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Fire Management Working Papers

Global Forest Resources Assessment 2005 – Report on fires in the Australasian Region

by
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The purpose of these papers is to provide early information on on-going activities and programmes, and to stimulate discussion.

Comments and feedback are welcome.

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FOREWORD

Fires impact upon livelihoods, ecosystems and landscapes. Despite incomplete and inconsistent data, it is estimated that 350 million hectares burn each year; however, the nature of fires determines whether their social, cultural, environmental and economic impacts are negative or positive. Up to 90 percent of wildland fires are caused by human activities primarily through uncontrolled use of fire for clearing forest and woodland for agriculture, maintaining grasslands for livestock management, extraction of non-wood forest products, industrial development, resettlement, hunting and arson - thus any proactive fire management needs to adopt integrated, inter-sectoral, multi-stakeholder and holistic approaches. The situation varies markedly in different regions of the world.

As a supplement and complement to the Global Forest Resources Assessment, 2005, this working paper is one of a series of twelve prepared by regional and country contributing authors to provide a greater depth of data and information on fire incidence, impact, and management issues relating to the twelve UN-ISDR Regional Wildland Fire Networks around the world.

The working paper series assesses the fire situation in each wildland fire region, including the area extent, number and types of fires and their causes. The positive and negative social, economic and environmental impacts are outlined. Prediction, preparedness and prevention as key elements in reduction of the negative impacts of fire, rapid response to extinguish fire incidents and restoration following fires are addressed.

The working paper series also addresses institutional capacity and capability in wildland fire management, including the roles and responsibilities of different stakeholder groups for prevention and suppression, particularly the unique role of community-based fire management.

From these working papers, a FAO Forestry Paper on Fire Management will synthesize the highlights from each region, but also provide a global summary of important lessons that can be used in fire management in the future. These papers are a valuable resource in the process to prepare the Fire Management Code, the Global Strategy to Enhance International Cooperation in Implementing the Fire Management Code and associated capacity building.

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This working paper is the product of a global team of dedicated people willingly giving of their time and specialist expertise within each of the twelve UN-ISDR Regional Wildland Fire Networks.

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1. Background

Following the release of the Global Forest Resources Assessment 2000 (FRA 2000) report in 2001, the global FRA process has now entered its next reporting cycle. FAO's Committee on Forestry (COFO) 2003 confirmed the directions of global FRA's that the Kotka IV Expert Consultation recommended in July 2002. Recommendations included the preparation of an update of the global FRA-data in year 2005 and to increasingly involve countries directly in the assessment and reporting, in particular to submit national reports on the status and trends of a range of forestry parameters. More information about FRA 2005 is available at www.fao.org/forestry/fra.

FRA 2005 also included thematic studies, including e.g. one on forest fire, forests and water, and mangroves. The thematic study on wildland and forest fire in 2005 is built on regional reviews on forest fire management in the International Strategy for Disaster Reduction (ISDR) Global Wildland Fire Networks (GWFN) The current report is a contribution and makes a review of the ISDR Australasian Region.

This Working Paper FM/13/E has been written by Mr P.F. Moore and does not reflect any official position of FAO.

2. Australia

2.1 Extent number and types of fire / forests burned

In the period from 2000 to 2005, the 2002-03 fire season in Australia was one of the most dramatic in the period since European settlement. Very large areas of South Eastern Australia experienced wildfires under severe weather conditions following a long and severe drought. The damage to assets and the nature of the fire season led to a number of inquiries and reviews of fire management for the jurisdictions and the nation as a whole. These are noted later in this thematic review.

The Council of Australian Governments National Inquiry on Bushfire Mitigation and Management that was initiated following the 2002-03 fire season prepared a table of fires and the areas burned (Table 2). The inquiry panel noted that:

> *The difficulties encountered in compiling this table highlighted to the Inquiry the limited and inconsistent nature of fire data held by jurisdictions and their agencies.*

This experience confirms the point made by Gill and Moore (2001) in the section on Australia in the Global Forest Fire Assessment 1990-2000, that various "problems arise in the use of statistics for forest fires in Australia." Included among these they noted:

- Forest fire statistics usually apply to data collected by State Forest Authorities and may not include the forests in National Parks, Crown Lands, and private property.
- The area base for the statistics is continually changing.
- The methods used for the establishment of a database of areas burned vary and thus the accuracy of the data varies.
- The diligence of reporting fires and the areas they burn may vary.
- Data may, or may not, include areas burned by prescription.
- Data are often presented for short periods only.

These difficulties have not materially been addressed to date and the reporting of a coherent and consistent set of fire information for Australia remains an objective to be met.

It is highly desirable to have a set of reliable fire data to analyse and enable performance monitoring, support planning needs and provide a basis for technical change and policy innovation. There remain significant issues in collecting, reconciling and reporting on fires in Australia. Importantly the information should be consistent and comparable but in some respects comparison may not be useful. Australia is a nation with a landmass of 7 617 930 km^2, ranging from the subtropical and reaching deep into southern temperate zones. As a result the nature, frequency, size and season of fires vary

markedly. For the 2002-03 fire season, Figure 1 illustrates this characteristic. Areas in green were burned up to June 2002 and occur mainly in the northern parts of Australia. The area in red, burned from June 2002 to March 2003, still shows a much greater area burned in the north. The areas burned in the south represent the fires that generated public concern and political energy, leading to a suite of reports and reviews.

In Northern Australia, tropical savanna and grasslands are “easy” to burn and the people, many living on the land and relying on it for their livelihood, do not fear fire - they use it, are used to it and comfortable with it. Grass, the most utilised natural resource, when burned replenishes rapidly (promoted by fire). The fire story in the northern parts of Australia is much more complex than presented here but ongoing research and historical information suggest fire use has both human and ecological implications that continue to be considered and applied in land management. In Southern Australia where settlement is denser, the landscape is highly fragmented and there are high value fire-vulnerable assets in the landscape when a fire suppression culture has developed. Additionally coastal communities are overwhelmingly urbanised and the majority of civil society, and those that influence it, sees fire as “bad”.

The area subject to fire annually has significantly reduced since European settlement due to changed land use patterns, fire suppression and cessation of aboriginal burning. These changes are leading to changing forest structures, emerging forest health problems, including dieback and an increase in landscape scale high intensity fires. Prescribed burning in south eastern Australia has been pressure and the area being prescribed burned declining.

The concept of a “bad” fire season varies across Australia. Fires may burn across millions of hectares, with little or no property damage, while in other parts of the country major loss of life and property can be the result of a single, perhaps quite small, fire affecting a relatively small area. It is still the case that the “costs” of fires are mainly recorded in terms of built structures and human values and not environmental losses or ecological impacts.

This aspect of fire in Australia is reinforced by the data collated for the National Bushfire Inquiry and copied below. One of the most severe fire seasons in past decades – 2003 – shows very nearly the lowest total area burned since 1997. The bulk of the area burned is in the tropical savanna.

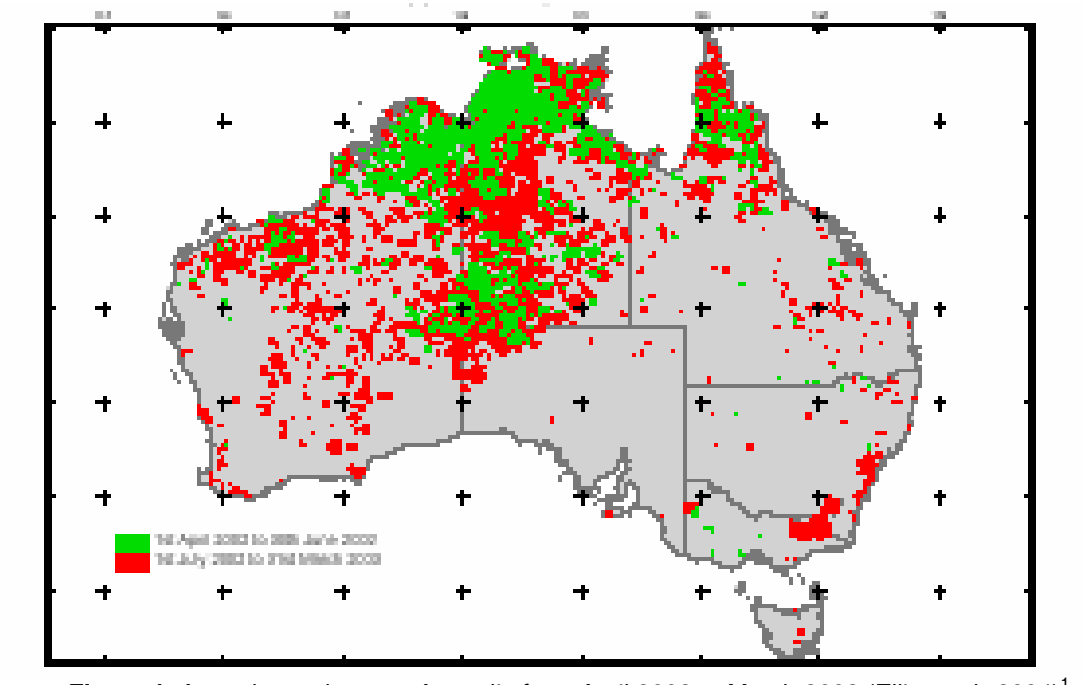

Figure 1. Areas burned across Australia from April 2002 to March 2003 (Ellis *et al.*, 2004)[1]

[1] Note: Areas burned are mapped from 1-km NOVAA-AVHRR satellite images. Fire scars less than 400 ha are not included in this dataset. Source: Western Australian Department of Land Information.

Table 1. Approximate fire-affected areas across Australia, 1997 to 2003[2]

Calendar year	Area (million hectares)	Percentage of total land area fire affected	Percentage of fire affected area that is tropical savanna[3]
1997	48.3	6.3	86
1998	26.3	3.4	92
1999	60.0	7.8	86
2000	71.5	9.3	65
2001	80.1	10.4	84
2002	63.8	8.3	63
2003	31.6	4.1	85

So for fire-related data to be useful, there is a need to consider how to break up the continent into sensible landscapes and also account for legal boundaries. It is likely to be meaningless to come up with national level statistics for Australia as a whole since not all fires are treated, considered or impact equally (Figure 1 and Table 1). Many fires in the northern parts of the country are not put out, yet there is heavy suppression applied to small fires in South-East Australia.

2.2 The 2002-03 bushfire (wildfire) season[4]

There being limited figures for Australia as a whole for the period 2000-2005, an examination of the 2002-03 fire season provides insight into many of the aspects and elements that represent successful approaches and solutions while illustrating those parts of the fire management process that require further development, deeper consideration or resolution.

The 2002-03 fire season was a very significant one for many parts of Australia, extending from May 2002 to April 2003 and was identified by the National Inquiry as being characterised by:

- A historically significant fire season;
- The potential to be the most severe fire season in all states and territories for between 20 and 40 years;
- Major fires in all jurisdictions, affecting in excess of 54 million hectares, with vast areas being affected in central and northern Australia;
- Major campaign fires in New South Wales, the Australian Capital Territory and Victoria and a major fire disaster in Canberra on 18 January 2003.

The fires claimed 10 lives, destroyed over 1 200 structures, killed over 21 000 heads of livestock, and resulted in great environmental damage and estimated insurance losses in excess of $A 400 million. There was no assessment of environmental damage.

Following the season, a series of investigations and reviews has been undertaken:

- Auditor-General Victoria 2003, Fire Prevention and Preparedness;
- Department of Sustainability and Environment 2003, The Victorian Alpine Fires, January–March 2003;
- Report of the Inquiry into the 2002-2003 Victorian Bushfires (Esplin *et al*., 2003);
- The Report of the Bushfire Recovery Taskforce-Australian Capital Territory (Hollway, 2003);

[2] Source: Western Australian Department of Land Information.
[3] Defined by the Department of Land Information, for the purposes of monitoring fire-affected areas, as being the area north of 21°S and east of 120°E.
[4] This section draws heavily on the work of the panel and contributing agencies and experts of the National Inquiry on Bushfire Mitigation and Management (Ellis *et al*., 2004)

- House of Representatives Select Committee on the Recent Australian Bushfires 2003, A Nation Charred: Inquiry into the Recent Australian Bushfires;
- Inquiry into the Operational Response to the January 2003 Bushfires in the ACT, ACT Government, Canberra (McLeod, 2003);
- Coronial Inquiry into the Circumstances of the Fire(s) in the Brindabella Range in January 2003, NSW Coroner's Office, Sydney (Milovanovich, 2003).

There is a major inquiry being conducted by the ACT Coroner that has not yet reported and is delayed by the need to resolve questions of law and process.

Figure 2 shows the fires mapped for the 2001-2002 and 2002-2003 fire seasons in the state of New South Wales. The fires are restricted to the eastern third of the state, the area where forests are concentrated. The major population centres are distributed along the coastline. This distribution of fires was strongly influenced by a severe drought that saw the grasslands and woodlands in the western parts of the state almost completely bare and unable to carry fires. The scenario would be similar in other south eastern states of Australia where the drought prevailed during the same period.

For the nation a data set was compiled for the purposes of the national inquiry and is reproduced in part in Table 2.

2.3 Reasons

As a developed nation, fire causes in Australia tend to follow the pattern seen in similar nations. Natural causes of fires are restricted to lightning with human causes providing the overwhelming numbers of fire ignitions. Generally, human causes are accidental or unintended though there is an increasing focus on "arson" as a cause of fires. This recent emphasis on arson is not reflected in the number of people convicted of offences following the 2002-03 fire season where, of a national total of over 10 000 fires identified as deliberately lit or potentially arson, there have been 43 convictions.

2.4 Damages

Generally in Australia all fires are assumed by the public, media and generally to be bad. The research, experience and history demonstrate that this is not the case but this over-riding impression is repeated, widely held and dominant in the public eye. So any estimate of area burned is thought to include bad effects for the total area burned. As a result, the assessment of fire effects and impacts does not ask which fires, or parts of fires, were detrimental and which fires, or parts of fires, were beneficial.

Social impacts

The social impacts of fires in Australia have been accommodated in the past by existing civil society structures and relevant government agencies when severe or damaging fires occurred. In the case of the Canberra fires in January, the response from government and civil society was more specific. A Bushfire Recovery Taskforce was set up with goals and objectives that included:

- Supporting those significantly impacted by the fires;
- Ensuring the community actively participates in the process of rebuilding and recovery;
- Ensuring the clean-up and facilitating rebuilding in a way that is safe, timely, efficient, cost-effective and respectful of the people involved;
- Providing up-to-date, relevant and useful information to assist the recovery process; and
- Learning lessons from this event so the community moves forward positively.

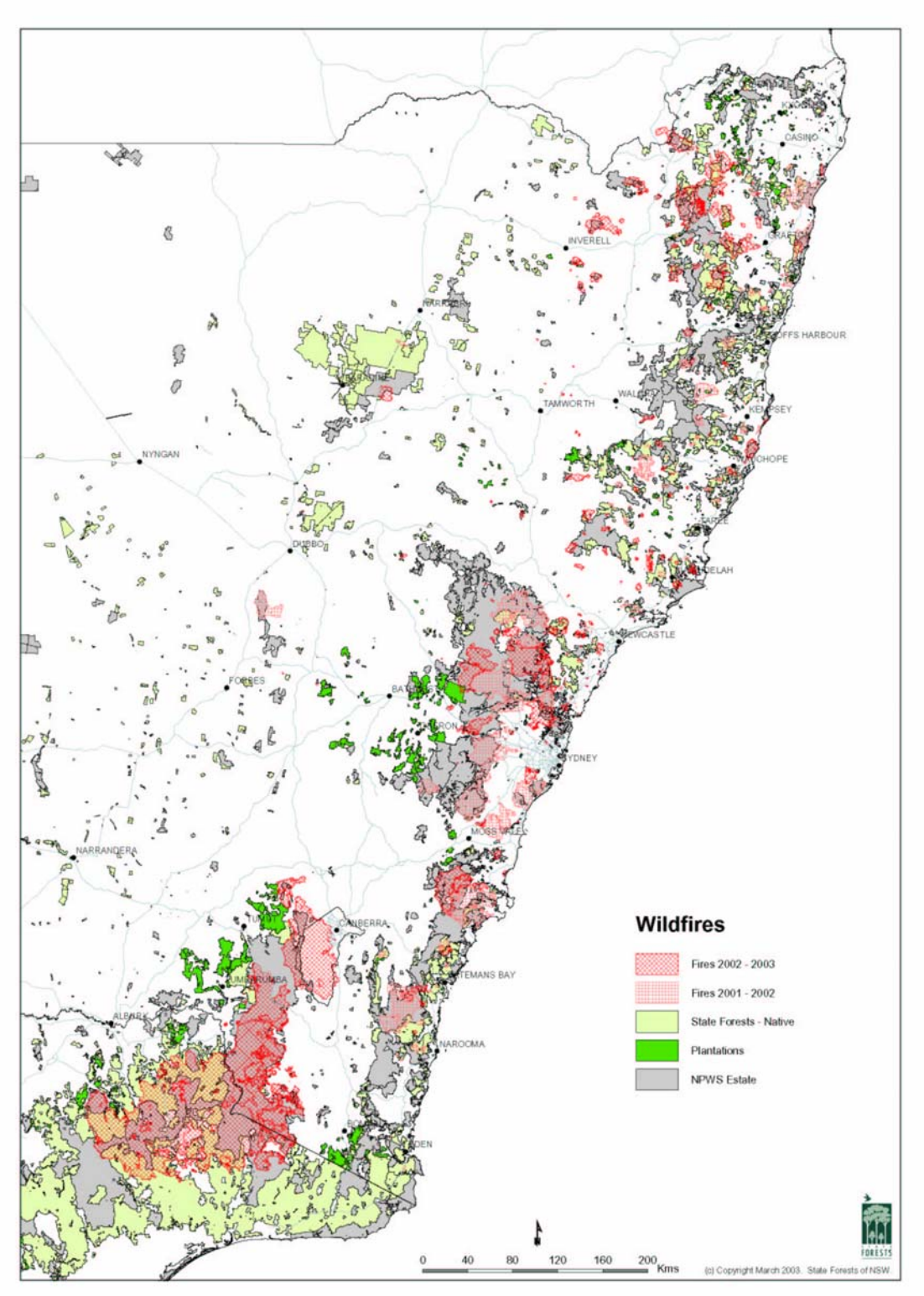

Figure 2. Map of NSW Fires for 2001-02 and 2002-03 fire seasons

Table 2. Australian Fire season statistics for 2002-03, by state and territory

Description	NT	Qld	NSW	ACT	Vic	Tas	SA	WA	TOTAL
Unplanned fires (No.)	2 886	2 778	>2 500a	94	>3 000	1 500	1 311	11 515	25 584
Estimated area burned (ha)	38 400 000	8 000 000	1 464 000	157 000	1 300 000	58 000	2 610 000	15 545 000	32 974 000
Duration of severe fire activity (days)	122	21	151	21	70	100	n.a.	149	
No. of total fire ban days statewide	11	15	13	20	4	5	2	48	
Estimate of fires - arson or deliberate (%)	79	7–10	25b	70	26	40	29	46c	10 375
Convictions	0	n.a.	25	1	0	17	n.a.	d	43
Firefighter fatalities	0	0	0	0	1e	0	0	1e	
Civilian fatalities (No.)	0	1	3	4	0	0	0	0	
Structures, vehicles damaged, destroyed	115	207	437	1 680	292	37	19	0	2 787
Insurance claims ($A million)	n.a.	n.a.	40	350	11.25	n.a.	n.a.	c	401.25
Suppression costs ($A million)	0.47g	n.a.	120	4.04	88e	4.75	9.30	25h	251.56

Acronyms of Australian states and territories: **NT**: Northern Territory – **Qld**: Queensland – **NSW**: New South Wales – **ACT**: Australian Capital Territory – **Vic**: Victoria – **Tas**: Tasmania – **SA**: South Australia – **WA**: Western Australia

Economic impacts

There is generally very poor information on the economic impacts of unwanted fires available. The data that is occasionally presented represents only a sub-set of the information available. It is restricted mainly to insured losses and much property is not insured, under-insured or not included in these assessments. From time to time an effort at estimation of fire costs and losses is made but not formally nor conducted by government agencies.

During a seminar in early 2003, immediately after the severe fires in Canberra, and a subsequent publication that arose from it published in mid-2003 (Cary *et al.,* 2003), there are no papers or estimates of the costs and losses as a result of the 2002-2003 fire severe season. In the period since then the various inquiries listed earlier have noted estimates but they are general and heavily based on insurance losses and counts of buildings and livestock damaged or destroyed as a result of the fires.

Historically, there is very little record of losses nor consideration of it and what it might be composed of. Possible areas where losses might be experienced and identified include:

- Productivity
- Impacts on tourism
- Smoke
- Infrastructure repair
- Loss of sales
- Loss of employment

Glover and Jessup (1999) undertook an early attempt of this type of comprehensive assessment for South East Asia. Their work represents a more comprehensive economic assessment than anything undertaken in Australia. Forestry organizations also do not seem to assess for timber degrade, loss or productivity.

It is possible to extract from annual reports and other sources indications of firefighting costs. These are not necessarily clear or simple to calculate. Generally in the recent past there is a strong impression of increasing budgets for fire agencies and perhaps decreasing budgets for the management of land including fire prevention. This thematic review does not allow a full examination of this trend. Readily available financial data does suggest a trend. Table 3 sets out the total budget for a provincial rural fire agency in Australia. [5]

The figures set out are for the total expenditure of the agency, not only for fire fighting. There are a series of positive reasons for the changes that include alterations in responsibilities, changes in span of control, recognition of a need for increased services, expanded staffing and equipment levels and improved training. The very large change in expenditure in 2002-2003 was due in large measure to the severe fire season experienced. There are also reasons for the change that may be worth further and deeper consideration. The trend in Australia and elsewhere sees a public profile for response (suppression) activities with an apparent reduction in the prevention processes and fire-related land management planning and management. It seems unlikely that any jurisdiction can sustain annual increases in expenditure or over a twelve-year period of the scale set out in Table 3. The balance of fire management elements and the roles and responsibilities of the stakeholders are two aspects of fire management in Australia that seem to require serious and considered review, as reflected by the National Inquiry undertaken after the 2002-2003 fire season.

[5] Rural Fire Service of New South Wales Annual Reports 1992-93 to 2003-04.

Table 3. Provincial Rural Fire Service, total budget by years

Financial Year (June to July)	Total Expenditure ($A)	Change from 1992-93
1992-93	28 625 000	N/A
1993-94	43 457 000	52%
1994-95	55 809 000	95%
1995-96	63 809 000	123%
1996-97	67 715 000	137%
1997-98	86 489 000	202%
1998-99	78 505 000	174%
1999-2000	84 129 000	194%
2000-01	93 200 000	226%
2001-02	179 218 000	526%
2002-03	240 989 000	742%
2003-04	141 074 000	393%

Environmental impacts

Media and community talk about fires, and areas affected by them, as being “destroyed” or “disastrous”. These epithets have not translated into a publicly available assessment of environmental impact of severe fires or fire seasons. The increasing concern and discussion on climate change would also seem to require an estimate of the contribution of fires to emissions in the national inventory and of the potential of climate change to influence fires, their incidence and potential for damage.

There have been no assessments prepared of ecological or environmental impacts. While these types of impacts are difficult to quantify, there have been efforts to establish environmental costs and losses for significant fire events in the past (Jessup and Glover, 1999; Tacconi, 2003) though not for Australia. Although not all that satisfactory in some respects to date, the evaluation of the impacts on environment is required and improved methods for doing so should be supported by research efforts. This information is particularly essential to underpin changes in land management practice and support the evolution of policy, a need emphasised by the public and persistent descriptions of large and damaging fires as “environmental disasters”.

Notably development controls require significant environmental impact assessments and there are sophisticated and highly regulated schemes and systems for these. Major wildfire events attract no such assessment or evaluation of the environmental impacts and the options for recovery from impacts. There is consequently a lack of information to support or priorities efforts for restoration of landscapes and ecosystems despite the specific skills and technical capacity to undertake restoration being available.

2.5 Fire prevention

Efforts to prevent fires have to consider the three elements:

- Prevent ignitions
- Prevent fires moving across the landscape
- Prevent fires causing damage

The measures and management undertaken to address these three elements of prevention are most easily applied for preventing ignitions and preventing damage. Ignition reduction strategies have been quite well developed in Australia and are evolving as civil society changes and the places where people choose to live alter extending the rural and urban interface further into natural areas including protected areas and rural lands. At the rural-urban interface, education about fire and systems to

reduce fire damage (engineering and managing human behaviour) are applied and worked on in all Australian jurisdictions.

Preventing fires moving across the landscape involves managing or reducing the fuels that fires burn in. There has been increasing pressure on fuel reduction activities through the influences of:

- The legal framework, which tends to make deliberate fire use a complex planning process and negative implications for unintended consequences.
- Balanced use of planned fire is not necessarily encouraged, recognized or permitted within the law so that use of fire is supported and unintended consequences are not punished. For example:
    - Acting in good faith to put out a wildfire is protected from litigation by law;
    - Damage caused by a prescribed fire has no protection provided by law.
- The sense in society that fire is "bad" includes the deliberate use of fire for both fuel management and environmental outcomes.
- Political and agency sensitivity to mistakes and errors or negative profile of any style creates a tendency towards risk averse behaviour.

The difference between tropical and non-tropical areas of Australia highlights the variation across the nation with respect to fire. In tropical areas, there is no real fire prevention focus at all. The emphasis is more an education as to when the community should use fire rather than not use fire at all, it is an issue of timing, not prohibition. There are also differences in land use, in some cases historically based, which influence the role fire plays. Some landscapes have a strong prevention culture and there are no random fires. In other landscapes, rural landowners use fire in a very unstructured way "throwing around matches" as they move across their properties.

2.6 Fire suppression

There is a high level of fire extinguishment taking place. The majority of fires are contained and controlled with the uncontained 5% of fires and cause 95% of the damage suffered. The trends or common denominators in the 5% of fires that escape containment include that damaging fires:

- Start on a bad day and get beyond suppression thresholds due to weather;
- Start in such numbers that cannot all be suppressed;
- Start in remote areas where difficult to suppress, especially in drought periods, and hence still burning when a bad fire day occurs.

Fires are put out mainly by ground firefighting techniques. Increasingly aerial firefighting is being used.

Rural-urban interface

Once again a fire, in Canberra, demonstrated the contribution of the urban 'landscape' and the fuels in suburbs to building loss and damage. Fires burned into the suburbs and the vulnerability of urban landscapes was much greater than anticipated by residents, fire agencies and fire experts. It had previously been considered that generally only the outer street of urban-interface zones would be vulnerable. Canberra graphically illustrated that in extreme conditions this is not the case, particularly with the inflammability and continuity of fuel loads in gardens and with extensive areas of open space between and within suburbs. The sustained and intense ember attack on houses during this fire is well documented. This knowledge should be used more generally to bring about improvements in planning, house design, garden layout, and maintenance and preparedness.

The extent to which the fires entered the suburbs suggests that the public information on the prevention of house and building losses, mainly due to ember attack, advice to stay and protect or evacuate and the timing of evacuations be reviewed and re-emphasised.

Aerial support

The National Aerial Firefighting Centre has been created through the Australasian Fire Authorities Council and Australian National and State Governments. The centre supports the deployment of aircrafts from states and territories where they are under-utilised to places where the need is greater. Air support to fire suppression operations was significant during the 2002-03 fire season. The states and territories incurred a total cost of over $A 110 million. On the busiest day, over 100 aircraft were used. Helicopters and fixed-wing aircraft have consistently gained extensive public exposure, especially through the media. The costs of aircraft are considerable and have a strong influence on overall fire management costs.

2.7 Stakeholder / actors situation

Cooperation between the states and territories

The 2002-03 fire season saw extensive interstate deployment of resources. Resources from overseas were also deployed, and Australian fire managers were deployed to the United States in August 2002 (Sneeuwjagt, 2001). The international agreements for exchange of fire management personnel between Australia, New Zealand and the United States are serving as an example for developing a template for other international agreements on cooperation in wildland fire management. This template was one of the outcomes of the International Wildland Fire Summit, which was held in conjunction with the Third International Wildland Fire Conference in Sydney (October 2003). [6]

The Australian Fire Authorities Council (AFAC), established in 1993, to improve the collaboration and co-ordination of effort between those Australian agencies with a responsibility for the protection of life and property from fire and other emergencies. The membership of agencies from the greater region saw AFAC's name change to the Australasian Fire Authorities Council in 1996. After the International Wildland Fire Summit and in line with the development of the UNISDR Global Wildland Fire Network (GWFN), the AFAC Council decided in 2004 to formally join the global network. With this decision AFAC is considered to represent the Regional Australasia Wildland Fire Network. [7]

Community involvement

Community-Based Fire Management (CBFiM) is a type of forest/fire management in which a locally resident community (with or without the collaboration of other stakeholders) has substantial involvement in deciding the objectives and practices involved in preventing, controlling or utilising fires (FAO definition).

Fire management in Australia has largely shifted away from the community to being influenced, managed and operated by government agencies. Due to the need for standards and diligence in various aspects of fire suppression, this influence extends to the volunteer bushfire movement. Although members of the community, committed to community protection from fire and to fire management and heavily relied upon this does not meet the accepted definition of CBFiM. There is little input to fire management expected from communities, few significant opportunities for them to have substantial involvement in decision making and little undertaken by them. Fire Management in Australia may benefit from a change in this balance.

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[6] Website of the International Wildland Fire Summit:
http://www.fire.uni-freiburg.de/summit-2003/introduction.htm
Summary publication in Int. Forest Fire News: http://www.fire.uni-freiburg.de/iffn/iffn_29/content29.htm

[7] http://www.fire.uni-freiburg.de/GlobalNetworks/Australasia/Australasia.html

2.8 Needs and limitations

Handmer (2003) identified that there are three categories of actors and stakeholders to consider in bushfire (wildfire) risk.

1. *Those that create the risk* – the formal planning and land development systems and the informal attitudes and actions of people at risk.
2. *Those dealing with the results of the activities that create the risk* – the key groups are the fire and emergency services, insurers and groups that work with them such as forest and land managers. In an informal way the media, volunteerism and individual and group behaviour are all part of dealing with the risk.
3. *Those that create the future risk* – these are factors such as urban expansion, governance, changes in lifestyle or values, possibly emergency management trends and climate change. These influences arise both from institutions and from individual choices and behaviour.

One aspect that is evident in the discussion by Handmer (2003) is that these three groups of actors and stakeholders are basically operating separately from each other:

"Those creating the risk historically have no direct interaction with those dealing with the results, the fires. Worse perhaps is the absence of any useful engagement with those creating the future risk – the risk that fire and emergency services, insurers and society, will be dealing with in the future" (Handmer, 2003).

This may well be a characteristic that is experienced more widely and not restricted to the jurisdictions in Australia.

2.9 Analysis and recommendations

Fire data

Compiling data for this chapter was difficult because of the current limitations in national bushfire data. Until the situation is remedied, the lack of an agreed, consistent data-collection process will hinder research, operational planning, and evidence-based funding of bushfire response capability.

Legal constructs

The legal framework in Australia may require a review to identify the extent to which it potentially contributes:

- Declining use of prescribed fire through inadequate recognition of the role and benefits of deliberate fire use, and
- Failure to support individuals and agencies engaged in applying fire to landscapes.

3. New Zealand

The report that was made by New Zealand in the Global Fire Assessment 1990-2000 (Craig 2001, 2002) contains information that remains current and will not be repeated here except in summary form. Notably a review of the arrangements for fire management in New Zealand is being carried out. This is part of periodic review processes of government and has not been stimulated by significant events or inquiries.

3.1 Extent number and types of fire / forests burned

The data available for fire seasons since 2000 is set out in Table 4. The table also includes information from 1990 to 2000. The averages for numbers of fires per season and the average area burned per fire, while indicative rather than definitive, suggest that the New Zealand fire management system is working well. Average fire size at 2.4 hectares is small for an annual average of 2 669 fires. While small fires can be significant in losses for plantations or natural ecosystems, particularly small scale or localised habitats, the figures reflect an effective set of arrangements for preventing fires, preparing for fires and responding to fires.

One factor is undoubtedly the organization of the Rural Fire Authorities, their role and responsibilities and the over coordination provided by the National Rural Fire Authority.

Table 4. New Zealand Fire season statistics for 1990-91 to 2003-04

Fire Season	Number of fires	Area (hectares)	Area per fire
1990-91	1 234	7 279	5.9
1991-92	1 153	1 889	1.6
1992-93	990	3 129	3.2
1993-94	2 198	7 350	3.3
1994-95	2 023	4 593	2.3
1995-96	1 646	4 586	2.8
1996-97	2 374	6 937	2.9
1997-98	3 610	6 253	1.7
1998-99	3 169	17 693	5.6
1999-00	2 944	2 054	0.7
2000-01	3 318	10 432	3.1
2001-02	3 709	3 938	1.1
2002-03	4 657	5 532	1.2
2003-04	4 336	7 626	1.8
Total	**37 361**	**89 291**	
Average per Fire Season	**2 669**	**6 378**	**2.4**

3.2 Reasons

Overwhelmingly in New Zealand as in most countries fires are human caused. Lightning fires occur and represent a very small percentage of ignitions. This may change with the alterations in vegetation in the uplands and highlands where changes in land use and efforts at soil stabilisation are taking place, or have, and are now having an effect on fuel loads and availability.

3.3 Damage

In common with many nations, the costs and losses through wildfires are not comprehensively measured in New Zealand.

3.4 Stakeholder / actors situation

The institutional and other capacities (prevention and suppression) for fire management in New Zealand are set out under legislation. They include clear identification of responsibilities and roles, the basis for collaboration (local/national/international) and community involvement.

Fire management arrangements

The Forest and Rural Fires Act (1977) provide the framework for the National Rural Fire Authority and Rural Fire Authorities carry out their responsibilities. In non-urban parts of New Zealand the National Rural Fire Authority coordinates Rural Fire Authorities, which are independent, and have the responsibility for prevention, preparedness and response for fires in rural areas. Approaches used by Rural Fire Authorities vary from having staff or contracted personnel, volunteers or using the New Zealand Fire Service (the urban fire service). Most Rural Fire Authorities use a combination of these options to effectively protect their area and meet their statutory responsibilities.

The Department of Conservation, landowners and the New Zealand Defence Forces all form Rural Fire Authorities in established Rural Fire Districts based on land tenure and responsibility. The National Rural Fire Authority supports Rural Fire Authorities through a Rural Fire Management Code of Practice, training, monitoring fire danger, technical advice and supporting equipment acquisition.

3.5 Needs and limitations

The fire management circumstances in New Zealand may change in the future. There is a trend for an increase in biomass and the quantity of available fuels. Native forest, tussock land, wetland and scrubland areas that had been converted to pasture lands are becoming less economic or non-viable. They are reverting to scrublands or being converted to plantations, which are economic and contribute to a dynamic export industry in which New Zealand is a leader.

As grazing lands are included in the protected area system, and livestock removed, there has been a much greater accumulation of fuels. Combined, changes in plantation forests and previous grazing lands will change the fire potential of large areas in New Zealand. Additionally, in the past there have been attempts, consistent with efforts elsewhere in the world, to stabilise and vegetate steep areas that have been affected by introduced exotic animals, in particular deer. Soil stabilisation was sought through aerial seeding of tree species onto degraded lands. Pines (*Pinus* spp.) and other species used have dramatically altered the fuels in these upland and highland areas.

Consequently some parts of the New Zealand landscape are moving from less complex, low fuel loads to increasingly complex and higher fuel loads. Fuels are also more continuous, meaning that fires have a greater chance to spread across the landscape when they start. Fires will become more difficult to control, may occur in more remote areas and are likely to be much larger in size when the fire weather conditions are severe. Severe fire weather conditions in New Zealand are suggested to recur probably each 15 to 25 years. The expansion of the plantation estate also suggests that losses will be higher.

3.6 Analysis and recommendations

Changes in the rural area, and the implications of these for fuels in particular, will potentially require adjustments to the way fire management is practiced in New Zealand. The National Rural Fire Authority has recognized this and initiated a range of strategies to begin the identification of changing needs and altered circumstances.

A first important step is the development of research projects to support and enhance fire danger rating; increase the understanding of the fuels, how they are changing and when they will burn; fire behaviour prediction; and creation of a decision support tool or system to assist rural fire managers in their planning and decision making.

In parallel, the management of resources, people and information is evolving to meet the anticipated need for fire prevention, fire suppression and incident management.

- Development of a method of assessing curing (or die-off) of grasslands, an essential element in grassland fire behaviour prediction;
- Describing New Zealand's fire climate using historical weather and fire danger data from the network of remote automatic weather stations around the country;
- Using Geographic Information Systems (GIS) to combine the climatic and physical factors that influence fire behaviour, so that maps of current and expected fire danger conditions can be produced;
- Combining this information into a decision support system that provides fire managers with the information to better prevent, predict and fight damaging wildfires.

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