UTS ePRESS

Cultural Studies Review

Vol. 25, No. 2
December 2019

AN ELEMENTAL ANTHROPOCENE

An Eternal Flame: The Elemental Governance of Wildfire's Pasts, Presents and Futures

Timothy Neale[1], Alex Zahara[2], Will Smith[3]

[1] Deakin University
[2] Memorial University
[3] Deakin University

Corresponding author: Timothy Neale: t.neale@deakin.edu.au; 221 Burwood Hwy, Burwood VIC 3125

DOI: https://doi.org/10.5130/csr.v25i2.6886
Article history: Received 20/03/2019; Revised 21/10/2019; Accepted 30/10/2019; Published 22/11/2019

Citation: Neale, T., Zahara, A., Smith, W. 2019. An Eternal Flame: The Elemental Governance of Wildfire's Pasts, Presents and Futures . *Cultural Studies Review*, 25:2, 115-134.https://doi.org/10.5130/csr.v25i2.6886

ISSN 1837-8692 | Published by UTS ePRESS | https://epress.lib.uts.edu.au/journals/index.php/csrj

Abstract

Views of fire in the contemporary physical sciences arguably accord with Heraclitus's proposal that 'all things are an exchange for fire, and fire for all things, as goods for gold and gold for goods.' Fire is a media, as John Durham Peters has stated, a species of transformative biochemical reactions between the flammable gases found in air, such as oxygen, and those found in fuels, such as plants. Inspired by an ignition source, these materials react and transform themselves and their surrounds into light and heat energy, carbon dioxide, water vapour, char and much else besides. Fire is conjunctural, durational and transformative. Fire is a dialectician, at once consuming living and dead organic matter and providing both the space and ingredients for new and renewed organic life. In this article, we draw upon our experience of combustible contexts—Australia, Canada and the Philippines—to consider the diverse ways in which fire is today framed as a social problem, an ecological process, an ancient tool, a natural disaster, a source of economic wealth and much more. In this way, we seek to explore the value and limits of 'elemental thinking' in relation to the planetary predicaments described by 'the Anthropocene'.

Keywords:

Wildfire; governance; Australia; Canada; Philippines

DECLARATION OF CONFLICTING INTEREST The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. **FUNDING** Research for this paper was partially funded through a SSHRC Canada Graduate Scholarship-Doctoral Award, SSHRC Insight Grant (435-2014-0968) and Northern Scientific Training Program grant. The author(s) received no other financial support for the research, authorship, and/or publication of this article.

Introduction

In one of the surviving fragments of his teachings, the pre-Socratic Greek philosopher Heraclitus suggests that 'all things are an exchange for fire, and fire for all things, as goods for gold and gold for goods.' There is some debate about the meaning of this partial thought, but one reading is that fire was both the origin and standard of an inconstant world for this paradoxical theorist. Fire creates other elements, such as air, and the ceaseless change visible in its flames reveals the universal truth that even the most visibly stable entities—such as mountains or the moon—are always in flux. A charitable contemporary analysis of this philosophy might say that Western scientific thought disagrees with Heraclitus in detail but not in spirit. From the quantum to the cosmic scale, things are ever in motion, and combustion plays a crucial role in these infinitely unfolding choreographies. At the same time, *contra* Heraclitus, fire is not itself convertible into or comparable with water or air because it is a process rather than a substance. It is a media, as John Durham Peters has argued, in that it is a channel or passageway through which materials are irreversibly transformed. A 'great dialectician', fire is the 'subtractive technique' through which materials and their surrounds are transformed into light and heat energy, carbon dioxide, water vapour, char and much else besides.[1]

From this latter perspective, the Heraclitian vision of fire as an exchange rings true. A fire is a 'conjunctural, durational and transformative' biochemical reaction.[2] Materials meet and interact, and the intensity and length of these interactions determines what then emerges.[3] Fire is thereby elemental, not because it is a substance or material essence that can be transformed, but because it is itself a transformative process fundamental to life on this planet. Fossil records suggest that since the end of the Devonian Period, some 350 million years ago, the Earth has had sufficient oxygen and carboniferous vegetation for its landscapes to freely combust.[4] Pulses and patterns of wildfire crept across the planet for tens of millions of years before the first mammals emerged. Subsequently, as historian Stephen Pyne states, *Homo sapiens* and their predecessors evolved as 'fire creatures' both shaped by the affordances of their flammable surrounds and, at the same time, shaping those surrounds through selective burning.[5] Nigel Clark notes that recent global climatic changes, now being glossed as 'the Anthropocene,' have been forced precisely because certain humans 'appropriated and advanced' the planet's own technique for exchanging and redistributing excess, namely combustion.[6]

This leads us to the intuition that fire is an important site for exploring the merit and limits of thinking elementally in the Anthropocene. Over the past decade, humanities scholars, social scientists and others have explored various types of 'elemental thinking' in an effort to understand present ecological entanglements. As Engelman and McCormack state, the elemental is alluring because 'it both captures something tangible about the world and also remains excessive of human agency or intervention'.[7] For some, this allure has led back to elemental philosophies—like those of Empedocles, Aristotle, Mendeleev, and many others—which describe existence as derived from certain fundamental forces or forms. An elemental ontology 'is one not built on composite or hybrids'.[8] For others, including ourselves, it is elemental analyses that are most alluring, focusing attention of the actual environmental milieus, or material substrates, in which we are irrevocably and particularly embedded. 'You are never out of your element,' as Cohen and Duckert suggest.[9] In this sense, elemental thinking is akin to infrastructural thinking, revealing the foundational background of our habits and habitat, but is capable of different kinds of analytical and narrative work.

The exact difference of elemental thinking—particularly the difference between 'elementalism' and materialism—is a matter of debate and will be explored in this essay. To begin, though, it is perhaps most usefully defined in reference to the anthropologist Gabrielle Hecht's recent theorisation of uranium as an 'interscalar vehicle'. As Hecht has argued, close attention to uranium takes us across its many temporal and spatial scales of existence, bringing into view the atomic level of its isotopes, the geographical specificity of a given ore, the local, regional and transnational economies of its extraction, and the international policing of its circulation. Unlike infrastructural thinking, which focuses its attention more tightly upon anthropocentric built structures, elemental thinking uses physical processes and entities as 'interscalar vehicles' to travel outside the envelopes of anthropoid life while 'keeping the planet and all of its humans in the same conceptual frame'.[10]

Thinking with Hecht's argument, this paper focuses on a type of combustive process that both precedes and conditions human life—wildland or landscape fires—to investigate elemental conjunctures or exchanges across scales and contexts. Every year, approximately 340 million hectares, or 4%, of the Earth's terrestrial surface burns.[11] Due to climatic changes forced by industrialised combustion over the past two centuries, slightly more of the Earth is burning every year, in fires whose frequency, intensity, and impact is steadily climbing. Constraining the combustion of living and dead organic matter in power stations or forests alike has become vital to maintaining the planetary boundaries suitable for human life.[12] But, without entertaining fantasies of ecological control, contemplating such constraint requires us to first understand how fire and its elemental accomplices are governed. Drawing on our respective research in three fire-prone countries—Australia, Canada and the Philippines—we seek to explore some of the diverse ways in which the presence and effects of landscape fires have been and are being discursively framed and socially distributed. Far from being simply an emergency or disaster, as it is often represented, the rich field of meanings surrounding wildfire's elemental exchanges and their inequities provide insights as to how another politics of fire is possible.

Australia: Fire as Deep Time Dialectician

Scholars within twentieth century fire science developed their own dialectical concepts to explain the occurrence of combustion in the world, centring on three nested triangles. The fire triangle, the first, has oxygen, fuel and heat at its vertices. These are the essential conditions of possibility for burning. Without all three there is no fire, and their relative abundance or absence has profound effects on a fire's expression or outputs. The fire environment triangle, the second, links fuel, weather and topography. These determine the behaviour of a particular fire in a landscape. Without fuel there is nothing to consume and without wind a fire will not travel. Topography affects behaviour as fires move much faster uphill than downhill; up to a limit, a fire's rate of spread doubles for every ten degrees of slope it traverses. The fire regime triangle, the third, includes vegetation, climate and landform. Some types of vegetation are more flammable than others, some climates have longer arid and windy periods than others, and some landforms have greater slopes than others. These three factors reveal the frequencies and intensities of burning expected in different locations over decades or centuries.

The three triangles implicitly describe the list of materials required for sketching out a history of fire in deep time. As Neale has stated elsewhere, efforts to write this history have largely revolved around attempts to discern relationships between a set group of ecological agents, events and materials lodged in geological strata.[13] Just as gas bubbles concealed in ice cores indicate past climatic compositions, the presence and abundance of pollen from

plants variously tolerant or intolerant of fire can tell us something of the prevailing order of combustion in particular places. From such signals we learn, for example, that many tree species developed their thick bark during the Cretaceous Period 100 million years ago, eager to insulate themselves from this 'high-fire world', and that sclerophyll or hard-leaved plants that promote fire came to dominate the Australian continent over 40,000 years ago.[14] Charcoal, spores, bones, eggshells and many other materials can, in the hands of palaeoecologists and archaeologists, be made similarly eloquent about this planet's past arrangements of oxygen, fuel and heat.

When and how anthropogenic agency becomes legible in these archaic remains is a matter of ongoing discussion. The first clear evidence of fire in human hearths has been found in sites located within northern Kenya and South Africa, dating to approximately 1.8–1.6 million years ago. When humans started 'off-site fire use' or burning the land is unknown. Recent comprehensive literature reviews suggest that anthropogenic fires are 'nearly invisible' in Earth's strata prior to the Holocene, 12,000 years ago, and that they were unlikely a 'widespread and broadly ecologically relevant factor on any continent' until somewhere between 8,000 and 4,000 years ago.[15] Combining archaeological evidence with more recent ethnographic evidence demonstrates that in almost all fire-prone locations people lit up their surrounds in 'planned, organised and complex' ways from this time on, though, as Bowman et al. summarise, 'debate rages' about their ecological impacts, with views ranging from beneficial to catastrophic to negligible.[16] Overall, we can say that landscape fires have been and continue to be used towards legion ends—Scherjon et al. estimate twelve different purposes including 'fun' and 'warfare'—and in each we can detect some form of elemental exchange. A well-placed fire can convert thick shrubs to a bed of ash and char, making a forest passable, or turn senescent grass into fertiliser for fresh regrowth, nourishing mammals for hunting and farming.

Due to its fire-tolerant flora, pre-colonial anthropogenic fire regimes, and post-colonisation issues with major landscape fires, the Australian continent has been singularly important for scientific understandings of human relations with combustible ecologies. Since European travellers began intruding upon and invading the landmass in the seventeenth century, they took note of Aboriginal peoples' fire practices, but it was only in the late 1950s, after centuries of state-sponsored dispossession, that the institutions of white settler science began to seriously inquire into their motivations and effects. Famously theorised by Jones as 'firestick farming', Aboriginal peoples' sometimes frequent and broad-scale burning of the landscape has subsequently been cast as, to quote two prominent historians, the 'skilled, detailed and provident management of country' and 'a Faustian bargain that further fed Australia's ravenous pyrophilia'.[17] In short, thousands of years of anthropogenic burning has at once enhanced the continent's habitability and its flammability. Putting aside the character and distribution of these practices, which many other authors have explored, our present interest here is in foregrounding how they have been figured in relation to current Anthropocenic problems of elemental arrangement and exchange.

As the following section will discuss, unplanned landscape fires or wildfires are the object of significant governance infrastructures globally, due to their massive potential economic, ecological and social impacts. In Australia, major fire events in the continent's forested south have typically been married with official inquiries, which, intent upon finding preventative solutions, have routinely observed that such fires are increasing in these places. The drivers of these increases are complex. As in other fire-prone nations, since the mid-twentieth century, people in Australia have moved towards ever-greater intimacy with the 'interface' of flammable

grasslands and forests, multiplying the sources of ignition and the scale of their potential impacts. Additionally, this same period has exhibited a 'clear signal' of climatic change towards more hazardous fire weather.[18] Nonetheless, as Buizer and Kurz argue, the aforementioned inquiries have maintained 'a degree of optimism' about the possibility of perfectible technical strategies that might 'generate win–win outcomes', the most consistent being prescribed burning.[19]

Prescribed burning involves burning forests and grasslands during wetter and cooler periods of the year in order to reduce fuels during the drier and hotter periods—'fires of choice' to mitigate 'fires of chance'. Periodically since the early twentieth century, policymakers have called for greater prescribed burning in the name of protecting (human) lives and homes, buoyed by research which suggests it is the 'only way' to prevent large wildfires in southern Australia.[20] Over the past two decades, prominent voices in the wildfire management sector have continued to insist that '[we] know the answers to megafires' in the hotter months (November–April), which is to intentionally burn 10–25% of forests every year as opposed to the 1–4% typically burnt.[21] These claims are made on two core bases, the first being experiments conducted in southwest Western Australia, and the second being hypotheses that there were few or no 'killer fires' prior to colonisation because precolonial Aboriginal peoples ignited 'most' of the continent at least every five years.[22] What is curious about such 'radical' solutions is not just that contemporary Aboriginal peoples' rights and interests are absent from their discussion, but that they also serve a broader status quo. The hope is to preserve recent human migrations into places occupied by pyrophilic plants by exchanging their presence for 'our' security.

Fire does not make such straightforward deals. Increasing landscape combustion by an order of magnitude or more also means vastly increasing the smoke and, thereby, the fine particulate matter (particularly PM2.5 or particles less than 2.5 micrometres in diameter) suspended in the air we breathe. Considering established correlations between wildfire and fatal inflammatory effects, more fires of chance may save houses in the exurbs of Sydney and Melbourne but will definitely lead to more people dying prematurely, choking on the ostensible answer.[23] This is not to question the acuity of Aboriginal fire practices, which are poorly represented by many non-Indigenous boosters, but rather to draw attention to what is displaced or elided in this imagined transaction. To expand on this point, let us look to northern Australia's tropical savanna, an area of approximately 1.9 million square kilometres. In any given year, more than 600ml of rain falls here in the annual monsoonal wet season, promoting the widespread rapid growth of annual grasses that cure and become increasingly flammable during the dry season between April and November, leading to grassfires over more than a third of its area. Due to the regularity and low intensity of fires in such savannas, compared to the types of temperate forests found in southern Australia, their emissions were included under the 2007 Kyoto Protocol as 'reportable' parts of a nation's annual greenhouse gas inventory. In this way, savanna fires were integrated into emergent carbon trading markets, to the point that now one can offset air travel with carbon credits from savanna burning.[24]

How are fire's exchanges fungible in this way? In short, since the methane, nitrous oxide and other greenhouse gases released by savanna fires form 'carbon debts', demonstrable reductions in these emissions can be translated into 'carbon credits'. Australia ratified the world's first accredited method for counting such credits in 2010. This involved first using past images from the spectroradiometers aboard NASA's Terra and Aqua satellites to generate aggregate 'baseline' data on the presence of fires in a given area, correlating this with vegetation mapping to calculate that area's 'baseline' emissions. By then managing land differently, chiefly

by burning it earlier in the dry season and suppressing fires when they do occur in the late dry season, land managers are able 'harvest' emissions abatements and have them translated into the Anthropocene's common 'metric of the human'—namely 'carbon'—ready for the market.[25] More than 70 projects have been established using this methodology to date.[26] Purchasers include not only multi-nation petrochemical companies such as Woodside and Caltex, and airlines such as Qantas, but also the Australian government, which has bought contracts for roughly AUD$200 million of carbon credits from savanna burning since 2013 in order to pay off carbon debt incurred by its citizens and industry.

Fascinating as these translations are, though, they can obscure the exchanges of temporalities occurring through savanna fires. By repurposing the ancient pulse of Aboriginal peoples' combustive interventions in their surrounds, economic value is created—part of which supports Aboriginal peoples' continued inhabitation of ancestral areas—and futures are paid down. The calculative device built around savanna fires, at least ostensibly, buys fractions of future time in a survivable climate. For hundreds of millions of years, combustion has been central to the elemental ordering of the planet, establishing and re-establishing rhythms in biotic exchanges from state to state and place to place. For tens or hundreds of thousands of years, humans have interceded in these rhythms, to the point where combustive activity has, over the past several decades, become the target of transnational political action, financial investment and global surveillance. Fire's dialectical character makes it a useful phenomenon for exploring how environments are now variously counted, translated, redistributed, and substituted across temporal and spatial scales.

Canada: Fire as Bureaucratic Achievement

Thinking elementally reminds us that wildfires, like other forms of environmental 'disasters', are highly social and material processes. Depending on where they go, how and what they burn, wildfires mobilise elements into and from landscapes and bodies in ways that are often difficult to predict.[27] Wildfire smoke, for example, commonly includes volatile organic compounds and trace minerals, though its chemical makeup is also dependent on a number of factors including the material properties of a given fuel source.[28] In Canada, most wildfires occur in the conifer-dominated Boreal Forest. This area encompasses nearly two billion hectares of land, spanning from the Atlantic to Pacific Oceans to its upper range in the Arctic tundra, in a region that coincides with much of the country's mining and industrial activities. In areas of industrial development, wildfires can activate contaminants previously deposited in the environment including radionuclides, heavy metals and other toxicants, mobilising them into waterways and bloodstreams.[29] Even in areas located beyond the urban-wildfire interface, anthropogenic activities, aided by techno-scientific developments and industrial productionism, can mix uneasily with fire regimes, creating novel problems for scientists and environmental managers alike.[30]

Anthropogenic climate change has led to a number of uncertainties or 'known unknown' problems that environmental managers try to anticipate and mediate.[31] These range from changes at the molecular level—incomplete fuel combustion, caused by changes to fire intensity, may lead to increased carcinogenic dioxin production—to those that directly influence fire management strategy. For example, fires located in peat bogs, which are now drier than before and more capable of combustion, are increasingly a concern for wildfire scientists. These sites are sources of gaseous mercury that, through fires' elemental translations, may be deposited in areas where they become methylated and rendered toxic to humans and other animale.[32] Practically speaking, wildfire managers have also noted an increase in what

they refer to as 'blow-downs', where strong winds feed powerful fires that knock trees down and make it difficult for fire crews to access fires and dig escape routes. Beyond producing a 'risk society', where managers face new difficulties in identifying and managing risks, the character of these problems is indeterminate, in the sense described by Brian Wynne, in that their 'inherent' risk is in part contingent on, and produced through the social world of regulatory regimes, scientific practices, and government priorities.[33]

In Canada, as in many fire-prone countries, wildfires are sites of bureaucratic governance, in which states and their delegate agencies play a major role in what is often referred to as 'fire and fuels management'. Fire and fuels management, like other forms of natural hazards management, involves a sophisticated process of identifying, accounting for, and anticipating social, institutional and environmental risks.[34] In this drama, risks are posited 'out there' in the world, providing a space and justification for intervention. Thinking with fire, we are pointed to how risks associated with flammable processes are characterized and shared within bureaucracies. For example, environmental agencies are focussed more explicitly on processes of combustion, which includes fire suppression and mitigation work. Smoke, by contrast, is managed as a public health issue, where air quality is monitored by public health officials who warn publics of known physiological health risks and 'acceptable' levels of smoke contamination.[35]

These categories of fire and air, disciplined over time by experts working in bureaucracies, may merge together when risks are deemed an emergency situation. During emergencies, elected officials responsible for the wellbeing of communities are tasked with weighing risks according to the experts (for example, the proximity of a fire to a community, the health effects of smoke concentrations), including risks made known to them by community-members when deciding whether to evacuate. All the way down, then, we see that the ways in which fires are categorized, monitored, measured, and evaluated as risks to certain people and values is not pre-given, but as Neale and others have shown, the outcome of 'intuition, experience, local knowledge, and political nous'.[36] Wildfire risk is an achievement, one which is always tinkered with and constantly changing.

Crucially, how risks are understood and addressed necessarily involves the material geographies—the presence of water bodies, rocky subsurfaces, minerals deposits, tree types—and the political economies of a given location. As in Australia, fuels management in Canada is organized provincially, meaning each province has its own policies and strategies for managing wildfire risks.[37] British Columbia, for instance, has policies of full fire suppression, while Saskatchewan and the Northwest Territories monitor fires until they threaten an institutionally identified 'value-at-risk'. In these latter provinces, what constitutes a 'value'—much like the idea of risk itself—is not an inherent quality or character of an object or thing being protected, but something enacted through the practices, policies, and ultimately interests of governments.[38] In different provinces, banal and generalised values such as 'human life' and 'threatened species' have been variously ordered and reordered over time. After the 2015 Fort McMurray fires in Alberta, which temporarily halted the multi-billion dollar Athabasca tar sands industry, oil and gas infrastructure was moved from fifth priority to fourth priority, above 'natural resources'.

To further scrutinise the combustive exchanges of such 'values' let us turn to the area commonly known as the province of Saskatchewan. The province's 65 million hectares is roughly divided between agricultural land in the south and 34 million hectares of Boreal forest in the north. Much of the northern forest is dominated by pyrophilic trees, including black spruce, jack pine, and the highly flammable balsam fir. Today, due to nearly a century

of forestry-inspired, provincially led fire suppression, many areas throughout the forest are overdue for a burn, becoming 'tinder boxes' prone to insect infestation and disease. As a response, the province adopted a highly controversial policy of fire re-integration in the early 2000s, where fire starts may be monitored rather than suppressed, and allowed to burn until they approach something determined to be of 'value'. [39] While fire is now promoted to improve 'ecosystem health', to reduce disease for the benefit of the foresters, and to protect communities from potentially massive wildfires, many of northern Saskatchewan's 60,000 residents—the vast majority of whom are Dené, Woodland Cree and Métis peoples—have expressed concern over the policy. Indigenous and local governments have argued that current practices do not take into account radical ecological differences caused by fire suppression and ongoing climate change. Fires burn differently now, lead to increased community smoke exposure, and have resulted in things of value to Indigenous peoples being destroyed, such as trap lines, cabins, animals, animal habitats, and sources of traditional medicines.[40] Managed wildfire shifts from a destructive to a rejuvenating to a colonizing force depending on whose values are protected or made 'at-risk'.[41]

Due to combustion's positive and negative possibilities, then, how fires are governed is always a process of environmental 'infrastructuring'—one that can favour different types of more-than-human relations.[42] A focus on the practices involved in this multispecies and multi-elemental kin-making may point us to the institutional and organizational structures through which fires and their ostensible 'risks' become objects of management. According to organizational theorist Henry Rothstein and others, regulatory agencies increasingly face what they have distinguished as 'social' and 'institutional' risks.[43] While social or societal risks might include things such as direct harm caused by smoke and fires, institutional risks result from heightened oversight and increased (often financial) accountability requirements regarding how risks are governed. These risks include potential harm to fire agency and government reputations or even threats of funding cuts. The confluence of these types of risks often results in the 'spiralling tendency' of what Rothstein et al. term 'risk colonization', whereby institutions become overly focused on managing their responses to societal risks as risks to themselves.[44]

As public institutions accountable to the oversight and scrutiny of legislative branches of government, risk colonization may influence fire management in Canada in a number of ways. First, how risks are addressed must be legible to bureaucratic forms of rationalization. This means that particular strategies might not be considered feasible if they are not already proven or their results not immediately tangible or calculable. In Saskatchewan, lack of legislative support for 'fuels mitigation' projects—what often amounts to cutting trees in areas immediately surrounding its many forest-enclosed northern communities—is one example of this. Despite being a more publicly favourable and cheaper option than fire suppression or emergency evacuation, the province's Wildfire Branch has struggled to secure funding from the provincial treasury for its fuels mitigation projects. While reducing fuel sources might seem intuitive when thinking elementally – subtracting combustible material from the surrounds of combustible communities – pilot projects are currently underway to prove the effectiveness and 'worthiness' of fuels mitigation strategies.

Second, risk colonization may impact wildlife management, with practitioners and government agencies allocating risks across spaces, publics and stakeholders.[45] This can take place through a range of practices, from the way entities are entered into fire prediction models to 'hazards reductions' programs geared towards property owners, to the different stakeholders brought into fuels management decisions. In many Boreal locations in northern Canada, foresters play a key role in managing the goods and bads of wildfires, and one increasingly

popular method of fuels management is the emulation of natural disturbance (or END).[46] This involves clear-cutting forest to mimic the ecological patterns and (ideally) functions of wildfires, provide community protection from potential major wildfires, and, to co mplete the triple bottom line, give industry access to a lucrative timber resource. This is not to say that having multiple stakeholders involved in fire governance is implicitly harmful. Rather, we suggest that processes aimed at finding the 'correct balance' of social, ecological, economic, and institutional risks (i.e. in this instance, the risk posed by foresters' political clout) are likely to favour particular ways of living with fire over others. Thinking of fire as an elemental process of relations and material exchanges can thus attune us to worlds made possible through contemporary practices of risk governance.

Philippines: Fire as Alternative Place-making

Landscape fire features prominently in colonial and postcolonial struggles over the world's forests. To turn again to Pyne's words, the work of authorising the right kind of fire for specific places forms a central part of 'the ancient debate between elites and folk.'[47] A brief survey of the literature that grapples with varied forest conflicts bears out how such contestations are, at heart, often struggles over where this elemental process belongs in place.[48] Control of combustion frequently means control of landscape and its use. This centrality raises a question: if combustion is already so deeply embedded in the social and material dynamics of resource conflicts, though sometimes peripherally, what are the possibilities that arise from analytically re-centring landscape fires? One entry point is in the tendency to treat fire-use as interchangeable with many other criminalized practices. A more expansive vision of elemental politics might work to 'take seriously' the implications of fire's tangible effects and the specific materiality of its genesis and movements. Beyond a more general turn towards materiality, the essential quality of an elemental analysis might foster, Adey suggests, attention to 'unlikely affinities, marriages and disjunctures between art, industry, poetics and conflict' that surround landscape fire's molecular circulations.[49]

Debates surrounding fire's exchanges have been particularly intense within tropical forest ecology. While an uneasy truce between scientists and policy-makers surrounding prescribed burning has emerged over the course of the twentieth century in the earth's temperate zones, the role of fire within tropical landscapes remains intensely divisive. Tropical forests of Southeast Asia are not strangers to fire, even if they are clearly less prone to the kinds of conflagrations that regularly unfold in temperate nations such as Australia, Canada and the United States. Archaeological evidence throughout the region has demonstrated the longstanding and recurring nature of wildfires alongside and beyond human occupation. This evidence, gleaned from the sedimentation of pollen and charcoal stretching back at least 300,000 years, suggests that wildfires often occurred in concert with recurring El Niño events and other changes in climate that have periodically sapped moisture from fuels.[50] The ubiquity of indigenous, fire-adapted plant species such as the Benguet pine and some varieties of the pervasive *dipterocarpaceae* also point to a much longer history of fire in these tropical forests, before humans began making incursions 65,000 years ago. [51] However, despite a growing body of evidence supporting a more complex deep time of tropical fires, colonial-era explanations remain firmly lodged in the region's resource management institutions. In these views, high levels of precipitation, densely crowded canopies and forest microclimates prevent combustion outside of human agency.[52] There should be no fire environment triangle here, according to these narratives, as fire is an aberration that occurs solely through humans'

careless modifications or malice. Any landscape fire is therefore the product of human mismanagement.

This framing of elemental agency reverberates throughout contemporary environmental politics in which fire's circuitous molecular exchanges are redisciplined. In Southeast Asia, national discourses surrounding regular El Niño-driven wildfires make few distinctions between the fire use of state- or corporate-sponsored palm oil expansion, long histories of industrial logging, and the much-maligned practice of swidden cultivation, a rotational form of agriculture in which sections of forest are annually cut and burned to sequester nutrients into the soil. These reductive understandings conflate the conditions for burning, such as larger shifts in forest composition, with any use of fire. In this context, marginalised ethnic minorities who reside on state forest lands and rely heavily on fire-dependent swidden agriculture for subsistence often endure disproportionate blame as the proximate cause of forest degradation and excess smoke that readily transgress international boundaries and penetrate the lungs of city-dwellers across the region.[53] More than impacting biodiversity, prominent forest governance schemes such as the United Nations' 'Reducing Emissions from Deforestation and forest Degradation and enhancing forest carbon stocks' (REDD+) program also rescale and manage swidden agriculture's carbon impact as a threat to humanity's survival. REDD+ and the powerful drive towards Climate Smart Agriculture—boosted by The World Bank and the Food and Agriculture Organisation of the United Nations—aim to secure a certain idea of tropical (and indeed global) futures through the enforcement of 'no burn' landscapes.[54] These projects represent an increasingly strict governance of elemental exchange—forests become carbon credits—in the name of climate mitigation that positions fire as solely a malign and destructive process. In doing so, the implications of these moral claims surrounding fire extend far beyond the margins of policy debate. In 2018, for example, the Indonesian military authorized a 'shoot on sight' policy in Sumatra against alleged 'arsonists' to prevent the spread of choking smoke haze.[55]

In the Philippines, control of fire was historically a key focus of the Spanish (1565-1898) and later American (1889-1946) colonial efforts to exploit forests. Prior to colonization, *kaingineros* or swidden farmers who purposely modify forests by clearing and drying vegetation, dominated much of the archipelago. Removing the canopy rendered the typically moist duff and humus of the forest floor combustible, making it possible for small-scale farmers to then light fires that simultaneously create both space and nutrient-rich soil for food crops. For the colonial and later national Philippine authorities, this form of agricultural production set off a chain reaction of environmental degradation. Colonial scientists and administrators during the late nineteenth and early twentieth centuries reasoned that, by diminishing tree cover, *kaingineros* promoted the growth of fire-adapted grass species whose combustion would further erode the margins of the forests[56]. These ideas have had a significant afterlife. Today, Philippine efforts to rehabilitate once-forested areas have emerged through a series of 'national greening' programs that aim to restore ecological values by intensively commodifying upland areas. Grassland and forest fires that impact these projects are blamed on a hard-headed peasantry who are figured as careless or malicious.[57] These recriminations are not relegated to technocratic foresters either. An emerging social movement of middle-class Filipino mountaineers, seeking to defend their own recreational use of forests, regularly point to Indigenous *kaingineros* as the source of forest fires.[58]

However, as Vayda states, not all ignitions lead to wildfire.[59] An elemental re-reading of swiddening and colonial histories, oriented towards the specificities of fire-use and deep environmental histories, might come to a different conclusion: the fire-dependent agriculture

of Indigenous peoples in the Philippines and throughout the region are sophisticated practices of micro-climatic transformation.[60] Far from the desperate setting of fires for subsistence envisioned by colonial and contemporary state foresters, many Indigenous peoples throughout the archipelago continue to wield combustion in precise combination with seasonal variations, topography, careful arrangement of vegetation types, and the construction of elaborate fire breaks. Through these processes, fire's biochemical alchemy exchanges forest biomass for ash, rich in nitrogen, potassium, phosphorus and other nutrients, thereby rendering otherwise unproductive tropical soils fertile and producing mosaics of forest succession across mountainous landscapes. This variegation has led some tropical forestry researchers to rework established narratives of fire-driven degradation. As Padoch et al. note hopefully, rather than a stage in a linear process of environmental decline, the 'illegibility of …patchy [swidden] landscapes' could represent 'biodiversity' itself to conservationists.'[61] In this alternative vision, the visible disturbance and landscape variability produced by swiddening practices can host a wider range of plant and animal species than might otherwise be supported by a mythical 'untouched' and uniform rainforest.

The claims of Padoch and others remain largely ungrasped. Instead, climate change mitigation schemes such as REDD+ and the push for fire-free landscapes in Climate Smart Agriculture have reproduced and intensified older efforts to constrain fire by linking Southeast Asian forests into global efforts to govern a specific elemental entity: carbon. Problematically, international efforts to address climate change reduce fire to a malign agent of degradation and destruction. The kind of elemental political ecology deployed here, attuned to the defiant spatiality of fire's molecular journeys, might help reorder issues of blame and causality in enduring debates over the decline of tropical forests. A focus on the specificities of fire in the region can, to quote anthropologist Anna Tsing, further bolster arguments for a 'contaminated diversity and slow disturbance' in forests in Southeast Asia.[62] Addressing old but persistent misconceptions that Indigenous peoples' use of fire was irrational helps put focus on longer colonial histories of logging and contemporary plantation agriculture that degrades forests and promotes fire at a much larger scale. While 'cultural burning' by Aboriginal peoples in Australia has recently enjoyed a partial rehabilitation in the popular imagination and fire management bureaucracies of that nation,[63] the use of fire for swidden agriculture in Southeast Asia is still awaiting an anticolonial revisionist moment.

Conclusion

There are many dangers to the Anthropocene both as an era and concept. But even if geologists have gifted the world with a poor diagnosis of this epoch, fraught with potential to further sediment anthropocentrism, there is both social and analytical force in the 'charismatic mega-category' yet.[64] It can act as an invitation to 'diplomacy,' as Stengers might say, around the potential composing of better worlds together.[65] The term offers a broadcast method for signalling human responsibility for present ecological predicaments, as Hecht argues, but without asserting control. The true danger for scholarship, she adds, is that our Anthropocenic excursions risk submitting to geologists' abstractions and thereby ignoring the need to keep things 'in place'. That is, the arrival of the Anthropocene concept actually represents a vital opportunity for formulating emplaced narrations of present predicaments while also 'keeping the planet and all of its humans in the same conceptual frame'.[66] As for the protagonists of sci-fi films like *Fantastic Voyage* (1966) and *Innerspace* (1987), such narrative work requires the selection of appropriate 'interscalar vehicles', in this case meaning entities or processes whose

journeys across scales illustrate how temporal and spatial bounds govern worlds. This is an elemental task in that it is a search for fundamentals.

In this article, we have sought to test wildfire's fitness to act as one such vehicle. Our choice was based on three factors. First, while our respective research commitments are grounded in different continents, they all centre on sites where concerns about landscape fires or wildland combustion are bound up with political questions about life in a changing climate. Higher temperatures, more extreme rainfall, and other effects of anthropogenic climate change socially redistribute wildfire's impacts and benefits according to familiar colonial and capitalist patterns. Subsequently, and second, we have a common sense that fires physically and symbolically act differently across different sites and scales, variously glossed as natural, unnatural, cultural, destructive, regenerative, aberrational, unavoidable, fungible, and wasteful. In short, fire is already the target of significant storytelling, particularly within science, about shared pasts and futures. Third, our pursuit of wildfire is also informed by an intuition that it has something useful to tell us about the value and limits of thinking elementally. In the recent efflorescence of literature in the humanities on 'the elemental', it has sometimes been hard to discern how elementality differs from materiality as an analytical frame.[67] Is this budding interest in the elemental just a 'revitalisation' of new materialism? Perhaps, but not necessarily.

The significant difference between materialism and elementalism, we suggest, is that the elemental contains a distinction between the fundamental and its other. As against the generalised vibrancy of matter in new materialism, in which absolutely all existent things are alive, an elemental philosophy gambles that some matter is not contingent; it wagers that some matter, following Braun, is 'determined to be determined'.[68] As we signalled in the opening of this essay, following the affined visions of Heraclitus and western science, we do not understand fire as a substance. Rather, fire is a conjunctural, durational and transformative biochemical reaction. It is a point of exchange conditioned by its specific time and space, a deterministic process of inputs and outputs that can feed new life but cannot be reversed to revive what it has consumed. *Fire is a process of contingency's determination*. Thinking with wildfire—a process entangled in the formation, perpetuation and possible extinction of life on this planet—arguably avoids the materialist trap of seeing everything as 'emergent,' requiring us instead to stay with the specific agents and histories of actual earthly exchanges. By thinking elementally, we attempt to foreground difference, emphasizing the particularity of wildfire and its many flammable relations.

If, as the geographer Simon Dalby suggests, maintaining the planetary boundaries suitable for human life requires us to 'constrain' combustion, we first need to understand the manifold ways in which its elemental exchanges are governed. Our survey of several fire-prone contexts in this essay has sought to demonstrate the diversity of ways in which this process has been socially and ecologically incorporated and on whose terms this incorporation takes place. These examples, we suggest, are more than the sum of their parts. Our case studies point to an international fire politics, in which regional specificities increasingly join up to global economies concerned with the governance of combustion to constrain risk, avert climate disaster and sometimes even make profit.

Denser and denser bureaucratic regimes of combustion governance are being transposed onto existing geopolitical rifts and economic unevenness. Russian aircraft are deployed to help fight fires in Borneo. North American fire managers, under the imprimatur of the United Nations, travel to Indonesia and Thailand to instruct communities in fire prevention. German companies offset their emissions by purchasing carbon credits dependent on the creation of fire-free landscapes in Latin America. Australian scientists and bureaucrats travel

to southern Africa to test the export potential of savanna fire-emissions-abatement techniques and economies. By attending to such sites—sites where the governance of fire is the issue at hand—we can come to a better understanding of how people and their futures after being governed through fire and, in this way, how another politics of fire might be possible. It would be a politics attuned to the multiple exchanges of meaning and materiality of landscape combustion; a politics compatible with the eternal return of fire in its manifold forms.

Acknowledgments: We are very grateful to the participants and guests of the Fire stream at the Anthropocene Campus Melbourne 2018 for their help in sharpening the thinking behind this article. We also thank Arn Keeling and Ignace Schoot for feedback on the Canadian case study and thank our peer reviewers for their guidance.

Works Cited

Adams, Mark A., and Peter M. Attiwill. *Burning Issues: Sustainability and Management of Australia's Southern Forests.* Collingwood, Vic.: CSIRO Pub. in association with Bushfire CRC, 2011.

Adey, Peter, 'Air's Affinities: Geopolitics, Chemical Affect and the Force of the Elemental.' *Dialogues in Human Geography* 5, no. 1 , 2015, pp. 54–75. https://doi.org/10.1177/2043820614565871

Beck, Ulrich. *Risk Society: Towards a New Modernity,* trans. M. Ritter, London: Sage, 1992. https://doi.org/10.1177/000169939303600409

Bennett, Jane. *Vibrant Matter: A Political Ecology of Things.* Durham, NC: Duke University Press, 2010.

Black, Carolyn, Yohannes Tesfaigzi, Jed A Bassein, and Lisa A Miller. 'Wildfire Smoke Exposure and Human Health: Significant Gaps in Research for a Growing Public Health Issue.' *Environmental Toxicology and Pharmacology* 55, 2017: 186–95. https://doi.org/10.1016/j.etap.2017.08.022

Blok, Anders, Moe Nakazora, and Brit Ross Winthereik. 'Infrastructuring Environments.' *Science as Culture* 25, no. 1, 2016, pp. 1–22. https://doi.org/10.1080/09505431.2015.1081500

Bonta, Mark, Robert Gosford, Dick Eussen, Nathan Ferguson, Erana Loveless, and Maxwell Witwer. "Intentional Fire-Spreading by "Firehawk" Raptors in Northern Australia." *Journal of Ethnobiology* 37, no. 4 (2017): 700-19. https://doi.org/10.2993/0278-0771-37.4.700

Bowman, David MJS, Jennifer Balch, Paulo Artaxo, William J Bond, Mark A Cochrane, Carla M D'antonio, Ruth DeFries, *et al.* 'The Human Dimension of Fire Regimes on Earth.' *Journal of Biogeography* 38, no. 12, 2011, pp. 2223–36. https://doi.org/10.1111/j.1365-2699.2011.02595.x

Braun, Bruce. 'Book Review Forum: Vibrant Matter: A Political Ecology of Things.' *Dialogues in Human Geography* 1, no. 3, 2011, pp. 390–93. https://doi.org/10.1177/204382061100100306

Buizer, Marleen, and Tim Kurz. 'Too Hot to Handle: Depoliticisation and the Discourse of Ecological Modernisation in Fire Management Debates.' *Geoforum* 68 (1), 2016, pp. 48–56. https://doi.org/10.1016/j.geoforum.2015.11.011

Canadian Council of Forest Ministers, *Canadian Wildland Fire Strategy: A Vision for Innovative and Integrated Approach to Managing the Risks*, Ottawa: Canadian Council of Forest Ministers, 2005.

Clark, Nigel. "Rock, Life, Fire: Speculative Geophysics and the Anthropocene." *Oxford Literary Review* 34, no. 2 (2012): 259-76. https://doi.org/10.3366/olr.2012.0045

Cohen, Jeffrey Jerome, and Lowell Duckert. 'Eleven Principles of the Elements.' In Elemental Ecocriticism: Thinking with Earth, Air, Water, and Fire, edited by Jeffrey Jerome Cohen and Lowell Duckert, 1–26: University of Minnesota Press, 2015.

Conklin, Harold. Hanunoo Agriculture: A Report on an Integral System of Shifting Cultivation in the Philippines. Rome: Food and Agriculture Organisation, 1957. https://doi.org/10.4200/jjhg1948.11.476

Dalby, Simon. 'Firepower: Geopolitical Cultures in the Anthropocene.' *Geopolitics*, 2017, pp. 1–25. https://doi.org/10.1080/14650045.2017.1344835

Davis, Heather and Zoe Todd. 'On the importance of a date, or decolonization the Anthropocene,' *ACME: An International Journal for Critical Geographies* 16, no. 4, 2017, pp. 761–780.

Dowdy, Andrew J. 'Climatological Variability of Fire Weather in Australia.' *Journal of Applied Meteorology and Climatology* 57, no. 2, 2018, pp. 221–34. https://doi.org/10.1175/jamc-d-17-0167.1

Engelmann, Sasha, and Derek McCormack. 'Elemental Aesthetics: On Artistic Experiments with Solar Energy.' *Annals of the American Association of Geographers* 108, no. 1, 2018, pp. 241–59. https://doi.org/10.1080/24694452.2017.1353901

EPC. *Inquiry into Fire Season Preparedness: Final Report.* Melbourne: Environment and Planning Committee, Parliament of Victoria, June, 2017.

Fairhead, James, and Melissa Leach. *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic*. Cambridge: Cambridge University Press, 1996.

Fowler, C. *Ignition Stories: Indigenous Fire Ecology in the Indo-Australian Monsoon Zone* . Durham: Carolina Academic Press, 2012.

Gammage, Bill. *The Biggest Estate on Earth: How Aborigines Made Australia.* Sydney: Allen & Unwin, 2012.

Goldammer, J. G., and B. Seibert. 'Natural Rain Forest Fires in Eastern Borneo During the Pleistocene and Holocene.' *The Science of Nature* 76, no. 11, 1989, pp. 518–20. https://doi.org/10.1007/bf00374124

Haikerwal, Anjali, Fabienne Reisen, Malcolm R. Sim, Michael J. Abramson, Carl P. Meyer, Fay H. Johnston, and Martine Dennekamp. 'Impact of Smoke from Prescribed Burning: Is it a Public Health Concern?'. *Journal of the Air & Waste Management Association* 65, no. 5, 2015, pp. 592–98. https://doi.org/10.1080/10962247.2015.1032445

Hecht, Gabrielle. 'Interscalar Vehicles for an African Anthropocene: On Waste, Temporality, and Violence.' *Cultural Anthropology* 33, no. 1, 2018, pp. 109-41. https://doi.org/10.14506/ca33.1.05

Hird, Myra J. and Alexander R.D. Zahara. 'The Arctic Wastes,' In *Anthropocene Feminism,* edited by Richard Grusin, University of Minnesota Press, Minneapolis, 121-145, 2017. https://doi.org/10.1086/696631

Hunt, C. O., and R. J. Rabett. 'Holocene Landscape Intervention and Plant Food Production Strategies in Island and Mainland Southeast Asia.' *Journal of Archaeological Science* 51, 2014, pp. 22–33. https://doi.org/10.1016/j.jas.2013.12.011

Hwai, Lee Seok. 'Shoot-on-Sight Order Issued in Riau as Growing Forest and Peatland Fires Cause Choking Haze.', *The Straits Times*, 2017, https://www.straitstimes.com/asia/se-asia/shoot-on-sight-order-issued-in-riau-as-growing-forest-and-land-fires-cause-choking-haze.

Jones, Rhys. 'Firestick Farming.' *Australian Natural History* 16, 1969, pp. 224–31.

Kaars, Sander van der, Xuan Wang, Peter Kershaw, François Guichard, and Duddy Arifin Setiabudi. 'A Late Quaternary Palaeoecological Record from the Banda Sea, Indonesia: Patterns of Vegetation, Climate and Biomass Burning in Indonesia and Northern Australia.' Palaeogeography, Palaeoclimatology, Palaeoecology 155, no. 1, 2000, pp. 135-153. https://doi.org/10.1016/s0031-0182(99)00098-x

Kohlenberg, Andrew J, Merritt R Turetsky, Dan K Thompson, Brian A Branfireun, and Carl PJ Mitchell. 'Controls on Boreal Peat Combustion and Resulting Emissions of Carbon and Mercury.' *Environmental Research Letters* 13, no. 3, 2018, 035005. https://doi.org/10.1088/1748-9326/aa9ea8

Kull, Christian A. *Isle of Fire: The Political Ecology of Landscape Burning in Madagascar*, University of Chicago Press, 2004. https://doi.org/10.1111/j.1745-5871.2006.00380_5.x

Nicole Klenk, Gary Bull, and Dave Cohen, 'What is the 'END' (emulation of natural disturbance) in forest ecosystem management? An open question,' *Canadian Journal of Forest Research,* 38, no. 8, 2008, pp. 2159–2168. https://doi.org/10.1139/x08-054

Lasco, Gideon. 'Remembering the Forest Fires – and Preventing Them.' *Pinoy Mountaineer*, 2017, http://www.pinoymountaineer.com/2017/03/essay-remembering-the-forest-fires-and-preventing-them.html

McArthur, Alan G. 'Plotting Ecological Change.' In *Historians at Work*, edited by D. Dufty and K. Swan, 27–48. Sydney: Hicks Smith, 1973.

Neale, Timothy. 'Digging for Fire: Finding Control on the Australian Continent.' *Journal of Contemporary Archaeology* 5, no. 1 (2018), pp. 79-90. https://doi.org/10.1558/jca.33208

Neale, Timothy. 'Burning Anticipation: Wildfire, Risk Mitigation and Simulation Modelling in Victoria, Australia.' *Environment & Planning A* 48, no. 10 (2016), pp. 2026-45. https://doi.org/10.1177/0308518x16651446

Neale, Timothy, and Jessica K. Weir. "Navigating scientific uncertainty in wildfire and flood risk mitigation: A qualitative review." *International journal of disaster risk reduction* 13 (2015), pp. 255-265. https://doi.org/10.1016/j.ijdrr.2015.06.010

Neale, Timothy, Jessica K. Weir, and Tara K. McGee. 'Knowing Wildfire Risk: Scientific Interactions with Risk Mitigation Policy and Practice in Victoria, Australia.' *Geoforum* 72 (2016), pp. 16-25. https://doi.org/10.1016/j.geoforum.2016.03.008

Packham, David. 'How to Make These Fires Our Last.' *Quadrant* (20 October 2013).

Padoch, Christine, and Miguel Pinedo-Vasquez. 'Saving Slash-and-Burn to Save Biodiversity.' *Biotropica* 42, no. 5, 2010, pp. 550–52. https://doi.org/10.1111/j.1744-7429.2010.00681.x

Pascoe, Bruce. *Dark Emu: Black Seeds: Agriculture or Accident?* Broome, WA: Magabala Books, 2014. https://doi.org/10.1017/qre.2017.23

Peters, John Durham. *The Marvelous Clouds: Toward a Philosophy of Elemental Media.* Chicago: University of Chicago Press, 2015. https://doi.org/10.7208/chicago/9780226253978.001.0001

Petryna, Adriana. "Wildfires at the Edges of Science: Horizoning Work Amid Runaway Change." *Cultural Anthropology* 33, no. 4 (2018): 570–95. https://doi.org/10.14506/ca33.4.06

Prince Albert Grand Council, *Fighting Forest Fires in Northern Saskatchewan: Task Force Interim Report*. Prince Albert: Prince Albert Grand Council, 2018.

Pyne, Stephen J. *World Fire: The Culture of Fire on Earth.* Cycle of Fire. Pbk. ed. Seattle: University of Washington Press, 1997.

Ranada, Pia. 'Rethinking the National Greening Program.' Rappler, 2014, https://www.rappler.com/move-ph/ispeak/60948-rethinking-national-greening-program

Reddy, Elizabeth. 'What Does It Mean to Do Anthropology in the Anthropocene?'. Platypus, 2014. http://blog.castac.org/2014/04/what-does-it-mean-to-do-anthropology-inthe-anthropocene.

Reid, Colleen E, Michael Brauer, Fay H Johnston, Michael Jerrett, John R Balmes, and Catherine T Elliott. 'Critical Review of Health Impacts of Wildfire Smoke Exposure.' *Environmental Health Perspectives* 124, no. 9, 2016, pp. 1334–43. https://doi.org/10.1289/ehp.1409277

RBGK. *State of the World's Plants 2017.* (Kew Royal Botanic Gardens, 2017).

Rothstein, Henry, Michael Huber, and George Gaskell. 'A Theory of Risk Colonization: The Spiralling Regulatory Logics of Societal and Institutional Risk.' *Economy and Society* 35, no. 1, 2006, pp. 91–112. https://doi.org/10.1080/03085140500465865

Russell-Smith, Jeremy, Catherine Monagle, Margaret Jacobsohn, Robin L. Beatty, Bibiana Bilbao, Adriana Millán, Hebe Vessuri, and Isabelle Sánchez-Rose. 'Can Savanna Burning Projects Deliver Measurable Greenhouse Emissions Reductions and Sustainable Livelihood Opportunities in Fire-Prone Settings?'. *Climatic Change* 140, no. 1, 2017, pp. 47–61. https://doi.org/10.1007/s10584-013-0910-5

Saskatchewan Environment, *Fire and Forest Insect and Disease Management Policy Framework Document*, Regina: Minister of Environment, 2003.

Scherjon, Fulco, Corrie Bakels, Katharine MacDonald, and Wil Roebroeks. 'Burning the Land: An Ethnographic Study of Off-Site Fire Use by Current and Historically Documented Foragers and Implications for the Interpretation of Past Fire Practices in the Landscape.' *Current Anthropology* 56, no. 3, 2015, pp. 299–326. https://doi.org/10.1086/681561

Scott, Andrew C. *Burning Planet: The Story of Fire through Time.* London: Oxford University Press, 2018.

Sigler, JM, X Lee, and W Munger. 'Emission and Long-Range Transport of Gaseous Mercury from a Large-Scale Canadian Boreal Forest Fire.' *Environmental science & technology* 37, no. 19, 2003, pp. 4343–47. https://doi.org/10.1021/es026401r

Sivaramakrishnan, K. 'The Politics of Fire and Forest Regeneration in Colonial Bengal.' *Environment and History* 5, no. 2, 1996, pp. 145–94.

Smith, Will. *Mountains of Blame: Climate and Culpability in the Philippine uplands* . Seattle: University of Washington Press, 2020.

Smith, Will and Wolfram Dressler. "Forged in flames: Indigeneity, forest fire and geographies of blame in the Philippines", *Postcolonial Studies*, forthcoming.

Stengers, Isabelle. 'The Challenge of Ontological Politics.' In *A World of Many Worlds*, edited by Marisol de la Cadena and Mario Blaser, Duke University Press, Durham, 83-111, 2019.

Taylor, Marcus. 'Climate-Smart Agriculture: What Is It Good For?'. *The Journal of Peasant Studies* 45, no. 1, 2018, pp. 89–107. https://doi.org/10.1080/03066150.2017.1312355

Tuck, Eve, and K. Wayne Yang. 'Decolonization Is Not a Metaphor.' *Decolonization: Indigeneity, Education & Society* 1, no. 1, 2012, pp. 1–40.

Tsing, Anna Lowenhaupt. 'Contaminated Diversity in 'Slow DisturBance': Potential Collaborators for a Liveable Earth.' *RCC Perspectives:Transformations in Environment and Society*, 2012, http://www.environmentandsociety.org/perspectives/2012/9/article/contaminated-diversity-slow-disturbance-potential-collaborators-liveable

Vayda, Andrew P. 'Causal Explanation of Indonesian Forest Fires: Concepts, Applications, and Research Priorities.' Human Ecology 34, no. 5, 2006, p 615. https://doi.org/10.1007/s10745-006-9029-x

Whitington, Jerome. 'Carbon as a Metric of the Human.' PoLAR: Political and Legal Anthropology Review 39, no. 1, 2016, pp. 46–63.

Wynne, Brian. 'Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventative Paradigm.' *Global Environmental Change* 2, 1992, pp. 111–127.

Wynne, Brian. 'May the Sheep Safely Graze?: A Reflexive View of the Expert-Lay Knowledge Divide.' In *Risk, Environment and Modernity. Towards a New Ecology*, edited by Scott Lash, Bron Szerszynski, and Brian Wynne, Sage Publication, London, 44–83, 1996. https://doi.org/10.4135/9781446221983.n3

Zahara, Alexander. 'On sovereignty, deficits and dump fires: Risk governance in an Arctic 'dumpcano'. In *Inevitably Toxic: Historical Perspectives on Contamination, Exposure, and Expertise*, edited by Brinda Sarathy, Vivien Hamilton, and Janet Farrell Brodie, University of Pittsburgh Press, Pittsburgh, 259-283, 2018. https://doi.org/10.2307/j.ctv7n0c37.14

Notes

1. John Durham Peters, *The marvelous clouds: toward a philosophy of elemental media* (Chicago: University of Chicago Press, 2015).

2. Timothy Neale, "Digging for fire: finding control on the Australian continent," *Journal of Contemporary Archaeology* 5, no. 1 (2018): 86.

3. See, for example, the materials politics of a self-igniting dump fire in Myra J. Hird and Alexander Zahara, "The Arctic Wastes," in *Anthropocene Feminism*, ed. Richard Grusin (University of Minnesota Press, 2017), p.121 & 132-137.

4. Andrew C. Scott, *Burning Planet: The story of fire through time* (London: Oxford University Press, 2018), 24, 85.

5. Stephen J. Pyne, *World fire: the culture of fire on earth*, (Seattle: University of Washington Press, 1997).

6. Nigel Clark, "Rock, Life, Fire: Speculative Geophysics and the Anthropocene." *Oxford Literary Review* 34, no. 2 (2012): 269. Notably, humans are not the only 'fire creatures' as Pyne suggests. See: Mark Bonta, Robert Gosford, Dick Eussen, Nathan Ferguson, Erana Loveless, and Maxwell Witwer, "Intentional fire-spreading by "firehawk" raptors in Northern Australia," *Journal of Ethnobiology* 37, no. 4 (2017): 700-19.

7. Sasha Engelmann and Derek McCormack, "Elemental aesthetics: on artistic experiments with solar energy," *Annals of the American Association of Geographers* 108, no. 1 (2018): 242.

8. Timothy Neale, Thao Phan and Courtney Addison, "An Anthropogenic Table of Elements: An Introduction." Society for Cultural Anthropology, 2019, accessed 2 August 2019, https://culanth.org/fieldsights/an-anthropogenic-table-of-elements-an-introduction.

9. Jeffrey Jerome Cohen and Lowell Duckert, "Eleven principles of the elements," in *Elemental ecocriticism: Thinking with earth, air, water, and fire*, ed. Jeffrey Jerome Cohen and Lowell Duckert (University of Minnesota Press, 2015), 11-13.

10. Gabrielle Hecht, "Interscalar vehicles for an African Anthropocene: On waste, temporality, and violence," *Cultural Anthropology* 33, no. 1 (2018): 135.

11. RBGK, *State of the World's Plants 2017*, (Kew Royal Botanic Gardens, 2017).

12. Simon Dalby, "Firepower: geopolitical cultures in the Anthropocene," *Geopolitics* (2017).

13. Neale, "Digging for fire": 84.

14. Scott, *Burning Planet*: 24.

15. Fulco Scherjon et al., "Burning the Land: An Ethnographic Study of Off-Site Fire Use by Current and Historically Documented Foragers and Implications for the Interpretation of Past Fire Practices in the Landscape," *Current Anthropology* 56, no. 3 (2015): 40.

16. David MJS Bowman et al., "The human dimension of fire regimes on Earth," *Journal of biogeography* 38, no. 12 (2011).

17. Rhys Jones, "Firestick Farming," *Australian Natural History* 16 (1969); Bill Gammage, *The biggest estate on Earth: How Aborigines made Australia* (Sydney: Allen & Unwin, 2012); Pyne, *World fire*, 39; also see: Bruce Pascoe, *Dark emu: Black seeds: agriculture or accident?* (Broome, WA: Magabala Books, 2014).

18. Andrew J Dowdy, "Climatological Variability of Fire Weather in Australia," *Journal of Applied Meteorology and Climatology* 57, no. 2 (2018), https://doi.org/10.1175/JAMC-D-17-0167.1.

19. Marleen Buizer and Tim Kurz, "Too hot to handle: Depoliticisation and the discourse of ecological modernisation in fire management debates," *Geoforum* 68 (1// 2016).

20. Alan G. McArthur, "Plotting ecological change," in *Historians at work*, ed. D. Dufty and K. Swan (Sydney: Hicks Smith, 1973); Mark A. Adams and Peter M. Attiwill, *Burning issues: sustainability and management of Australia's southern forests* (Collingwood, Vic.: CSIRO Pub. in association with Bushfire CRC, 2011).

21. David Packham, "How to make these fires our last," *Quadrant* (20 October 2013); Adams and Attiwill, *Burning issues*.

22. Gammage, *Biggest estate*, 157, 287; EPC, *Inquiry into fire season preparedness: Final report* (Melbourne: Environment and Planning Committee, Parliament of Victoria, June, 2017), 3.

23. Anjali Haikerwal et al., "Impact of smoke from prescribed burning: Is it a public health concern?," *Journal of the Air & Waste Management Association* 65, no. 5.

24. Jerome Whitington, "Carbon as a Metric of the Human," *PoLAR: Political and Legal Anthropology Review* 39, no. 1 (2016).

25. Whitington, "Carbon as a metric."

26. See: Jeremy Russell-Simth et al., "Can savanna burning projects deliver measurable greenhouse emissions reductions and sustainable livelihood opportunities in fire-prone settings?," *Climatic Change* 140, no. 1.

27. See: Adriana Petryna, "Wildfires at the Edges of Science: Horizoning Work Amid Runaway Change," *Cultural Anthropology* 33, no. 4 (2018).

28. Carolyn Black et al., "Wildfire smoke exposure and human health: Significant gaps in research for a growing public health issue," *Environmental toxicology and pharmacology* 55 (2017): 187.

29. Colleen E Reid et al., "Critical review of health impacts of wildfire smoke exposure," *Environmental Health Perspectives* 124, no. 9 (2016).

30. Ulrich Beck, *Risk society: Towards a new modernity*, trans Mark Ritter, (London: Sage, 1992), 51-83.

31. Brian Wynne, 'May the Sheep Safely Graze?: A Reflexive View of the Expert-Lay Knowledge Divide', in Scott Lash, Bronislaw Szerszynski, and Brian Wynne (eds), *Risk, Environment and Modernity. Towards a New Ecology*, Sage Publication, London, 1996, pp. 55-61; Timothy Neale and Jessica K Weir, "Navigating scientific uncertainty in wildfire and flood risk mitigation: A qualitative review" *International journal of disaster risk reduction* 13, (2015), pp. 259.

32. Andrew J Kohlenberg et al., "Controls on boreal peat combustion and resulting emissions of carbon and mercury," *Environmental Research Letters* 13, no. 3 (2018); JM Sigler, X Lee, and W Munger, "Emission and long-range transport of gaseous mercury from a large-scale Canadian boreal forest fire," *Environmental science & technology* 37, no. 19 (2003).

33. Brian Wynne, 'Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventative Paradigm,' *Global Environmental Change*, vol. 2, no. 2, 1992, pp. 119-126.

34. Henry Rothstein, Michael Huber, and George Gaskell, 'A Theory of Risk Colonization: The Spiralling Regulatory Logics of Societal and Institutional Risk,' *Economy and Society,* vol. 35, no. 1, 2006, pp. 99-106; Timothy Neale, "Burning anticipation: wildfire, risk mitigation and simulation modelling in Victoria, Australia," *Environment & Planning A* 48, no. 10 (2016), pp. 2026-45.

35. For a discussion of how 'acceptable' levels of smoke exposure are both made and contested, see Alexander Zahara, 'On sovereignty, deficits and dump fires: Risk governance in an Arctic 'dumpcano'. In Brinda Sarathy, Vivien Hamilton and Janet Farrell Brodie (eds), *Inevitably Toxic: Historical Perspectives on Contamination, Exposure, and Expertise,* University of Pittsburgh Press, 2018, pp 265-275.

36. Timothy Neale, Jessica K. Weir, and Tara K. McGee, "Knowing wildfire risk: scientific interactions with risk mitigation policy and practice in Victoria, Australia," *Geoforum* 72 (2016), pp. 24.

37. The exception to this is lands of federal responsibility, such as National Parks or First Nations reserves, though, in these instances, agreements have been made with the provinces to engage in fire management on the Government of Canada's behalf.

38. Saskatchewan Environment, *Fire and Forest Insect and Disease Management Policy Framework Document*, Regina: Minister of Environment, 2003, pp. 15.

39. Saskatchewan Environment, pp. 1-5.

40. Prince Albert Grand Council, *Fighting Forest Fires in Northern Saskatchewan: Task Force Interim Report*. Prince Albert: Prince Albert Grand Council, 2018, pp. 1-5.

41. This refers to risk management protocols of listing and protecting what are called 'values-at-risk'. This is not to say that Indigenous folks are 'at-risk' or endanger of disappearance, which would be an incorrect assertion and what Tuck and Yang (2012) refer to as a 'settler move-to-innocence'. Rather, Indigenous people continue to actively engage in what Neale (2016) refers to as 'calculative re-articulation', 'wherein figurations of the future are rebooted, reconstructed or calibrated' through their various involvement in fire management practices (as lobbyists, firefighters, practitioners, scientists, and more). Eve Tuck and

K. Wayne Yang, "Decolonization is not a metaphor," *Decolonization: Indigeneity, Education & Society* 1, no. 1 (2012), 22-23; Neale, "Digging for fire," 2016.

42. Anders Blok, Moe Nakazora & Brit Ross Winthereik, 'Infrastructuring Environments', *Science as Culture*, vol. 25, no. 1, 2016, pp. 2-4; Davis and Todd, following the work of Indigenous thinkers refer to a similar process of what they refer to as 'terraforming', which they link directly to the building and severing of relationships. Heather Davis and Zoe Todd, 'On the importance of a date, or decolonization the Anthropocene,' *ACME: An International Journal for Critical Geographies*, vol. 16, no. 4, pp. 770-772.

43. Rothstein et al., 'A Theory of Risk Colonization', pp. 99-106.

44. Ibid, pp. 93. Note: the authors are referring to institutional arrangements that coalesce in response to risks and not forms of colonization, such as settler colonialism, that are characterized by the domination of one group over another.

45. See also Neale, 2016.

46. Nicole Klenk, Gary Bull, and Dave Cohen, 'What is the "END" (emulation of natural disturbance) in forest ecosystem management? An open question,' *Canadian Journal of Forest Research,* vol. 38., no. 8, pp. 2159-2168.

47. Stephen J Pyne. *Vestal Fire: An Environmental History, Told through Fire, of Europe and Europe's Encounter with the World*. Seattle: University of Washington Press, 2012, p. 411.

48. James Fairhead and Melissa Leach. *Misreading the African Landscape: Society and Ecology in a Forest-Savann Mosaic*. Cambridge: Cambridge University Press, 1996; Sivaramakrishnan, K. "The Politics of Fire and Forest Regeneration in Colonial Bengal." *Environment and History* 5, no. 2, 1996; Kull, Christian A. *Isle of Fire: The Political Ecology of Landscape Burning in Madagascar*, University of Chicago Press, 2004.

49. Peter Adey. "Air's Affinities: Geopolitics, Chemical Affect and the Force of the Elemental." *Dialogues in Human Geography* 5, no. 1, 2015, pp. 54-75.

50. Sander van der Kaars et al. "A Late Quaternary Palaeoecological Record from the Banda Sea, Indonesia: Patterns of Vegetation, Climate and Biomass Burning in Indonesia and Northern Australia." *Palaeogeography, Palaeoclimatology, Palaeoecology* 155, no. 1, pp. 135-153.

51. Hunt, C. O., and R. J. Rabett. "Holocene Landscape Intervention and Plant Food Production Strategies in Island and Mainland Southeast Asia." *Journal of Archaeological Science* 51, 2014, pp. 22-33.

52. One key example that complicates these narratives is the role of coal seam burning in Borneo's tropical rainforests, see: J.G. Goldammer and B. Seibert, "Natural Rain Forest Fires in Eastern Borneo During the Pleistocene and Holocene," *The Science of Nature* 76, no. 11, 1989, pp. 518-20.

53. Will Smith. *Mountains of Blame: Climate and Culpability in the Philippine uplands*. Seattle: University of Washington Press, 2020)

54. Marcus Taylor, "Climate-Smart Agriculture: What Is It Good For?" *The Journal of Peasant Studies* 45, no. 1, 2018, pp. 89-107.

55. Lee Seok Hwai,. "Shoot-on-Sight Order Issued in Riau as Growing Forest and Peatland Fires Cause Choking Haze.", *The Straits Times*, 2017, https://www.straitstimes.com/asia/se-asia/shoot-on-sight-order-issued-in-riau-as-growing-forest-and-land-fires-cause-choking-haze.

56. Will Smith and Wolfram Dressler. "Forged in flames: Indigeneity, forest fire and geographies of blame in the Philippines", *Postcolonial Studies*, forthcoming.

57. Rethinking the National Greening Program https://www.rappler.com/move-ph/ispeak/60948-rethinking-national-greening-program

58. Gideon Lasco, "Remembering the Forest Fires – and Preventing Them," *Pinoy Mountaineer*, 2017, http://www.pinoymountaineer.com/2017/03/essay-remembering-the-forest-fires-and-preventing-them.html

59. Andrew P Vayda, "Causal Explanation of Indonesian Forest Fires: Concepts, Applications, and Research Priorities," *Human Ecology* 34, no. 5 (2006): 615.

60. Harold Conklin, *Hanunoo Agriculture: A Report on an Integral System of Shifting Cultivation in the Philippines*. Rome: Food and Agriculture Organisation, 1957; Cynthia Fowler, *Ignition Stories: Indigenous Fire Ecology in the Indo-Australian Monsoon Zone* (Durham: Carolina Academic Press, 2012).

61. Christine Padoch and Miguel Pinedo-Vasquez, "Saving Slash-and-Burn to Save Biodiversity," *Biotropica* 42, no. 5, 2010, pp. 550-52.

62. Anna L. Tsing, "Contaminated Diversity in 'Slow DisturBance': Potential Collaborators for a Liveable Earth," *RCC Perspectives: Transformations in Environment and Society*, 2012, http://www.environmentandsociety.org/perspectives/2012/9/article/contaminated-diversity-slow-disturbance-potential-collaborators-liveable

63. Neale, "Digging for fire."

64. Elizabeth Reddy, "What does it mean to do Anthropology in the Anthropocene?," *Platypus* (2014), http://blog.castac.org/2014/04/what-does-it-mean-to-do-anthropology-inthe-anthropocene.

65. Isabelle Stengers, "The challenge of ontological politics," in *A world of many worlds*, ed. Marisol de la Cadena and Mario Blaser (Durham: Duke University Press, 2019), 83-111.

66. Hecht, "Interscalar vehicles," 135.

67. For routes into this flourishing literature, see: Cohen and Duckert, "Eleven principles"; Engelmann and McCormack, "Elemental aesthetics"; Peters, *Marvellous clouds*; Adey, "Air's Affinities"; Neale et al., "Anthropogenic Table."

68. Bruce Braun, "Book review forum: Vibrant Matter: A Political Ecology of Things," *Dialogues in Human Geography* 1, no. 3 (2011); Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham: Duke University Press, 2010).