

Landscapes of Fire: origins, politics and questions

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‘*Tany misy afo misy olona*--Where there is fire, there are people’ says a proverb in Madagascar. The mastery of fire defines humans more than any other trait. Fire is the most long-term and widespread way in which humans have shaped the surface of the earth. If it were not for fires lit by people, landscapes from the Great Plains of America to the savannas of Africa would look fundamentally different. Australia’s eucalypt savannas, Madagascar’s grasslands, Venezuela’s *gran sabana*, Norway’s coastal islands--what would they be without fire either today or in the past?

This chapter reviews the importance of anthropogenic fire as a key human tool for landscape management. It shows how the contrasting land management goals of different interest groups, shaped by long-term processes of ideological, political, and economic change, can lead to conflict over landscape firing. Case studies from Australia, Madagascar, and North America illustrate both the long history of anthropogenic burning and the way fire – and our reactions to it – have rapidly changed in recent times. The chapter then discusses a number of tools that researchers can use to investigate the material expressions of anthropogenic fires, and concludes with several questions for further investigation.

Humans and Fire

Over a million years ago, our ancestors observed that the animals they hunted congregated on the flush of new grass after lightning-strike fires, or that different useful plants grew in burned areas. They picked up burning sticks and carried fire to new places, and learned to maintain and stoke fires. By 350,000 to 400,000 years ago, evidence of home bases and domestic fires suggest that humans had fully mastered fire tending, including ignition. Ever since, throughout the world, throughout history, humans have relied on fire as a simple and effective tool to manage their environment (Stewart, 1956; Sauer, 1975; James, 1989; Schüle, 1990; Westbroek et al., 1993; Rolland, 2004).

If the land could burn, *Homo sapiens* have burned it. In seasonally dry places prone to lightning, people often beat nature to the task, setting fires as soon as plants were dry enough. Elsewhere they created the right conditions by unleashing livestock or slashing the vegetation. They burned for many reasons, unified by the desire to control and shape landscapes for a better life. Fires renew and expand grasses crucial to both wild game and domestic grazers. They clear brushy vegetation and thus facilitate cultivation as well as travel, visibility, and security. Frequent, small, early fires are the best way to control wildfires, by avoiding fuel build-up. People also burned to encourage (or discourage) specific plant types, to flush out animals for hunting or bees for hive collection, to better see mineral outcrops or wild tubers, or for a variety of social reasons not directly related to resource management (Bartlett, 1956; Jones, 1969; Pyne, 1995; Laris, 2002; Kull, 2004).

The result is fire-shaped landscapes. At its simplest level, increased burning favours fire-adapted species; woody plants give way to grasses. Yet actual outcomes vary enormously depending on the timing and frequency of fires. For example, early dry season burns every few years can, in the savannah environments of Africa, promote tree cover (Campbell, 1996; Bassett & Koli Bi, 2000). Seed availability, grazing intensity (whether by domestic livestock, wild mammals, or even insects), soil type, annual variability in timing and amount of precipitation--each of these also affects the outcomes (Pyne *et al.*, 1996). Land managers learn by experience the probable outcomes of certain burning regimes in their particular landscapes.

People not only *set* fires, they can also *control* fires: they created, and create, *fireless* landscapes. For example, people strictly circumscribe free-ranging fire in any intensive farming area. They protect certain places from flames, whether to protect economic resources (like timber or settlements) or due to cultural ideals (e.g. sacred groves or nature reserves). As a result, landscapes can be shaped by not just the presence of fire--in varied rhythms and intensities--but also by the absence of fire.

Political Fire

Not everyone benefits from fire. The pastoralist with his wandering herds and free-burning fires inevitably clashed with those whose homes, crops, or fallow fields he burned. Conflict over fire, however, has escalated in the modern age. Scientific advances, growing capitalist economies, and new, powerful state bureaucracies in the 19th century moved the management of many resources out of the hands of rural villagers. In both Europe and its colonies (or ex-colonies), resources were separated into categories (forestry, agriculture, livestock) to which 'rational' management strategies were applied. Research sought to increase yields within each sector, leading to plantation forests, intensive single-crop agriculture, and improved pastures. There was no room for fire. Ecological theories of the day supported this view, in particular the theory of succession, which viewed change in vegetation communities as an orderly, staged progression from bare soil to a climax, usually forest (Odum 1969). Fire was seen as an outside disturbance working against succession.

These ideas gained power as technological advances (e.g., the internal combustion engine in tractors and bulldozers) and political changes (e.g., growing state bureaucracies with colonial empires) facilitated their wide-scale implementation. As a result, fire landscapes changed. Rich industrialized countries like France and the U.S. used impressive fire-fighting technology to suppress burning in most forested landscapes. In tropical countries, rulers sought to replace firestick farming with intensive agriculture and state forests (Pyne, 1997). Such changes in resource management were inevitably politicised, as they favoured certain landscapes and certain livelihoods over others. That is why villagers in Kumaon, India, repeatedly torched the woodlands in the 1920s (Agrawal, 2005), and

why farmers in highland Madagascar burned forestry stations in 1947, 1992, and 2005 (Kull, 2004).

One way to understand fire conflicts builds on Pyne's (2001) scheme of 'first fire', 'second fire', and 'third fire'. 'First fire' refers to fires lit by lightning and other non-human sources. 'Second fire' is anthropogenic biomass burning like slash-and-burn agriculture or rangeland fires. 'Third fire' is the combustion of fossil biomass like coal and oil, characteristic of the industrial, modern age. Following this scheme, when humans domesticate fire or arrive in new lands, second fire replaces first fire. With industrialization, second fire is replaced by third fire--fields are fertilized using chemicals, not slash-and-burn rotations, and production moves to the cities. This industrialization frees up some marginal lands, which are then redefined as nature reserves, and sometimes subjected to first fire again.

Conflict occurs at the temporal and spatial boundaries between these types of fire--in the turbulent moment when one fire regime replaces another, or at the geographical margin between two types. For example, the arrival of people (carrying 'second fire') on unsettled ('first-fire') islands--as frequently occurred in the Malayo-Polynesian diaspora--led to important shifts in vegetation communities. While this shift was historically uncontested, more recently it fuels high profile controversies, such as the tension between farmers and foresters over rainforest loss in Madagascar. Likewise, the juxtaposition today of nature reserves managed for 'first fire' located alongside 'third fire' landscapes (like industrial pine plantations or suburbia) inevitably sparks anxiety.

Case studies

The complex relationships of people, fire, and landscape are best illustrated with examples. Three cases are highlighted below--Australia, Madagascar, and North America--including their implications on an archaeology of fire landscapes.

Australia

Australia is perhaps the most famous home of fire. Annual fires burn a broad swath of the of the northern third of the country, while hot fires periodically blaze through the forests of the southern fringe. Fires burn infrequently in the arid lands in the middle and in the agricultural zones. These fire regimes--and their accompanying vegetation--result from long term shifts in climate, ancient rhythms of Aboriginal burning, and recent changes in land uses and fire policy (Jones, 1969; Pyne, 1991).

The ancestral Aborigines, who arrived on the continent at least 40,000 years ago, brought anthropogenic fire with them. Their burning contributed to a vegetation shift already long underway due to climatic drying--from broadly 'rainforest' (*Nothofagus* dominated) vegetation to *Eucalyptus* sclerophyllous forest. Much of the currently dominant vegetation exhibits typical signs of fire adaptation, like *Banksia*'s fire-cured seeds and *Eucalyptus*' prodigious sprouting (Bradstock *et al.*, 2002). Many classic Australian landscapes, like eucalypt woodlands or savannah grasslands, may in one sense be seen as artefacts of Aboriginal culture.

European colonization, beginning in 1788, led to new shifts in fire regimes. Introduced livestock replaced some fires in the role of vegetation removal and altered vegetation communities (with consequences on fire regimes). Agricultural expansion necessitated the clearance of much vegetation cover. Finally, state-led forest management introduced a variety of new forces, from airplane-based prescriptive broadcast burning, to highly organized and mechanized fire fighting (Pyne 2006).

Australia is unique in that the government (perhaps out of pragmatic necessity) never completely abandoned 'second fire'. 'Burning off' remains a key management tool in

many regions. Key current debates, particularly in the management of state owned lands like parks and reserves in the southeast, centre on whether one should seek to emulate 'first fire' (natural) or 'second fire' (Aboriginal) burning patterns, what the 'second fire' patterns actually were, and whether either approach is pragmatically possible (Cary *et al.*, 2003; Low, 2003; Whittaker & Mercer, 2004; Pyne 2006).

Madagascar

Madagascar was settled unusually late for a landmass of its size. Before the first human contact, thought to be 2300 years ago, landscapes ranged from humid rainforests in the east, to dry deciduous forests in the west, to a mosaic of riparian forests, woodlands, and open savannas in the central highlands (Burney 2003; Burney *et al.*, 2004). Vegetation types changed over the longer term in response to climatic variations, over the short term in response to lightning fires and cyclone disturbances, and always in concert with herbivores such as grazing megafauna.

The island's early visitors and eventual settlers followed the worldwide pattern Pyne (1997) has called *landnam*--burning, grazing, and clearing to reshape a landscape to their use. Their fires did not penetrate the humid rainforests, but the highlands were dramatically cleared of almost all woody vegetation. Frequent human-set fires replaced most lightning wildfires, resulting in wide-open stretches dominated by pan-tropical grasses like *Aristida*, *Heteropogon*, and *Hypparhennia*. These landscapes are perhaps the key relic of the original 'Vazimba' settlers of the highlands, and continue to be maintained by modern Malagasy herders and farmers despite a century of state repression (Kull, 2004).

Other types of fire landscapes abound on the island. Pockets of *Uapaca bojeri* woodland persist due to the tree's fire adaptation and its usefulness to people (hence a tendency to protect it). There are fire exclusion landscapes--the intensive agricultural lands shaped by the hard labour of spades and ploughs and protected from burning. Finally, there are unusual new fire landscapes, where, for example, naturalized imported trees like *Acacia*, *Pinus*, and *Eucalyptus* submit to both 'constructive' fires that prepare seedbeds or clear undergrowth, and 'destructive' fires like politically-motivated arson of forest plantations (Kull, 2004).

North America

People spread rapidly into the North American continent following the last Ice Age, carrying fire with them. The vegetation of a re-warming continent evolved in their presence, and in many cases was shaped by their fires. In southern New England, scattered park-like woodlands dominated by sprouting hardwoods like oak and chestnuts marked the impact of Amerindian fires (Cronon, 1983; Russell, 1983; Abrams, 1992; Parshall & Foster, 2002). The tallgrass prairies in the middle of the continent owed much of their expanse to both large-scale grazing by bison and frequent fires set by people and lightning (Hulbert, 1988; Howe, 1994). In California, up to 13% of non-desert lands burned yearly before white settlement (Martin & Sapsis, 1991). Amerindians burned to improve ungulate habitats, clear underbrush and protect settlements, to manage forests (e.g. redwood, Douglas firs, and oaks), to promote plants useful for basketry and weaving, and to improve hunting (Biswell, 1989; Huntsinger & McCaffrey, 1995; Keeley, 2002; Stewart, 2002). In northwest British Columbia, native people continue to burn patches of berry-rich land to stimulate new growth and impede conifer invasion (Gottesfeld, 1994). Each of these landscapes--or its legacy today in overgrown plots found at the edge of crop fields or suburbs--can be seen as an ephemeral artefact of the people that came before.

This influence of Native American fire on landscapes was long ignored by scholars and policy-makers who preferred an idea of a pristine, pre-Columbian wilderness (Denevan,

1992). Denevan's and others' research on indigenous fire landscapes (e.g. Stewart, 2002), however, is debated by scholars (e.g. Vale, 2002) who question the extent of Amerindian influence. A landscape archaeology of fire may be required to resolve this debate.

Researching Fire Landscapes

Fire is a tool, but it is ephemeral. Unlike arrowheads, fish traps, or spades, it does not await the archaeologist's trowel. Even fire sticks or matches decompose rapidly. The attention of a landscape archaeologist must instead focus on oral and archival history, or on the landscapes, sediments, and vegetation that are the outcome of fires. Researchers from a variety of fields have over the past decades assembled an interdisciplinary tool kit of use in documenting fire landscapes.

Ecological analysis of vegetation community change can help find and understand anthropogenic fire landscapes. Such analysis might focus on the characteristics of individual plant species that condition their responses to fire. Botanists have long recognized certain vegetation traits as fire-adapted or tolerant, including thick bark, seeds that require fire to open or ash beds to sprout, the ability to re-sprout from epicormic buds, or the placement of significant plant parts underground. Ecological analysis also focuses on disturbance regimes--like fire--and how these influence the evolution of particular plant communities. The vegetation that results will depend on the particular management and disturbance regime interacting with different species characteristics, conditioned by the path dependencies of particular places--the inherited soil characteristics, seed availabilities, and current vegetation cover (Goldammer, 1990; Whelan, 1995; Cary *et al.*, 2003; Veblen *et al.*, 2003; Goldammer *et al.*, 2004). Based on such ecological analysis, one can build an understanding of the origins and maintenance of specific vegetation communities. Kepe & Scoones (1999), for example, show specifically how different vegetation communities result from specific management practices--including grazing and fire, in various combinations--in coastal South Africa.

A number of tools are useful for investigating historical fire landscapes--or the vegetation communities they created. *Remote sensing* provides broad-scale evidence in the shorter term (Laris 2002), while repeat photography of *archival photographs* (e.g. Veblen & Lorenz, 1991) and investigation of *archival documents* (e.g. Preece, 2002)--whether traveller's accounts or ecological monographs--provide evidence going back centuries. A particularly well-developed technique in temperate forests is *dendrochronology*, or the use of tree rings and associated fire scars to create forest fire histories (e.g. Swetnam & Baisan, 2003). *Palaeo-ecologists* analyse pollen and charcoal in lake or ocean sediments to provide a window into much older vegetation communities (see chapters by Porch, Rowe & Kershaw, Haberle, this volume; Westbroek *et al.*, 1993).

The *stories and experiences of people* are further, rich resources to understanding fire landscapes. No account of Australia is complete without reference to the complex ideas embodied in the 'Dreaming' (Langton, 1998). In Madagascar, scholars cite the legend of a 'Great Fire' that burned the centre of the island bare (Battistini & Vérin, 1967). Stories and experiences sometimes emerge in surprising places, even in popular song (e.g. Kuhlken, 1999:343; Kull, 2004:179). *Interviews* of people about their fire practices past and present can sometimes be politically touchy (due to repressive fire politics), but are crucial sources for documenting fire landscapes (Lewis, 1989; Kull, 2004).

Finding fire landscapes in stories and song--let alone in buried lake sediments--emphasises the fact that they can be rather ephemeral artefacts of past human ecologies. To unearth them is not easy; one must look for clues wherever possible.

Conclusions

Seeing fire adaptations and fire legacies in the landscape opens a window into the lives and livelihoods of people through the ages. Some useful questions emerge for further investigation. First, can we read changes in social organization, economy, and technology from the fire record in the landscape in ways analogous to our study of settlement sites? For instance, how clearly recorded in today's landscape are the changes to fire regimes occasioned by the conquering of a pastoral people by agriculturalists one thousand years ago?

Second, the question of causality and proof of the complex adaptations between fire-wielding humans, plants, herbivores both wild and domestic, and soils remains insufficiently probed. As Pyne (2001:18) notes, proving adaptation demands circular logic. Did the chicken or the egg come first? What forms of proof are sufficient? If, for example, we demonstrate that *Uapaca bojeri* woodlands in highland Madagascar display common adaptations to fire, that woodland composition is modified from pre-human times, and that humans rely on the woodlands for parts of their livelihoods, then can we argue that this landscape is a material manifestation of human economies layered upon certain ecological characteristics (Kull, 2004)? Is adaptation the best metaphor, or are there less circular, less problematic ways of understanding the complex path-dependent interactions of soils, plants, animals, and people?

Finally, if some landscapes are the material expressions of the social and economic lives of disappeared or changing cultures--think of African savannas and resident pastoralists--then should we preserve these landscapes as we do other vestiges of past civilizations, whether Roman ruins or Aboriginal burial grounds? What management practices does this imply? Led by whom? Current debates over fire regimes in Australia reflect some of these difficulties: what is 'the' Aboriginal fire regime? If Aboriginals are the archetypal 'fire stick farmers' (Jones, 1969), then is the maintenance of fire stick landscapes the ultimate in cultural recognition?

The anthropogenic use and control of fire on the lands we inhabit is a crucial force in shaping vegetation patterns. People use fire to manipulate the land socially, ecologically, and politically. Current-day landscapes may be artefacts of previous cultures' fire practices. By analysing regional fire histories, landscape archaeologists--working with both social and ecological research tools--can tell us about the human societies that used the fires, and contribute to debates about modern day fire management.

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