that face us, and argues that much greater focus is required to more closely investigate diverse temporalities and their contextual complexities. Although they cannot constitute an exhaustive overview, the articles comprising this collection draw attention to a range of temporal practices and conceptions that are being mobilised in response to the pragmatic, conceptual and political imperatives that are emerging. In drawing upon theoretical understandings, empirical research and case studies, these papers importantly attest to how more attuned practices might be enacted in developing more ecologically sustainable entanglements between humans and others.

In this introduction, to contextualise this special issue, we briefly identify some of the major ideas about time that have been considered over the past three decades by geographers before highlighting some of the key temporal conceptions that have been mobilized around climate and environmental change. We primarily focus on the vexed notion of the Anthropocene, and on regressive political and economic ideas and processes that curtail more stringent analyses of environmental temporalities and preclude more radical action to ameliorate the advent of critical events. Subsequently, we consider the emergence of slower temporal practices that adopt more ecocentric perspectives and the mundane but critical everyday routines that form part of a rhythmic response to dramatic changes in situated environments. We also embrace an expanded understanding of the social in emphasising the imperative to become more attuned to the non-human temporal processes that are transformed in response to environmental change and that always accompany human temporal regimes. Following this brief discussion, we turn to summarize the rich papers that comprise this special issue.

The consideration of time as a social construct has attracted significant attention within the social sciences (Thrift 1996; Urry 1999). Theoretical debates have focused on social attitudes towards time (Adam 1990); identified different kinds of social time ('nature time', 'event time' and 'clock time') (Levine 1997); extended understandings of the experiences of time (Nowotny 1994); and explored the power of rhythm as a particular temporal manifestation (Edensor 2010; Lefebvre 2004). More specifically, in geographical discussion there has been much interest in the relationship between time and space (May and Thrift 2001), their mutual constitution and their centrality to understanding and interpreting social processes and social change (Massey 1992). There has also been substantive consideration of the influential idea of 'time-space compression' in which geographical distance is conceived as reduced by technological development and the pace of economic and social processes accelerated in an increasingly globalised world (Harvey 1989).

More recently, human geographers and others have turned attention to the temporalities of the more-than-human world. Adam (1995) foregrounds how 'environment time' is rhythmic, cyclical and interconnected, and how different human ways of life become entangled with these different temporalities in diverse ways (see also Bastian 2012). For example, agricultural practices before the

Industrial Revolution 'were linked strongly to natural rhythms of climate variation and seasonal growth and decay' (Pahl et al. 2014: 377), but there are now many social processes that produce dissonances between the rhythms of seasonality and the practice of agriculture. While natural scientists have long examined notions of deep time in discussing geological change or human evolution, there are also important contributions to be made from the environmental humanities about our relationship with the Earth and the ways that deep time seeps into our present and future lives (Ginn et al. 2018). Such perspectives contrast with the way that climate change is often communicated as a phenomenon that is measurable, quantifiable and predictable (Brace and Geoghegan, 2010; Pahl et al. 2014).

In contributing to these emerging bodies of work, this special issue more explicitly focuses on exploring the relationships between time, temporality (that is, social and cultural conceptions and perceptions of time) and environmental change. It is crucial to start from the premise that cultural, social and spatial understandings of time must be conceived as dynamic, multiple and heterogeneous (May and Thrift, 2001). Yet though this is invariably so, Barbara Adam draws attention to how time is socially organized so that the 'when, how often, how long, in what order and at what speed' are governed by implicit, embedded 'norms, habits and conventions' about temporality (1995: 66). These cultural norms shape spatio-temporal conformity and consistency, soliciting the development of, often unreflexive, everyday, weekly and annual routines, life-cycle and life stage conventions, as well as attitudes towards the past and the future. At present, such doxic assumptions are being challenged, shaken up by the advent of accelerating climate and environmental change, inspiring a reconfiguring of the temporal perspectives through which humans imagine the past, present and future, and consider time from divergent angles and at different scales.

Clearly, the rapidly accumulating impacts of human activity on earth and environmental processes have encouraged the emergence of key terms that directly refer to these changing temporalities. Most obviously, they are signified in the concept of the Anthropocene, although the accelerated change that it construes contrasts with the slow, inexorable transformations wrought over millennia during the geological eras to which it is compared. The Anthropocene is characteristically conceived within a temporal frame that begins with processes of clearing forests and burning fuel and subsequently devolves into another temporal conception, the 'great acceleration', as large numbers of species rapidly become extinct and sea levels rise. There are, however, other temporalities through which humans can learn to coexist with the non-humans who share the Earth, to become more sensitively attuned to the diverse rhythms, growth patterns and life cycles.

Popular discourses often anxiously suggest that there is a 'tipping point' at which accelerated environmental and climate change will snowball, although many now argue that we have already passed this juncture and that remedial action is immediately required. For instance, at the time of writing, Matt McGrath (2019) reports that environmental change is more rapid than anticipated by the fifth assessment report from the UN's Intergovernmental Panel on Climate Change (IPCC) in 2014. Increased rates of atmospheric CO<sub>2</sub>, sea-level rise and the rate at which the polar ice caps are melting have accelerated and such worries are compounded by the rising worldwide occurrence of extreme weather events, biodiversity loss, wildfires and floods. Yet this scientific orthodoxy that points to an impending and irreversible environmental crisis has been labelled by Urry (2015) as a 'new catastrophism' that can deter ameliorative action. A paralysing anxiety generated by the assumption that it is too late to act may potentially lead to a stasis wherein people fatefully accept an inevitably catastrophic future. Such concerns with environmental effects in the near future, and the imperatives to meet short term targets, as well as a generational perspective that focuses on children and grandchildren (White, 2017), may also defer consideration of medium and longer term futures, focusing only on a coming cataclysm but not what might come after (Orlove, 2010).

The notion of the Anthropocene also situates humanity within a geological temporal frame, though whether the transformations wrought on current and future geologies constitute a distinctive era is contested by geologists. Some contend that in contradistinction to the extensive temporal periods that mark geological epochs, some contend that the Anthropocene is at most only 250 years in the making (Tyszczyk, 2016); others arguing that it has been 8000 years in the making. Here, humans are imagined as a geological force who will leave a trace of their presence and the environmental depredations they perpetrated in future stratigraphic formations (Rickards, 2015). Nonetheless, the notion of deep time that it conjures lends a certain humility to the temporal span of human existence and can foreground successive epochs in which other turbulences emerge and subside, in which certain species prevail, decline and become extinct, and in which vast spans of time in which sea level rises, ice-advance and volcanic activity transform environmental conditions. In this sense, recent environmental change might seem like a minor temporal event within an unimaginably immense time span.

Many environmentalists point to the complicity of contemporary capitalist practices with the rapid advent of dramatic environmental and climate change, referring to intermittent periods of economic boom and bust, and to the creative destruction that accompanies the new quest for short-term profits that surge following spells of decline. John Tomlinson (2007) contrasts the slower, more fixed rhythms of earlier capitalist eras with the adaptable and flexible rhythms of 'liquid modernity'. Here, the rhythms of interest repayments, investments, cycles of innovation and obsolescence, and product cycles and fashions are accelerating, with crucial environmental consequences. Is it possible for late capitalism to respond in ways that ameliorate these malign effects or are they beyond repair, and thus call for the adoption of more sustainable economic procedures that offer slower, more stable, less environmentally threatening market and industrial practices? Alternatively, some claim that science will resolve resource, environmental and ecological crises through the rapid development of advanced technologies, offering a vision of an 'extended present' (Nowotny, 1994) wherein that which is newly envisaged comes to eventuate in the very near future.

On the other hand, do messages about a coming environmental apocalypse promote market-driven desires to exploit as much as possible while the going is good and before time runs out? And do intimations of an insecure future facilitate oppressive responses to securitization? As Anderson (2010) shows, futures are materialised in the present in diverse ways. While the extraction of fossil fuels continues to provide rich financial rewards for oil, gas and coal industries, environmental impacts are regarded as of subsidiary political concern for corporations and for the populist politicians such as Donald Trump, Scott Morrison and Jair Bolsonaro who put narrow economic and national interests before wider global concerns. Such questions are complicated by the emergence of rapidly rolling news in the media - also part of a global cultural acceleration - that often articulates a 24/7 temporal perspective that keeps us in an ever-changing present in which environmental events and episodes rapidly follow each other. While these may be given momentary serious attention, they confound attempts to discern what is significant, thereby paralysing action for change. As individuals we may be disarmed by the speed of changes that have already happened or are happening now and consider it too late to do anything. More worryingly, the aforementioned self-interest of large corporations may benefit from the prevailing uncertainty. Additionally, the effects of electoral cycles, as well as governments' entanglements with neo-liberal market and corporate imperatives, mean that undertaking any long-term planning that does not appeal to the immediate interests of voters is not politically expedient. As such, many of those who seek more urgent political strategies that address climate change become increasingly disheartened and fatalistic. On the other hand, accounts are emerging that accept that we are already living in a postapocalyptic world and that accepting loss might allow us to 'free the imagination to find new ways of adapting to the world' (Cassegård and Thörn, 2018: 575)

Despite their widespread salience, these large-scale spatial and temporal perspectives often ignore the various ways people might imagine their own futures and the alternative strategies they may devise. Amongst activists, the 'great acceleration' of human-induced environmental change has prompted the emergence of alternatives that resist the rapid global flows of people, fast food consumption and economic change. Individual rhythms of eating, moving, consuming and enjoying leisure are being adopted and more collective strategies to promote 'slow food', 'slow tourism' and 'slow towns', more sustainable ways of commuting, and dissonant practices such as growing, downshifting and idling are rising. We are also seeing more frequent interventions by activists of many kinds, most recently Extinction Rebellion, who call for immediate political action to minimise the coming environmental crisis by undertaking ongoing acts of civil disobedience and non-violent resistance.

Furthermore, less heralded, more mundane responses have been instigated, perhaps indicating that certain authoritative assertions about the time-scale of climate and environmental change are abstracted from everyday lived realities. For instance, future-oriented scientific discourses identify likely scenarios and adaptation strategies, postulating predetermined policy prescriptions with identifiable outcomes that might mitigate the effects of climate and environmental change. There is, furthermore, a tendency for the future oriented discourse of impending crisis to empty out the present, taking attention away from more immediate concerns that people currently endure, negotiate and challenge (Arnall and Kothari 2015). Yet responses in the immanence of everyday life can reveal how ordinary people negotiate, resolve and endure environmental change through tactical appropriations, manoeuvres and adaptations. Modest household routines and rhythms are emerging that deal with waste, repair, consumption and growing (Toole et al, 2016). Such altered everyday rhythms suggest that habits may be conceived as not merely exemplifying dull repetition and subjection to overwhelming authoritative compulsions but as replete with dreams, as exemplified by adaptive tactics that engage in more ecocentric everyday practices (see Edensor, 2010). Temporally, this also testifies to a sense of becoming that supplements practices of daily repetition. Moreover, the discomforts produced by the effects of environmental change may open up possibilities for thinking and acting in ways that are more acutely attuned to producing everyday sustainable practices. These everyday rhythms, which are often unreflexive and habitual ways in which we do things, can also be connected to the practices of others, thereby undergirding collective modes of being and doing. Since these become embedded and embodied in everyday practice they may be hard to shift, yet habits may be considered according to a more progressive perspective opening up possibilities for thinking and acting in ways that are more acutely attuned to producing an everyday sustainability (Kurtz et al, 2015).

In addition to these adaptive everyday human rhythms and routines, the rise of thinking across the social sciences and humanities has usefully foregrounded non-human agents, replacing accounts that have considered the non-human dimensions of place to be a passive backdrop upon which human activity unfolds. It is therefore essential to recognise how the very different temporalities of non-humans are affected, threatened and altered by human practices, for places are always pulsing with the intersecting trajectories and temporalities of non-human energies. Such processes are perhaps much slower or faster than human rhythms, and cyclical rather than linear, as with the brief life cycles of insects, the extended growth of large trees or the myriad bacterial and chemical cycles that take place unseen. This difficulty of perception can be overcome by technological means of representation that reveal environmental transformations, as Margret Grebowicz (2014) discusses with regard to the time-lapse photography of James Balog's Extreme Ice Survey (EIS). Catherine Brace and Hilary Geoghegan (2010: 297) point to how we might become more attuned to these different rhythms by developing localised understandings of place and landscape, noticing how people 'connect with the life cycles of geology, weather, plants and animals and envision the real or imagined, current or projected impacts of climate change on them'.

In undergirding May and Thrift's (2001) insistence that studies must acknowledge the heterogeneity, multiplicity and dynamism of time, the papers in this special issue adopt temporal perspectives and concepts that challenge the typically linear temporal explanations of climate and environmental change that prevail. Within the human realm, multiple scaled temporal processes that react to these threats range from sedimented institutional and political procedures to household and work routines, that also deploy divergent understandings about past, present and future. It also becomes evident that the unfolding of these human responses to these critical transformations, as well as non-human responses and agencies, take place within cyclical temporal processes that emphasise reiterative rhythms and routines. Here, the shifting times of reproduction, arboreal growth, seasonal changes, tides and weather must be considered alongside the complex human temporalities that are emerging. Such human and non-human agencies are inevitably entangled, challenging dominant perceptions that construe them as distinct, bounded and always in tension.

Several papers engage with the hyperbolic notions that we now exist within a culture of speed – just in time production, product innovation and corresponding instant obsolescence, the instant circulation of money, information and ideas, and hyper mobile subjects. There are corresponding reactions to this through, for example, slow tourism, slow cities, the slow food movement and even slow universities that cannot accord with this quest for the rapid and the ever new. Erin Fitz-Henry's paper in this issue discusses these slower processes through which malign environmental impacts emerge, and accordingly explores the political strategies that are emerging to challenge this search for the new evident in the temporalities of policy making. In her paper, *Conjuring the Past: Slow violence and the temporalities of environmental rights movements*, she refers to feminist posthumanism and anthropological literature to illuminate different and conflictual temporalities. She suggests that the rapidity and speed of mainstream environmental policy making invisibilises the ongoing, slow violence of environmental collapse (Nixon 2011). Drawing on research with 'rights of nature' activists in the United States, Ecuador, and New Zealand she reveals how their strategies challenge the dominance of these 'spectacular' interventions without diminishing their urgency, by adopting the kinds of longer term approaches necessary to foreground and address the slow, invisible violence of environmental destruction.

Papers by Eliza de Vet and Lesley Head and by Elspeth Oppermann and Gordon Walker explore changing patterns, temporalities and impacts of weather and how these are incorporated into everyday life. Eliza de Vet and Lesley Head examine weather relations, or 'weather-ways' across daily temporalities in Melbourne, a city renowned for the changeability of its weather on this temporal scale. Weather temporalities are entwined with those of the city: 'urban rhythms, household routines and everyday practices'. High levels of adjustment and attunement are seen in the home, where people can change clothing and the nature and timing of activities. In office-based work, by contrast, restrictive timetables and dress codes mean that more energy-intensive technologies for heating and cooling are privileged. They argue that as urban areas warm under climate change, the adaptive temporalities expressed in the home provide resources that could help rethink work practices and scheduling demands.

Elspeth Oppermann and Gordon Walker also challenge the future-oriented emphasis in climate change discourse to reveal how weather is encountered at the micro-level in the present. Drawing on research in Darwin, Australia, a place where average temperatures have already risen substantially since 1990, they examine how electricity-grid workers' everyday practices and rhythms are shifting and adjusting to the changing climate. Specifically, they demonstrate how heat, rhythm and climate conjoin in ways that lead to 'thermal entanglements' of the human body and the ways in which workers respond. Both these papers focus on how individuals encounter shifting weather patterns in the present and examine how they adapt and respond to these alterations in everyday practices.

Climate change is a relational phenomenon that needs to be understood at the local level, attending to its distinctive spatialities and temporalities. As such, many of the articles here bring to the fore the knowledge and forms of negotiation and adaptation of those who are witnessing changes in their immediate environment. These situated responses are detailed in Celia McMichael's paper that investigates how Fijian coastal communities navigate planned relocation policies and the anticipation of future change due to sea level rise. She also explores the realm of the everyday, highlighting the impacts of climate change on people's daily experiences. She illuminates how residents living in low-lying coastal villages, make sense of different temporalities of climate impacts through an exploration of their historical attachments to place and their uncertainty about having to relocate in the future. Drawing on the notion of 'thick' time, the paper reveals how the past and future of sea-level rise are tangible in people's everyday lives in the present. In drawing our attention to the significance of the realm of the everyday, the papers reveal that far from being dull or mundane, the everyday can be replete with extraordinary practices and strategies, and is an important site of adaptation to changes in the environment.

The weather is also examined by Bawaka Country including S. Wright, S. Suchet-Pearson, K. Lloyd, L. Burarrwanga, R. Ganambarr, M. Ganambarr-Stubbs, B. Ganambarr and D. Maymuru, but here as a means to confound notions of universal, linear time and to decentre technocratic, colonising understandings of time. Their paper focuses on the performance of a song cycle, 'Wukun', by the Yolngu people from northeast Arnhem Land, Australia, which responds to the annual gathering clouds and early rain which herald the coming harvest season. In their examination of the increasing incidence of powerful weather events, they argue for the need to adopt more sophisticated understandings of time that transcend the linear in our consideration of changing weather and its effects. They argue for a more detailed investigation into *weather cultures*, to consider how the weather is embodied and felt to reveal how people, places and times are always becoming and are co-constituted.

This key temporal notion of 'becoming', whereby the future has not happened yet but will emerge in response to myriad influences, is also central to other papers in this special issue. Uma Kothari and Alex Arnall highlight how islands and islandness are, through processes of environmental change, always in the process of becoming. They show how the speed, pace and cadence of the movement of sand in a small island in the Maldives are shaped by the different temporalities and entanglement of human and non-human agents. Furthermore, they reveal how these multiple temporalities and timescales combine to generate intertwining rhythms through which sandscapes endlessly shift, thereby ceaselessly reworking a (unique) sense of islandness.

The multiple temporal intersections and entanglements between humans and non-humans are also examined in papers by Catherine Phillips on the timescapes of bees and beekeepers, and by Chris Gibson and Andrew Warren on the temporalities of trees. In her paper, 'Telling times', Catherine Phillips provides a grounded example of how beekeepers must accommodate, respond and fold into their practice the multiple temporalities of bees. She focuses on co-ordinated and interrelated timescapes of beekeeping in Australia in the context of climate change vulnerabilities and adaptations. These various timescapes include those of the stretched present, cyclical rhythm, linear progression, stochastic irruption and future folding. The case of beekeeping serves to highlight multiple entwined more-than-human temporalities, and thus inspires us to think through the times in which we live. Thick ethnographic descriptions underline that these temporalities include urgency and crisis – the need to 'save the bees', the intimate rhythms of the hive which demand slowness, and seasonality of pollen and nectar connected to tree rhythms. For Phillips, the complex interplay of temporalities 'offer a means to disrupt notions of unitary natural time and straightforward accounts of ecosocial challenges'. She argues that this interplay allows us to be open to a wider range of possible responses to our times: 'we

might work to admit tellings of times of crisis into collective stories, but that need not mean being confined to such tales’.

Chris Gibson and Andrew Warren explore human and non-human encounters in a context of uncertainty, the unknown and unpredictability. Drawing on research in rural Australia, the US Pacific Northwest and Hawai’i they unearth the relationship between forestry and manufacturing forged in the process of guitar making. They examine present and future temporalities being created by those in the craft industries who are planting trees, the benefit and use of which will only be realised beyond their lifetime. Their paper reminds us of the unpromising capitalist rhythms of investment and profit return, and the difficulty of aligning these with other social, environmental and political rhythms. They show how timber specialists, in recognising the probability that industrial forestry will fail to address the scarcity of supply of trees and cognisant of the temporalities of trees, are currently invoking relations of care with future trees in environments characterised by profound ecological change. Their paper reminds us that the future has not happened yet but will emerge and unfold in response to myriad influences. Thus, despite a widely articulated discourse of despair and societal decline in accordance with environmental concerns, there is also hope. This is manifest in the possibilities that future generations might act in progressive ways in contradistinction to the idea that they will only be passive victims of such changes. As such, our imagining of the future cannot be overdetermined by our assumptions about the past. Here there is a return to a key temporal notion of becoming that is, as shown above, engaged with in many of the papers in this special issue.

Through their diverse approaches, the papers in this special issue insist that a far greater acknowledgement of the multiplicity of the temporal processes that are entangled in climate and environmental change is required than simplistic androcentric linearism. In foregrounding the situated complexities of time and temporality in diverse settings, accounting for the divergent responses of people amidst these ecological transformations, the papers also suggest a how a greater range of conceptual approaches to time might be deployed to more seriously investigate these urgent processes.

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