Constructing Fire Histories

A workshop on techniques and approaches to reconstructing past fire events

Simon Haberle

As part of the recent successful Archaeometry Conference, held in Canberra between the 12th and 15th December 2005, a dedicated symposium and follow-up workshop on "Constructing Fire Histories" attracted a large contingent of charcoal buffs. A total of 16 oral presentations (7 from PhD students) and 3 posters were presented exploring the range of traditional and emerging techniques available to reconstruct past fire regimes. These include the analysis of small fragments of charcoal preserved in sediments in archaeological and palaeoecological (lakes and swamps) contexts, fire-scars within tree-rings, historical records of fires and modeled simulations of past fire events. Researchers within these different disciplines often encounter common problems of analysis of charcoal and its interpretation as a fire event, and yet they have largely worked in isolation from each other. The oral presentations and posters brought together people working within these fire history disciplines to present a "state-of-play" assessment of individual areas of research. The follow-up workshop provided the opportunity to identify uncertainties and common-ground that exist in efforts to define, quantify and interpret charcoal in the palaeo/archaeological record.

The major outcomes of the session and workshop were:

(1) Exposure of young researchers in each discipline to the major issues across all areas of research.

(2) A synthesis in understanding the major scientific problems in definition/quantification/interpretation faced by each discipline with regard to charcoal and its relation to past fire events.

(3) A better understanding of the traditional as well as emerging techniques and the ways in which these might be adapted for use in other disciplines.

The wrap-up discussion looked at the possibility of development of a network of expertise around key areas of high research potential in constructing fire histories. The Atherton Tableland, Victorian Highlands and Tasmania were considered areas of high potential.

I would like to thank all the participants for contributing to a very productive 2 days and the ARC Network for Earth Systems Science for sponsoring all the PhD students to attend the meeting. Also, congratulations to Simon Connor (University of Melbourne) for his award for one of the best student paper presentations at the conference. Abstracts and an outline of the fire workshop can be found at http://palaeoworks.anu.edu.au/news.html

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Abstracts

Using tree-rings to reconstruct fire histories in Australia

Patrick Baker, School of Biological Sciences, Monash University

Fires are an important determinant of vegetation structure and composition in Australia. Understanding the historical variation in spatial and temporal patterns of fire is necessary for integrating sound fire management practices into broader vegetation conservation and management policies and anticipating potential shifts in fire regimes associated with changing climate patterns. Data on modern fire regimes are available from historical records and, more recently, remote sensing imagery. Data on palaeo-fire regimes are available from stratigraphic analyses of charcoal and pollen in soil and sediment cores. These approaches provide data on historical fire frequency and extent at the scale of years to decades and millennia, respectively. However, there remains a major gap in our understanding of fire regimes in Australia at the intermediate temporal scale (i.e., decades to centuries). This is a major shortcoming because it is this scale that is concomitant with the lifespan of most tree species and with the occurrence of catastrophic disturbances and post-disturbance forest development patterns. Dendrochronology, the study of tree rings, has been used to reconstruct centennial-scale fire regimes in many forests around the world. Despite the close relationship between fire and forests in Australia, dendrochronological studies have rarely been attempted here. This stems from the widely held belief that most Australian trees do not form annual growth rings. Recent surveys suggest that the Australian tree flora has greater potential for dendrochronological studies than previously believed. In this paper I discuss potential opportunities and limitations of dendrochronology as a means of reconstructing fire histories and their spatial and temporal variation across the Australian landscape in recent centuries.

Seasonal patterns in biomass smoke pollution and the mid 20th century transition from of Aboriginal to European fire management in northern Australia

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A major impediment in discussions about changes in the fire regimes in the savanna biome is the paucity of reliable historical data. The most important aspect of the fire history in the highly fire-prone tropical savannas concerns the seasonal patterns of burning rather than frequency of burning: the seasonality of burning can not be resolved from most historical ecological records. We analysed Darwin Airport visibility records made from the airport control tower between 1955 and 2004 to identify changes in the seasonal pattern of biomass smoke. Our study has three parts: (i) we develop a predictive statistical model between visibility and other meteorological data and measurements of PM10 in Darwin during the dry seasons of 2000 and 2004; (ii) to test the model and its application to the broader airshed we (a) match the prediction of this model to PM10 measurements made in Darwin in 2005, (b) match the predictions to Charles Point data some 20 km from Darwin city (1993-1994) and (c) match peaks in PM10 to known major fire events in the Top End (dry season 2000 – 2001); and (iii) we explore changes in air quality over the last 50 years, a period that spans the transition from Aboriginal to European land management, using visibility data from the Darwin airport . We demonstrated that airport visibility data can be used reliably as a proxy for biomass burning across the largely uncleared savannas of the coastal and sub coastal regions of the Northern Territory. Tests using independent data demonstrated our predictive model was robust, and geographically and temporally representative of the larger airshed. Using our model to hind cast we're able to

demonstrate that seasonal air quality has changed since 1955, with a trend to increasing smoke in the early dry season. This result suggests that the transition from Aboriginal to European fire management has been associated with an increase in fire activity in the early months of the dry season. It is possible that compared to Aboriginal fire management the current regime of landscape burning throughout the dry season may be reducing the number of convection storms because (i) of the solar radiation associated with high concentrations of aerosols that are trapped by inversions throughout the dry season and (ii) rapid vegetative recovery on areas burnt early increased albedo and therefore do not contribute to convection at the end of the dry season. If these conjectures are correct it is possible that the current management paradigm of early dry season burning may be delaying the onset of the monsoon, reducing the penetration of the monsoon or both. This hypothesis is contrary to suggestion that sustained burning following the colonisation of Australian by Aborigines reduced the convective activity over the interior and hence limited the continental penetration of the monsoon

Landscape simulation of fire regimes

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FIRESCAPE is a process-based model for simulating fire regimes over long time periods in spatially complex landscapes. It incorporates the effects of weather, topography and vegetation on patterns of ignition and fire spread. Individual modelled fire events are combined over time to generate fire regime patterns. These have been compared to historical fire occurrence, as determined by dendrochronology, descriptions in the literature, and to the behaviour of other models. The model is being used to explore the sensitivity of fire regimes to variation in a range of natural and anthropogenic factors including climate change, vegetation succession, fuel management and their interactions.

The model has been used to explore the sensitivity of simulated fire frequency to predicted changes in climate in the Australian Capital Territory region. A moderate change in climate (an increase in daily maximum temperature of 2^{o}C with other meteorological variables scaled equivalently) halved the average simulated interval between fires across the landscape. Historical shifts in climate have been greater, and the model could be used to explore the effects of past climate variations on fire activity.

The model has also been used to investigate possible historical interactions between ignition frequency and rates of vegetation succession in shaping current vegetation patterns in south western Tasmania. The pattern of observed vegetation appears to be a result of complex interactions between these two processes, with some, but not all, combinations of ignition frequency and rate of succession plausible for explaining current vegetation patterns. These results assume constant climate over long time periods. Improved simulation would incorporate long term climate patterns and investigate their influence on fire regimes, and therefore, vegetation dynamics.

Fire, ENSO and the Aboriginal settlement of Australia's wet tropics

Richard Cosgrove (La Trobe University), Ron Stager (James Cook University), Jugo Ilic (CSIRO, Melbourne) and Judith Field (University of Sydney).

Recent wood and charcoal identification from ancient river terraces, rainforest-sclerophyll patches and coastal lowland zones in the north Queensland wet tropics has suggested both increased fire regimes and coexistence of established sclerophyll

and rainforest vegetation c. 12,000 to 9,000 BP. It supports pollen evidence that this period saw a reduction in rainfall between 24,000 to 12,000 BP (Moss and Kershaw 2000), increased fire regimes between 13,000 and 8,000 BP (Hopkins et al. 1993) and the late establishment of rainforest on the lowland coastal plains. More recent evidence of fire indicates highly variable regimes from c. 1,000 BP until c.200 years ago. Evidence points to a relatively recent, widespread tropical vegetation and the sustained maintenance of a patchy sclerophyll-rainforest vegetation complex by humans in the late Holocene.

Fire in the Tropics: A Paleoclimatic Assessment of a Charcoal Record from the Atherton Tableland

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The extensive destruction of rain forest by fires across Southeast Asia and New Guinea during the severe 1997-98 El Niño clearly demonstrated the susceptibility of large areas of rain forest to burning under conditions of extreme drought and proximity to ever increasing human populations. Whilst historical evidence for fire events has been used to suggest that tropical fires are not unprecedented and may increase in the future (Cochrane, 2003), there have been no attempts to directly examine whether there is a relationship between known climate oscillations and Holocene burning events identified in microfossil charcoal records.

In this paper I use a new fine-resolution charcoal record from northeastern Australia that spans the last 23,000 cal. yr BP to examine the relationship between this record and millennial to decadal oscillations such as the 'Bond cycles' (Bond *et al*., 2001) and 'Pacific Decadal Oscillation" (Minobe, 1999). Questions to be addressed include: Are tropical fires, and the charcoal records they produce, a good indication of drought events in the past? Are distinguishable burning cycles apparent in the record? Are these related in time and frequency to known millennial to decadal oscillations? Do these burning cycles become less distinguishable from approximately 6000 cal. yr BP with the onset of widespread anthropogenic burning? What are the implications of historical burning data for tropical ecosystems under future climate change scenarios?

Bond, G, et al., (2001) Persistent Solar Influence on North Atlantic Climate During the Holocene. *Science*, 294, 2130-2135.
Cochrane, M.A. (2003) Fire science for rainforests. *Nature*, 421, 913-919.
Minobe, S. (1999) Resonance in bidecadal and pentadecadal climate oscillations over the North Pacific: Role in climatic regime shifts. *Geophysical Research Letters*, 26, 55-858.

Archaeomagnetism as part of an interdisciplinary approach to the identification of fire in the archaeological record

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Archaeomagnetism as defined here is the use of magnetic methods of analysis on archaeological materials. Two main methods of analysis exist with those related to looking at the direction and intensity of fossil remnant magnetisations, as in palaeomagnetism, and those related to looking at the mineralogy, grain size and concentration of minerals within a rock or sediment, as in mineral (rock, environmental) magnetism. In the later case identification of these parameters is achieved by inducing different types and strengths of laboratory induced remnant magnetisations and/or heat into samples to see how they alter. A study of the thermomagentic properties of archaeological materials is still not well understood and is very dependent on source location. It is thus necessary in many cases to perform control experiments in each location to identify the exact processes that occur during heating of the local deposits. Work on Bulgarian pottery kilns has shown that while temperature is an important controlling factor on mineral magnetic alteration, the

atmosphere of heating (oxidising versus reducing) can be a much greater controlling factor on magnetic mineral alteration. Palaeomagnetic work on burnt rocks from Early to Later Stone Age caves (Cave of Hearths, Sibudu, Rose Cottage and Pinnacle Point Caves) in various areas of South Africa has enabled the identification of the temperature of last heating of hearths and the identification of *in-situ* and *ex-situ* burnt material. Mineral magnetic studies of related burnt and unburnt sediments have shown that similar thermomagnetic alteration processes occur in caves located in a range of environments and host rocks and across different time periods in South Africa. At some caves this has led to the realisation that coloured sediments once thought to have been due to burning are actually due to natural processes occurring under specific environments within the caves. This work has been done in conjunction with other methods of analysis including micromorphology, XRD, FTIR, Phytoliths and Charcoal analysis.

Late Quaternary vegetation change and slope stability interpreted from soil charcoal, Central Highlands, Victoria

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Some interesting spatial and temporal patterns have emerged from the results 26 AMS 14C dates on single charcoal fragments selected from six described soil pits. The pits were located within wet sclerophyll forest along a valley transect across an east-west flowing creek in the upper O'Shannassy Catchment, north-east of Melbourne.

The dates fall essentially into three age groups, one older than 33,000 and generally beyond 45,000 years BP, another at the around 10,000 years BP and finally a group falling within the last 4100 years and mostly within the last 2300 years. This suggests that fire was rare or absent during the intervening periods or that there was a lack of woody material to form charcoal. The lack of trees is a possibility for the later part of the last glacial period, including the Last Glacial Maximum (LGM), where the sparse pollen evidence from the Central Highlands region does suggest a predominance of herbs and grasses (Kershaw 1981, Kershaw et al 1991). Forest vegetation must have existed during the early and mid Holocene period. It is perhaps possible that the vegetation during this period was dominated by relatively fire sensitive *Nothofagus cunninghamii* cool temperate rainforest that effectively excluded fire. Pollen evidence provides some support for temperate rainforest being more extensive at that time (McKenzie 1997, 2002). The addition of a grouping of charcoal dates at the LGM Holocene transition may by evidence of rapid expansion of eucalypt forest (presumably wet sclerophyll) and with it increased burning, the result of an amelioration of the climate. If the charcoal particles are indicative of vegetation change, it suggests that the present extensive wet sclerophyll forest with its occasional high intensity fires, only expanded in the late Holocene, and briefly at the at the beginning of the Holocene, after at least 30,000 years of a largely much more restricted distribution.

The presence of old charcoal in the soil tends to support the idea that the soils have been more stable in the past than they are today – otherwise degradation might be expected from constant mixing. The proposal of a relatively recent onset of instability is supported by the presence of old and young charcoal in the lower and mid slope soil profiles with a lack of chronological order in accordance with stratigraphic position evident. However, groupings within profiles of age classes do occur, a feature that has also been observed by Carcaillet (2001) and Gavin (2003) in overseas studies, though not involving charcoal of such antiquity. Mixing may have resulted from uprooting of the massive eucalypts of wet sclerophyll forest as well as soil movement associated with fire. The younger ages of charcoal fragments from the upper slope profile (likely to be the most active area of the slope) would seem to

indicate downslope movement of fragments at a young age relative to the other profiles (Johnson 1993). Another interesting spatial pattern has emerged recently in relation to the temporal spread of the dated charcoal fragments. Those fragments dated from the south slope are all of Holocene age while all dated fragments that fall within the age group greater than 30,000 years BP (as mentioned above) are found with in the northern slope soil profiles only. It seems unlikely that no fires occurred on the south slope prior to 10,000 years BP with the most likely explanation being that charcoal of such antiquity was removed prior to the Holocene. The site falls within the proposed periglacial zone of the LGM for the southeastern Australian region (Galloway 1989). With the northerly aspect of the of south slope and thus it's greater exposure to incident sunlight, it is possible that solifluction during the periglacial conditions of the LGM was more pronounced on this slope due to more extreme freeze/thaw cycles, thus removing slope materials. This aspect is to be further investigated.

Data on particle-size, magnetic susceptibility, charcoal concentrations, charcoal fragment identification and pollen counts from a nearby swamp will also be presented to help elucidate the development of the soil profiles and changes in vegetation.

Luminescence of single quartz grains to determine past heating

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Quartz thermoluminescence (TL) sensitivity has long been observed to increase on heating. The increase in TL sensitivity of the 110ºC TL peak was also found to be approximately proportional to previously administered radiation dose (referred to as pre-dose) for a given heat treatment, and this forms the basis of a convenient dating method for young samples such as archaeological ceramics. In this talk, we present measurements of TL sensitivity changes of multi-grain and single grain aliquots of sand-sized quartz from a surface soil sample collected from near Sheehys Creek, Lake Burragorang Catchment, NSW. These preliminary studies were undertaken in order to assess the feasibility of using the observed TL changes to determine the timing and magnitude of past bushfire events. We provide some interesting observations and speculative preliminary interpretations of the data, as an introduction to the huge potential that this approach offers for resolving these events in the future.

A new fire record from Lynch's Crater, Northeast Queensland, Australia

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Lynch's Crater on the Atherton Tableland, northeast Queensland has been influential in the debates over the time of arrival of Aboriginal people on the continent and the degree of impact on the landscape through their burning activities. This analogy has been based on the marked changes in the charcoal record corresponding to vegetation change from rainforest to sclerophyll vegetation. However, recent research suggests high frequency climate forcing phenomenon, such as ENSO, may also been influential on burning frequency and therefore a more detailed study is required of the charcoal record from Lynch's Crater. In this paper a new fine-resolution charcoal record through the Holocene will be examined applying Umbanhowar and McGrath's (1998) proposal that there is a 2:1 relationship between wood and poaceae charcoal.

Umbanhowar CE & McGrath MJ 'Experimental production and analysis of microscopic charcoal from wood, leaves and grasses' *The Holocene* 8, 3 (1998) 341-346.

Fire records and the archaeology of the Caucasus

Simon Connor, School of Anthropology, Geography and Environmental Studies, University of Melbourne.

The history of fire in many regions of the world has been elucidated through charcoal analysis. In Australia and parts of North America, fire histories have been instrumental in understanding past changes in vegetation, and particularly in identifying past phases of human impact. In other regions, particularly Europe and its close neighbours, fire histories are yet to be fully embraced in palaeoenvironmental research. Unfortunately, this has severely impeded our knowledge of past human impacts in the Near East. Most pollen diagrams from this region lack charcoal records, leaving open the question of how, when and if early agriculturalists cleared land in Western Asia for the planting of crops. The Caucasus is no exception – there are no published fire histories from this region of great botanical and archaeological significance – and yet fire is an important agricultural tool in the Caucasus today.

New data from a series of sites in southern Georgia reveal a striking relationship between fire history and archaeology. Sites on the highland plateaux consistently show a considerable increase in fire during the Chalcolithic period, followed by an absence of fires during the Bronze Age. Fires again become important in the Classical period, destroying coniferous forests and creating open, steppic grasslands. In the foothills, fire was important during the Neolithic period, but far more important in the post-Classical period once intensive grazing was abandoned and former pastures were overtaken by forest. Even on the damp west coast of Georgia, where rainfall averages 2300 mm per year, fire is closely associated with two major phases of forest clearance, in the late Iron Age and in the early 20th Century.

Palaeoclimatic records indicate that few of the recorded fire events were likely to have been controlled by climate. Instead, it appears that humans have used fire in the Caucasus region throughout the Holocene, both as an agricultural tool and an instrument of war.

Translating Evidence of Fire into Functional Narrative: A Historian's Nightmare

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Paper given on the historiographic problem of utilising interdisciplinary evidence within a Rankean historical method. Specifically, fire famously destroys historic evidence more than almost any other force, natural or human. Yet as of late historians, especially Australianists, have come to view fire as evidence itself and as the revealer, highlighter and signifier of other evidentiary forms. Would Ranke roll in his grave at this or be pleased? Can history be written focusing on fire and using fire as a primary source, which does not devolve into relativistic, wishful and unscientific near fiction? These are the primary questions, which much answered effectively by those attempting to advance the historiographic status of fire.

Aboriginal impact on the mid-holocene Moira Marshes, NSW, Australia

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For at least 18,000 years people have been an integral part of the Murray River landscape supported by the abundant resources along the river and in its hinterland. Although the history of the river systems has been extensively studied; little is known of the regional Holocene vegetation history or of the impact of people

on this landscape. In the palaeo-ecologicial record it is difficult to separate localized cultural activity is from long-term climatic variability as sites that provide a small spatial -scale record are rare.

The mid-Holocene landscape of the Moira Marshes, NSW was reconstructed using palynological, charcoal and sedimentological data from floodplain and lake sediments deposited 2-5 metres below the modern floodplain surface. Regional vegetation and fire histories were reconstructed from the pollen record. But, more importantly, by using specific pollen indicators for human activity and the ecology of the local wetland plants present in the pollen record it was possible to determine the local and regional anthropogenic impact on this area of the floodplain. Macro-charcoal particles provided a record of fire in the immediate vicinity of the site. Particle size analysis was utilized to assess climate induced changes in the Murray River system at this time and also the importance of the river to the site and to settlement.

The results show that the regional vegetation and fire regime were dominated by increasing climatic aridity and variability. As the floodplain dried and the river increasingly influenced the site, people progressively settled the area. Later, as the lake dried, local swamp and possibly river resources were managed intensively using fire. This intensive management altered the local vegetation. Site-use was possibly opportunistic indicating a resource-rich environment that included both the river and the swamp.

Radiocarbon Dating Charcoal in Archaeological and Palaeoecological Contexts

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Radiocarbon dating is a routinely applied method for deriving chronologies from a large number of late-Pleistocene environments. In most cases, a simple acid-base-acid pretreatment followed by bulk combustion (ABA-BC) can yield reliable radiocarbon age estimates. It has been demonstrated, however, that the ABA-BC procedure does not remove all contaminants, and the problem of ensuring the complete removal of contaminants becomes increasingly severe as the age of the sample increases. In practice, this means that many laboratories will only quote 14C ages to about 40ka BP, with ages greater than this generally considered to be 'infinite', or indistinguishable from procedural blanks. The so-called 'radiocarbon barrier' and the difficulty of making reliable age estimates at <1% modern carbon levels has hindered research in many disciplines.

A newly developed acid-base-wet oxidation pretreatment with stepped combustion (ABOX-SC) has been developed (Bird et al., 1999). Combustions are performed in a vacuum line which is ‘insulated’ from the atmosphere by a second backing vacuum to eliminate the risk of atmospheric leakage into the line at any stage of the procedure. Combustions are performed at three temperatures (330˚, 630˚ and 880˚C) with a graphite target produced from the CO2 evolved during each combustion step. In this way, the progressive removal of any contamination can be monitored, and a high degree of confidence can be placed on the final age assessment. The total pretreatment, combustion, graphitisation and measurement blank for the procedure is equivalent to 0.04±0.02%M (1s, n=14), or an ‘age’ of approximately 60ka for a 1mg graphite target. Examples from key archaeological sites will be presented.

The fire, humans and climate nexus during the Holocene in the Sydney Basin, Australia

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Post-glacial and Holocene palaeoecological sequences are presented for Kings Waterhole (dating back to ~6.2 cal. ka BP), Griffith Swamp (~6.5 ka), Gooches Swamp (~14.2 ka) and Lake Baraba (~23 ka), which are all located within the Sydney Basin, in eastern Australia. Here we highlight the accumulation of macroscopic charcoal as a proxy for local fire activity and compare this with nearby archaeological evidence, used as an index of human activity through time. The rationale for this work was to assess anthropogenic influences on fire activity, with the aim of untangling any interrelationships between fire, climate and humans.

Together the sites suggest that fire was a variable feature in the landscape both spatially and temporally. Using the longer sequences (Lake Baraba and Gooches Swamp) fire activity was lower in the early Holocene but underwent an abrupt increase from about the mid-Holocene (~5.5 ka BP), after which fire activity is generally elevated but variable. This is most apparent at Gooches Swamp which seems to be the most climatically sensitive site, perhaps reflecting a higher altitude. At Gooches Swamp the onset of ENSO-dominated climates from the mid-Holocene witnessed a shift to a fire regime similar to that of the modern setting. The influence of people on fire at this site remains unclear.

Kings Waterhole and Griffith Swamp are located relatively close together but revealed distinctly different records of fire in the late Holocene. Despite this, the timing of changes at both sites corresponds well with changes in archaeological evidence, which we interpret as suggesting either greater human presence in the landscape or altered subsistence and land use strategies. The differences in the charcoal records of these sites are interpreted as reflecting a diversity of management strategies across the landscape.

Notably, at Kings Waterhole and Lake Baraba charcoal accumulation decreased in the late Holocene as Aboriginal activity apparently increased in the surrounding regions. This change perhaps resulted from people intensively managing fire at these sites thereby influencing fuel loads and charcoal taphonomy. This late Holocene change may also have been a response to a climate that promoted fire and hence risk.

This work has several implications for our understanding of human-environment relationships and for the contemporary management of these fire-prone landscapes. Generalisations about the use of fire by Aboriginal people are probably premature.

What the 2003 fire demonstrated. Fire as a geomorphic agent of erosion in the Cotter River catchment, Namadgi National Park, Australian Capital Territory

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Fires of variable intensity burnt approximately 95% of Namadgi National Park in the ACT in mid-January 2003. As a result, the erosional susceptibility of the hillslope soils, via the removal of the surface roughness caused by the vegetative ground cover, increased. Less than a month after the fires, two intense convective rainstorms occurred over two areas of the Cotter River catchment. The runoff from these storms eroded large amounts of soil and organic matter from the hillslopes, depositing gravels on to the valley floor system below and fines further downstream. In August 2003, further storm events caused mass movents in other sub catchments. As a result, for 2003, catchment sediment yields into the Corin reservoir increased by 5.3

times the pre-fire rate. After fire, the window of opportunity for erosion after the removal of vegetation by fire varies depending on catchment morphology, soils and vegetation. While most areas affected have seen a vegetation response suitable to prevent erosion under average rainfall conditions, others still produce material, nearly three years after the fire.

Stratigraphic investigations reveal material similar to that which washed onto the valley floor after the series of events in 2003, is not uncommon in the sedimentary record from one of the sub catchments. So far three Optically Stimulated Luminescence (OSL) ages from similar gravel layers indicate this sort of deposition occurred 0.41 ± 0.065 ka, 5.4 ± 0.8 ka and 6.5 ± 0.8 ka with fire being the most probable cause of reducing hillslope roughness. This suggests while events such as this are not frequent, there is a history in this particular landscape where fire had a causal relationship and plays a key role in erosion processes.

Posters

Brief Observations: Interpretation of Fire Histories Using Microfossils

Parr, J.F., Kerr, G., Arthur, J., Bolton, K., Jacobsen, G., and Taffs, K.H., (Southern Cross University, Plantstone Pty Ltd and AINSE)

There is substantial post fire subsidence of the peat layers, suggesting that this process needs careful consideration when reconstructing palaeoenvironments. Moreover, subsidence of the peat layers significantly reduces the useability of the land for economic agricultural purposes which also needs to be considered for site process interpretation. Although fire-induced colour change is probably limited to a portion of microfossil assemblages, phytolith colour in particular remains a tool that can be confidently used to indicate the presence of fire in various sedimentary contexts.

Fire histories from the wet tropics and the implications for palaeoclimatology

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Records of ancient microscopic charcoal show fires have repeatedly occurred in tropical forests since at least the late Pleistocene, resulting in disturbance of forest ecosystems that periodically lead to long-term depletion of rain forest communities. What are the primary drivers for forest fires in the wet tropics and what are the implications of fire histories for the persistence of tropical plant diversity? This study presents a review of charcoal records from the three main equatorial landmasses of the world (10°N-10°S) and examines potential influence of climate change and human activity on burning histories for these regions.

Environmental dynamics in the Torres Strait region: The integration of palaeoecological and archaeological data

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Torres Strait is a largely submerged area of continental shelf separating Cape York, Australia, from New Guinea. The region spans approximately 150km north-to-south and contains more than 100 islands, coral reefs and cays. The 1970's marked the start of sustained archaeological research in the region, yet island palaeoenvironmental records, allowing for a multi-disciplinary approach to such issues as the chronology of human settlement, are much more recent.

This poster paper explores island palaeoenvironments across Torres Strait, in what is a summary of the author's doctoral research. Palynological and charcoal records from the islands of Mua, Badu and Zurath are presented. Results indicate significant shifts in coastal and inland island vegetation

at key points in the Holocene, and by comparing environmental change across a number of study sites, cause may be attributed to a number of integrated mechanisms. A loss of vegetation cover, sedimentary changes and a greater fire frequency in the late Holocene, in particular, supports the archaeological interpretations of permanent island use and occupation by at least 3000 yr BP.

Workshop outline

Session 1: Techniques in Fire History Research
conveners: Janelle Stevenson and Scott Mooney

This session will cover the approaches available for reconstruction of fire histories, focusing on the charcoal record. The main questions to ask/answer are: What is the nature of the data and what are the limitations? (i.e. the data that fire ecologists and fire modelers might be interested in). The session will also aim to provide a greater understanding to the wide range of practitioners about what our charcoal records mean and how they can be interpreted.

Session 2: Interactions in Fire History Research
conveners: Ian Lunt, Ross Bradstock, Geoff Cary and Karen King,

This session will cover the potential for interaction between fire histories and current processes and future modeling. The main question to ask/answer is: What historic fire data can be used/is required by fire ecologists and fire modelers? The session will also aim to highlight the potential interactions between different disciplines and come at some understanding of the common temporal and spatial resolutions that exist between the different research methods.

Session 3: Regional Focus of Fire History Research
convener: Simon Haberle

This session will look at possible future work in fire histories based on areas were current research is ongoing and could be expanded by integrating new techniques or approaches.