FINAL CALL-OUT

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Thank you for the introduction and can I thank the organisers for giving me this opportunity.

A tribute to George Peet …

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At about midday on the 7 January 2016 I was called-out to perform in the role of fire behaviour analyst on the Waroona fire based at the State Operations Centre in Cockburn Central. Little did I know it at the time but this would be the last major incident I would be involved in before I retired earlier this year - it would be my final call-out.

From some 60 km away, I could see two large convection columns which struck me as odd - it looked like two fires. From the columns it was evident that, despite the relatively innocuous Fire Danger Rating, the fire, or fires, had developed some serious behaviour – it was burning in dry, long unburnt, heavy forest fuels, it was crowning, it was dangerous, it was unstoppable.

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Final Call-out

- Opposition to prescribed burning – ignorance or ideology?
- Shortcomings of peer review
- Impediments to prescribed burning

This address comprises three related themes.

First, and for background, I'll touch on a keynote address I gave at a bushfire Conference in Perth in September last year entitled 'Conflicting Evidence', subtitled - - 'Prescribed burning – when 'evidence' is not the reality'. In that address I explored the conflicting views, and evidence, for the efficacy of landscape prescribed burning as the cornerstone to mitigating the impacts of wildfire in southern Australian forests. I identified shortcomings in a number of published papers that, in short, purported to demonstrate that landscape prescribed burning was of little benefit to wildfire mitigation and worse, it threatened biodiversity.

In this address, I pose a question, "Is opposition to landscape prescribed burning ignorance, or is it driven by ideology at the expense of good science?"

The other two themes I will address stem from feedback that I received following my Perth keynote address. A common response was, "If the papers that oppose prescribed burning are flawed, how did they get published? A good question - so I will discuss some shortcomings of the scientific peer review process.

The second common response I received was, "It is relatively easy to prescribed burn forests of south-west Australia, but in south-east Australia, it is much more complex and difficult". Again, a legitimate observation, but a separate issue to whether or not prescribed burning is beneficial. So to finish, I'll touch on some of the impediments to prescribed burning, which I'm sure will be familiar to many of you.

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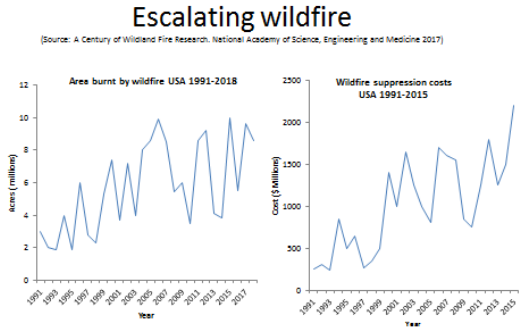

Over the 42 year span of my career as an applied bushfire scientist, globally, there have been literally thousands of papers published on wildland fire science, so we know a lot more. Fire management is much more sophisticated. We have access to technologies we could not have imagined 40 years ago. Our fire fighters are better equipped and better trained, and there are more of them. We have slick information and education programs to ensure that our communities are better prepared - the list of advances in bushfire science, policy, management and education goes on.

Despite these advances, the area burnt by wildfire, wildfire losses and the cost of wildfire suppression have increased in most jurisdictions, or at best, have remained unchanged in others.

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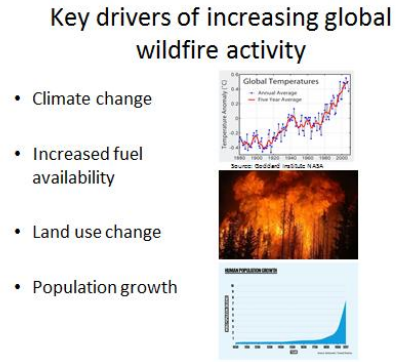

The primary drivers of the recent global trend of increasing wildfire activity are climate change or climate variability, increased fuel availability, land use change and population growth. In many regions of the world, the climate is becoming warmer and dryer, conducive to the start and spread of bushfires. The specific effects of climate change on the bushfire environment of course vary around the globe. Generally, the 'fire season', or the period when fuels are dry enough to burn, has been extended and there's been an increase in the frequency and duration of severe fire weather conditions – and in some regions, there has been an increase in dry lightning activity.

In many fire-prone regions, fuel levels have increased as a consequence of anthropogenic behaviours - including fire suppression policies, inadequate levels of prescribed burning, the cessation of traditional burning practices and changed land use such as the abandonment of agricultural land, and the decline of grazing in natural vegetation systems.

Another factor contributing to the global increase in wildfire disasters is population growth and expansion of settlements at the rural-urban interface. Too often urban development at the interface, and semi-rural subdivisions, are poorly planned and take insufficient account of the bushfire risk.

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According to some observers, climate change has resulted in a doubling of the burnable area of the planet due to the more frequent drying of previously wet vegetation types, or vegetation types that historically experienced long inter-fire periods.

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The increase in the incidences of disastrous wildfires globally has caused significant loss of life, destruction and damage to the built and natural environments, and has been very costly economically.
Accurate data on the full global economic cost of wildfires is unavailable, but estimates place it in the many billions of dollars per annum, and rising.

More importantly catastrophic bushfires are human tragedies, with loss of life and homes, physical and emotional trauma, and major disruption to regional economies and communities. Catastrophic fires also harm the environment, damage and destroy critical infrastructure and regional industries, and kill and injure livestock and wildlife.

Unprecedented global weather conditions in the last couple of decades or so have resulted in many so-called 'out-of-scale' bushfire catastrophes. But such conditions are likely to be part of the normal distribution of future weather patterns, albeit at the tail of the curve.

Knowing this, publically declaring such events as 'out-of-scale', or blaming climate change, will not be an acceptable reason for failing to protect communities and the environment from bushfire catastrophes.

As fire and land managers, there is little we can do about climate change, land use change and population growth – these are largely matters for governments. And I have little confidence that globally, we will address these issues in a timely manner. However, fuel or hazard mitigation is, or should be, core business for fire and land management agencies because it is the cornerstone to mitigating the bushfire threat and buffering the wildfire cycle.

This includes landscape prescribed burning, managing fuel at the rural-urban interface and managing fuel in 'backyards', or around structures. Unless fires are attacked with

sufficient force in the first 15-20 minutes of ignition, suppression will likely fail if the fire is burning in heavy fuels and under fire danger ratings of High or worse.

Prescribed burning is not a panacea, but done at appropriate spatial and temporal scales, it can greatly enhance hazard reduction measures at the interface and in backyards, it can greatly assist the suppression effort, and it can synergise community preparedness measures.

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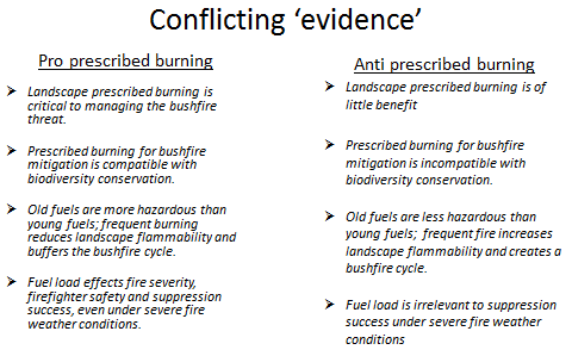

However, the benefit of landscape prescribed burning is a view not shared by all.

There have been a number of papers published in the last decade or so that, in summary, claim to demonstrate that landscape prescribed burning is ineffective at mitigating the bushfire threat unless a high proportion of the landscape is burnt each year, and what's more, it is a threat to biodiversity.

These studies have mostly been done by academics with little or no fire management experience, with a limited, mostly theoretical understanding of fire behaviour, prescribed burning and fire suppression, and who use unvalidated, and in my view, flawed theoretical models and computer simulations.

On the other hand, there are a number of papers published by scientists embedded within, or who have worked closely with, fire and land management agencies that demonstrate that prescribed burning, done at the appropriate spatial and temporal scales, is effective at mitigating the fire threat and is not a threat to biodiversity.

These papers are usually based on fire behaviour science, analysis of historical data, case studies, fire fighter's experience and space-for-time or long-term studies of fire ecology.

In my 2018 keynote, I detailed what I considered to be serious shortcomings of the anti-prescribed burning papers, if I can call them that.

So if these papers have shortcomings how did they get published? To answer that question, we must turn to the peer review process.

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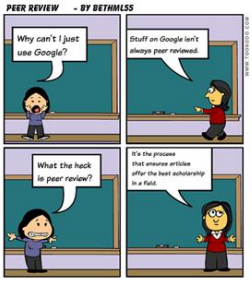
The peer review process



From the outset, let me make it clear that I support, in principle, the peer review process – it has many 'up' sides and for the most part, it serves us well - over my career as a research scientist, I have had dozens of papers published that have been improved by peer review. However, we must also be willing to acknowledge its shortcomings.

While there has been much debate about the role of science in society, debate about how research funding should be allocated, and debate about science on controversial issues, there has been little debate about the peer review process, which underpins the production of good science and everything that flows from it.

Anonymous peer review has been variously defined as a process of evaluating the research, or proposed research, for its competence, significance and originality - mostly by other scientists. It's scientists judging science, and it is the quality control or imprimatur for published research.

But it is much more than quality control - the process determines who and what research gets published, it determines research funding allocations, scientist's career prospects, the standing of scientific journals and of institutions, and importantly, it informs public opinion and shapes policy development. In the words of one observer, "Peer review pervades science from beginning to end".

In brief, manuscripts submitted to journals are distributed to anonymous reviewers who are required to evaluate them in an objective, impartial, ethical manner and according to the journal's guidelines.

The manuscript is returned to the journal editor with comments, including a decision about whether or not it should be published, and if so, what is needed to get it to publication standard.

Through this process, the paper is either accepted or rejected for publication – so reviewers and editors are in a powerful position and carry a burden of responsibility.

Understandably, non-peer review papers do not have the same standing in the scientific community as peer-reviewed papers. Peer review is somewhat like Churchill's assessment of democracy - no one pretends it's perfect, but it's the best we have.

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A view on peer review

"Academic researchers have grown accustomed to a world in which small cliques dominate certain journals, and with it establish back channels that benefit themselves, their friends, and their students. Hence the (empirically verified) adage that science proceeds 'one funeral at a time'.

In some fields, political posturing often seems indistinguishable from scholarship, unpopular ideas are made to disappear, and researchers who deign to challenge (academic) orthodoxy are mobbed. …The result of the academic hazing process is watered-down research, stifled creativity, and groupthink".

Crane[1] and Martin[2] (2019). What is the purpose of peer review? http://heterodoxyacademy.org/diversity-peer-review-purpose/
[1]A/Prof. Statistics Rutgers University
[2]A/Prof. Statistics North Carolina State University

Despite its broad acceptance in the scientific community, concerns have been raised about the effectiveness of the peer review process as it is usually applied. There have been a few published evaluations of the process particularly in the fields of health and medical science, and I acknowledge drawing on these in this address.

The findings of these studies, some of which I'll summarise later, are consistent with my experience and observations of the peer review process in the environmental sciences, including bushfire science.

The process presumes that reviewers and editors are objective, impartial and immune to external interests, which, for the most part, I believe they are. However science sociology studies have demonstrated that this is not always the case – no surprise, first and foremost, scientists are fallibly human. Importantly, it also assumes that the reviewers are in fact peers, or subject matter experts, but again, this is not always the case.

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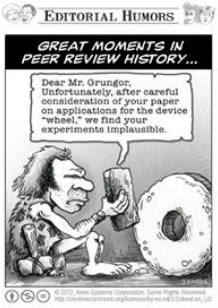
Cognitive bias in peer review

- Prestige bias
- Affiliation bias
- Content bias
- Publication bias
- Confirmation bias



Clearly, reviewers and editors are the key to the peer review process and they determine the fate of a manuscript. In published evaluations of the peer review process, reviewer bias has been reported as being of the greatest concern. Of the ten or so forms of cognitive bias reported in the literature, the most common are these;

- prestige bias - where prominent researchers from well-reputed institutions are likely to be given an easier ride through the process;

- affiliation bias - where an affiliation is shared between author and reviewer;

- content bias - where reviewers will be more favourable to authors of the same 'school of thought' – so-called 'cognitive cronyism'; And some 'schools of thought' actually exist as physical entities where diversity of ideas is discouraged. More on that later.

- publication bias – where editors are more likely to publish articles that are publically controversial and critical of the status quo, and of conservative governments and their policies; and

- confirmation bias - where the impartiality of reviewers is compromised by ideological preferences and beliefs. Reviewers are likely to be less critical of research that aligns with their beliefs or their published research - conversely, if a reviewer encounters a manuscript that supports a competing idea, or is not ideologically aligned with the beliefs of the reviewer, then the manuscript will likely be scrutinised more rigorously, subjectively and unfairly.

Confirmation bias can also manifest in papers when authors selectively cite literature that aligns with their beliefs, or findings, ignoring literature that does not.

Today, to make the journal editor's job easier, to speed up the publication process and to improve the chances that the reviewers are in fact subject matter peers, many journals invite authors to submit a list of preferred and non-preferred reviewers. But this can increase the risk of cognitive bias and cronyism.

There are documented case studies in medical science of confirmation bias where reviewers and editors have allowed their beliefs to influence their conclusions about a paper. I suggest this also occurs in ideologically contestable arenas in the environmental sciences, especially on controversial and emotive land management practices such as prescribed burning and timber harvesting in native forests.

Generally, those who are left leaning are more likely to oppose these interventionists practices and those who are moderates or right leaning, are more likely to support these practices.

I'm not having a whinge about the peer review process - I have been a part of it for four decades - but I am concerned about cognitive bias and how it influences what is published and what is not published in relation to prescribed burning and fire management generally.

For example, a couple of decades ago I submitted a paper outlining the rationale for prescribed burning to mitigate the bushfire threat in south west forests. One reviewer made objective, constructive, helpful comments. The second reviewer was clearly determined to see that the paper was not published and recommended it be rejected because, amongst a few other minor things, it was seen by the reviewer as an attempt to, "*justify CALM's destructive prescribed burning policy*".

And I have often received contrasting reviews of the same paper submitted to the same journal from '*publish with minor revision*' to '*reject*' – which, on closer analysis, I interpreted as reviewer cognitive bias. Editors usually take the conservative path of rejection. And I know of many authors who have had similar experiences.

As I mentioned earlier, and as I detailed in my Perth keynote address, many peer reviewed papers opposing prescribed burning in Australian forests have, at least to me, obvious shortcomings. They passed the peer review process, so were not reviewed by people with a sound knowledge and understanding of fire behaviour and its nuances, or of the complex operational aspects of prescribed burning and wildfire suppression. So it would appear that the reviewers were not subject matter experts.

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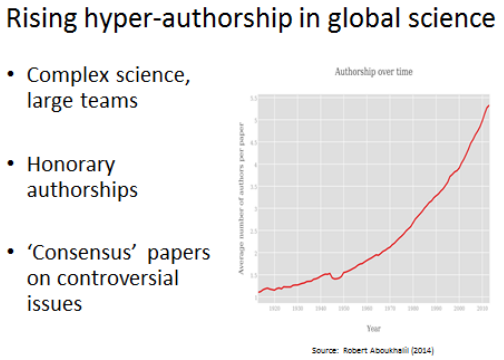

There is also a trend towards multi-authored papers, so called hyper-authorship.

There are several reasons for this – firstly, science can sometimes be so complex that it requires teams of people working in collaboration – this is often the case with astronomy and genome sequencing for example.

In a climate of scarce funding, granting authorship to minor contributors, or honorary authorship, is also on the increase.

On controversial issues, hyper-authorship turns the paper into a 'consensus', or a science 'petition'. This sends a message to reviewers, editors and readers along the lines of, "this paper is the consensus of many esteemed scientists, so its conclusions can be trusted", making reviewers, editors and readers less inclined to be critical in their analysis.

In an attempt to curb disingenuous multi-authorship, some journals now require information about the contribution of each author.

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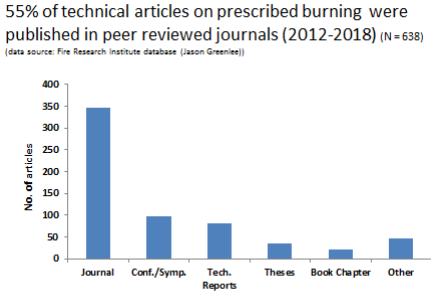

So who reviews papers on prescribed burning and fire management? We don't know of course, because it is a 'blind' process. However, from the journals, we can obtain general information about the sectoral affiliation of reviewers, and from that, an inkling of their competency, experience and suitability to review papers on fire behaviour science, and the operations of prescribed burning and bushfire suppression.

Their sectoral affiliation is also likely to reveal something of their ideological position on the practice of prescribed burning – where guilty by association may be a statistically significant judgement.

While some journals occasionally publish lists of reviewers and their affiliation - without revealing which papers they reviewed - most journals don't. For this keynote, I was interested in understanding more about the broad sectoral affiliation of reviewers of fire science rather than who they are individually.

To obtain data on the affiliation of reviewers I first sought information on where papers on prescribed burning are being published, using Jason Greenlee's Fire Research Institute data base. I searched on titles with 'prescribed burn' or 'prescribed fire' in the topic and for the period 2012-2018.

This turned up a total of 638 papers, of which 55% were published in 109 peer reviewed journals – the remainder were published in what could be termed 'the grey literature'. I must say I was surprised at the number and types of journals these papers turned up in; many being open access journals with varying standards of peer review.

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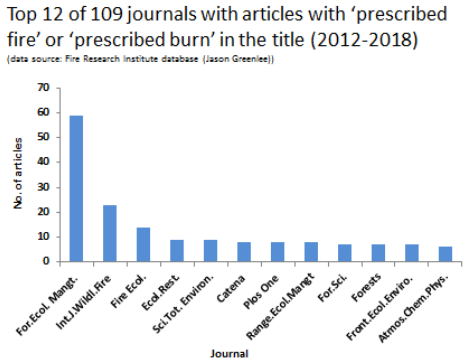

The three most popular journals that published papers with 'prescribed fire' or 'prescribed burn' in the title were, perhaps unsurprisingly, *Forest Ecology and Management*, with 17% of journal publications, the *International Journal of Wildland Fire*, with 7%, and *Fire Ecology*, with 4%.

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Editorial group and reviewer

sector affiliations

of top 3 journals accounting for 28% of journal papers published with 'prescribed fire' or prescribed burning' in the title (2012-2018)

Sectoral composition of editorial groups and reviewers is similar - and probably reflects the affiliation of fire scientists generally:

- 66% Academia scientists
- 33% Non-academia scientists (e.g. CSIRO, USDA For. Serv. labs, Canadian For. Serv., etc.)
- 1% Professional fire practitioners

The make-up of the editorial boards of these journals, which published about one third of all journal publications on prescribed fire, is about two thirds academia scientists and about one third non-academia scientists or scientists in organisations such as CSIRO, the USDA For. Serv. etc.

The sector affiliation proportions were similar for reviewers and probably reflects the ratio of the affiliation of scientists generally.

There were a few instances where editors sent papers to professional fire practitioners to review, but this was rare and probably happened at the author's suggestion, because this group, the professional fire managers, would be largely unknown to editors, and are not recognised as science peers.

With regard to the make-up of reviewers of the other 106 journals that published about 70% of the papers with prescribed burning and prescribed fire in the title, I can only assume that the sector affiliations of reviewers is similar to the three journals for which I have data.

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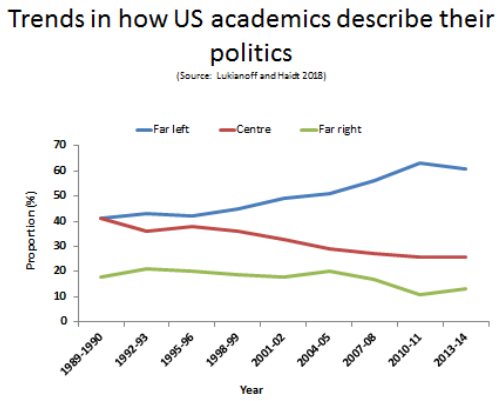

Data from the US shows that the proportion of US academics with far left politics has increased since the late 1980s and now forms the 'establishment' of academia in that country. I am not aware of similar data for Australia, or other countries, but the trends are probably similar, -- and I would expect the proportion of academics with far left politics it

to be higher in the Humanities and Environmental Science departments. As far as I know, there are no data for non-academia scientists.

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Consensus, group-think and orthodoxy in academia?

"The actions of James Cook University follow a now-familiar pattern of behaviour by Australia's universities. The search for truth has been replaced by unquestioning allegiance to consensus, group-think, and orthodoxy".

The IPA's 'Free Speech on Campus Audit 2017' found 34 of Australia's 42 universities are hostile to free speech on campus through their actions and policies.

"We will enter a new dark age of unreason if universities are afraid of debate", said Mr Roskam.

(Source: Institute of Public Affairs, 2019)

And there have been some disturbing incidents where the university 'establishment' has attempted to censure or sack employees who dared to challenge the science of colleagues working on controversial issues such as climate change and the condition of the Great Barrier Reef.

As well as likely having left leaning views, academics generally specialise in fairly narrow fields of fire science, and most have little or no wildland fire policy, planning or operational experience. So when it comes to reviewing papers on fire management practices such as prescribed burning and fire suppression, the question needs to be asked, "Are they actually peer reviewers"?

Academic authors often fail to recognise, or are unable to perceive, how their logic and the results of their research make sense in the broader context of wildland fire management, or even whether their data are in any way representative, and their modelling assumptions valid.

Reviewers with the same background suffer the same ignorance so are unlikely to recognise the shortcomings of these papers.

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How does 'bad' prescribed fire science get published?

- Reviewer ignorance
  Could it be improved by:
  - including professional fire practitioners in review process?
  - collaborative review?
  - peer review of peer review?
- Cognitive bias
  Could it be improved by:
  - double / triple blind review?
  - open review?
  - collaborative review?
  - peer review of peer review?
  - training reviewers?

So there are two possible explanations for how flawed papers on prescribed burning manage to be published in peer review journals.

Either the reviewers are ignorant of the nuances of fire behaviour and its effects, of prescribed burning and of bushfire suppression operations, or there is a violation of impartiality through cognitive bias.

Like most scientists, I agree that peer review in science is necessary. The issue is how can we improve it? There are many recently published papers that propose workable ways of improving the peer review process, which I mention but won't discuss in detail here.

To improve transparency and to reduce bias, some journals are trialling or advocating alternative models including double-blind review, open review, hybrid review, *a priori* review, *a posteriori* review, peer review of peer review, and collaborative review.

And I think it would be of great benefit to include more professional, tertiary trained fire practitioners in the peer review publication process – both on editorial boards and as reviewers, especially for papers that have important fire policy and operations implications.

Mentoring or training young scientists in how to peer review might also be beneficial.

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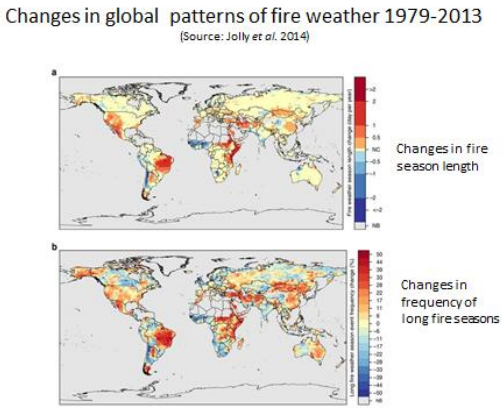

Turning now to impediments to prescribed burning.

As I mentioned earlier, wildfire extent is projected to increase globally as the planet warms and much of it becomes drier. While we continue the crusade for emissions reduction on the premise that fossil fuel emissions are the major cause of climate change, it is unlikely that the global community will react sufficiently to stave off the unfolding of climate change.

I am of the view that more than ever, vegetation or fuel management, including wise prescribed burning, is the cornerstone to mitigating the damaging effects of wildfire in most vegetation types. There are some vegetation types, such as chaparral, which are difficult, but not impossible, to prescribe burn and the where the benefits of doing so are not so clear.

Reducing the potential size and intensity of wildfires by adequate prescribed burning in most vegetation types will enhance the efficacy of suppression actions and all other planning, preparedness, response and recovery measures put in place to reduce the threat to communities and the environment.

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But in most situations, this is not easy to do. The impediments to undertaking an effective prescribed burning program, one that underpins bushfire threat mitigation and maintains ecosystem and community resilience, are context dependent, varying across the spectrum of global fire-prone environments and socio-economic circumstances.

For example, prescribed burning is a routine, relatively common practice in much of southern USA, in many of the world's grasslands and savannah woodlands, and in dry eucalypt forests of Australia. In other typically fire-prone parts of the world, including shrublands, some woodlands, boreal forests, alpine vegetation and moist sclerophyll forests, prescribed burning is less prominent and more challenging.

Particularly challenging are the so-called 'go - no go' fuel types that have multiple fire spread thresholds, and vegetation types that have narrow prescribed burning opportunities because of weather conditions and fuel moisture regimes.

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Broadly, prescribed burn complexities and challenges can be summarised into a dozen or so categories, the relative importance of each varying geographically. Assuming that

there exists the political will to carry out prescribed burning, then the greatest impediment is probably resources to do the job.

- The priority of course is to treat fuels within about 5 km or so of settlements. This is usually difficult, risky and expensive. Using risk-based frameworks to help determine priorities, many jurisdictions aim to, theoretically at least, reduce risk by 20-30%, leaving a residual risk of 70-80% - this probably reflects what the agencies think is achievable, rather what is desirable.

  Given that hazard mitigation around settlements is unlikely to be adequate, it is crucial to also treat fuels in the broader landscape, which is less risky and less expensive than settlement protection burns.

  A strategic mix of settlement protection burns and landscape burns would be most desirable because fires mostly start in forests and bushland well away from settlements. In addition to enhancing the effectiveness of settlement protection burning, strategic landscape burning enhances opportunities to put the fires out before they reach settlements.

  If I can re-phrase Johnny Cash – “don’t bring the fire to town son".

  In addition, there are important fire-vulnerable values and assets beyond settlements.

- Another impediment is lack of operational expertise – planning and implementing a prescribed burning program is part science, and part ‘art and craft’ developed from hard won experience.

  Because of uncertainties, prescribed burning is an inherently risky business on a number of levels, and accidents such as escapes can erode confidence and credibility.

- This leads to risk aversion – not burning because of fear of escapes and subsequent fallout. The risk is high when treating fuels at the convoluted urban fringe, or adjacent to settlements, infrastructure and other assets, or when attempting to burn long unburnt fuels surrounded by long unburnt fuels.

- Another constraint is small windows of opportunity for prescribed burning because of weather patterns or legal restrictions on when and where prescribed burning can be done.

- Having a firm understanding of fuel dynamics, of fuel moisture content and of fire behaviour in the various fuel types, and having reliable weather forecasts, is fundamental to safely planning and implementing prescribed burning programs.

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Impediments to prescribed burning

- Wildlife regulations
- Environment and health regulations
- Accessibility and operational impediments
- Socio-cultural constraints
- Conflicting land use
- Fragmented landscapes
- Fire ecology knowledge

- Wildlife regulations often prohibit, or restrict burning of some ecological communities and species. For example in some jurisdictions formal permission from the relevant authorities is required to burn landscapes containing populations of declared rare flora or threatened ecological communities. Obtaining permission can be onerous and time consuming, and if granted, can come with stringent conditions, further complicating the process.

- Environmental and health regulations such as air quality and smoke management present major challenges, further narrowing burn windows.

- There may be operational impediments to implementing burning programs because of rugged, inaccessible terrain or regulations restricting access and on-ground operations such as track or firebreak construction in gazetted wilderness areas.

- Socio-cultural constraints including poor land use planning and urbanisation at the peri-urban interface, local community opposition to the practice for a variety of reasons including perceived threats to conservation values.

- Conflicting land use such as horticultural crops affected by smoke, amenity values and industries such as apiarists being temporarily effected.

- Fragmented landscapes comprising fine scale mosaics of different fuel or vegetation types including agricultural land, plantations, fire sensitive regrowth forests, mining rehabilitation, etc.

- Lack of Fire ecology knowledge may be an impediment - It is neither possible nor necessary to know everything about how ecosystems respond to fire.
  While research continues, the best available information should be used rather than delaying action until we 'know more', and prescribed burning should be implemented in an adaptive management framework so we learn by doing.

This list of impediments is somewhat daunting, and probably provides adequate reason for not prescribed burning. In response, I can think of only two reasons for prescribed burning – to save lives and protect the environment.

Working our way through these impediments is not easy but it's not impossible. I am confident that most, if not all of these impediments can be largely overcome by agency, community and political support for the program, by having well trained and well

equipped professional fire practitioners, by good planning and execution, and by ensuring the program is underpinned by good science.

On that note, the community would be well served by researchers working more closely with fire and land management agencies to address some of these impediments to prescribed burning.

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So to finish where I began – at the Waroona fire.

The fire burnt 70,000 ha of forest, farmland and settlements, it destroyed 165 homes, essentially wiping out the town of Yarloop, and it cost an estimated $155 million. Remarkably, only 2 lives were lost.

Peak forest fire danger rating during the fire was mostly High to Very High, not unusual for this time of year. The fire travelled west some 30 km from its origin deep in the forest before impacting settlements at the base of the Darling Scarp. On its journey through the forest, the head fire did not encounter a recent prescribed burn, and in the dry, heavy fuels, it defied suppression.

After burning down the scarp, it travelled a further 25 km or so through a mosaic of farmland, plantations and remnant vegetation, to the Indian Ocean.

This fire was not a case study in how prescribed burning 'saved the day', but the reverse - a lesson in how the 'day was lost' because of a lack of landscape prescribed burning and fuel hazard mitigation in and around settlements.

Most of the forest involved in the Waroona fire, like so many disastrous fires, had not been prescribed burnt for more than 10 years for the reasons I discussed earlier.

The fuel management, or lack thereof, fire behaviour and fire suppression lessons and insights gained from this and other fires, are unlikely to be published in peer reviewed journals, so remain unknown to most scientists.

But they are indelibly written into the diaries and memories of the hundreds of men and women who are called out each season to fight these fires.

Lest we forget.

Thank you