New South Wales

Contents

The first part of this chapter provides **contextual information** about New South Wales (NSW), including basic information about its climate, geography, land use and population. It also provides an outline of the bushfire regimes, historically important bushfire events, and overview of fire services in NSW. The second part represents an **analysis of data** provided by the NSW Fire Brigade (NSWFB), the NSW Rural Fire Service (NSWRFS), and the NSW National Parks and Wildlife Service. Although both the NSWRFS and NSWFB attend many types of fire, this analysis exclusively refers to vegetation fires, unless otherwise indicated.

For an explanation of the key terms, limitations and methodology refer to the introduction, glossary and methodology chapters.

Introduction

New South Wales is located in southeastern Australia, and is bordered by Queensland to the north, Victoria to the south, the Tasman Sea in the east, and South Australia in the west. It also encloses two territories – Jervis Bay and the Australian Capital Territory – that do not fall within the jurisdiction of the NSW Government.

Geography

The Great Dividing Range (Figure 1), a mountainous range that extends from northern Queensland to central Victoria in eastern Australia, effectively divides NSW into four zones:

- The coastal strip, east of the range, is the most fertile and wettest area of the state. It is further subdivided into the Far South Coast, South Coast and Illawarra, to the south of Sydney; and the Central Coast, North Coast and Northern Rivers regions between Sydney and the Queensland border.
- The Great Dividing Range is not particularly high by global standards, reaching a peak of 2,229 m at Mount Kosciuszko, in the south of the state. Relief on many parts of the central and northern range is comparatively low, but a sharp escarpment that is intersected by numerous steep-sided valleys typically defines the eastern margin. Much of NSW forestry resources and many of the conservation areas lie within this zone. The range itself is divided into the Southern Highlands, Central Tablelands and the New England Region. The Blue Mountains region lies on the eastern edge of the range to the west of Sydney.
- The western margin of the range is largely characterised by gentle slopes that transition westwards into vast agricultural plains that contain only isolated major urban settlements. The regional classifications for this area vary markedly but names applied to this region include the Northwest slopes and plains, Southwest slopes and plains, central west, Riverina and the Murray, but also include Explorer Country among others.
- The far west of the state is arid and sparsely populated, with only a few major settlements, which owe their origin to either transportation, agricultural or mining industries.

Figure 1: Map of New South Wales

Climate

The timing and amount of rainfall received is highly variable across the state. The highest rainfall is experienced on the coastal strip and mountain ranges (Figure 2). The majority of the coastal strip experiences in excess of 1,000 mm of rainfall per year, but the northeast corner of the state locally receives in excess of 2,000 mm per year. Precipitation along the tablelands is commonly in excess of 800 mm per year, but locally reaches in excess of 1,600 mm in parts of the Snowy Mountains and as little as 400 to 500 mm near Cooma. Rainfall decreases inland, with the western quarter of the state receiving less than 300 mm of rain on average (Australian Bureau of Meteorology 2007b).

Precipitation in NSW is strongly influenced by:

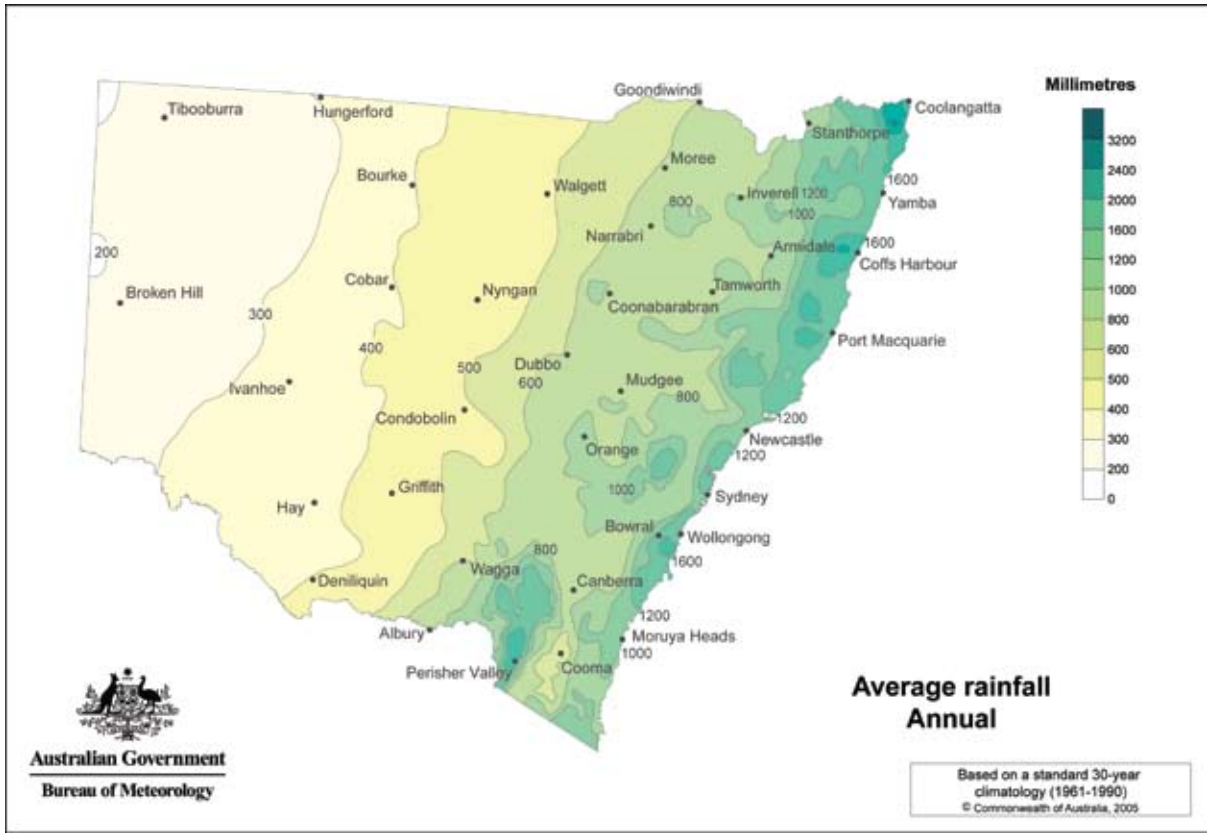
- the passage of cold fronts across southern Australia, particularly during winter
- moisture-laden air moving onshore from the Tasman Sea
- the southward movement of equatorial low pressure systems during summer.

Hence, there is a shift from wet winters – low rainfall summers in southwestern NSW to wet summers – low winter rainfall in the northeast. In the central region, which incorporates the state capital, Sydney, precipitation is typically more uniformly distributed throughout the year.

Average maximum temperatures increase inland, away from the moderating effects of onshore coastal seas breezes, but also from south to north. Average daily maximum summer temperatures range from 21 to 24°C on the far south coast, to 27 to 30°C on the far north coast, to more than 39°C in the state's

far northwest (Australian Bureau of Meteorology 2007a). Snow is typical during winter on the highest parts of the range in southern NSW during winter. Occasion snowfalls may also occur along other parts of the range, but snow rarely persists for more than a couple of days. Hence, the climates range from cool temperate on the far south coast to subtropical in the north coast; and from alpine and sub alpine on the southern mountain ranges to arid desserts in the state's west.

Figure 2: Average annual rainfall for New South Wales



Source: Australian Bureau of Meteorology 2007b

Native vegetation

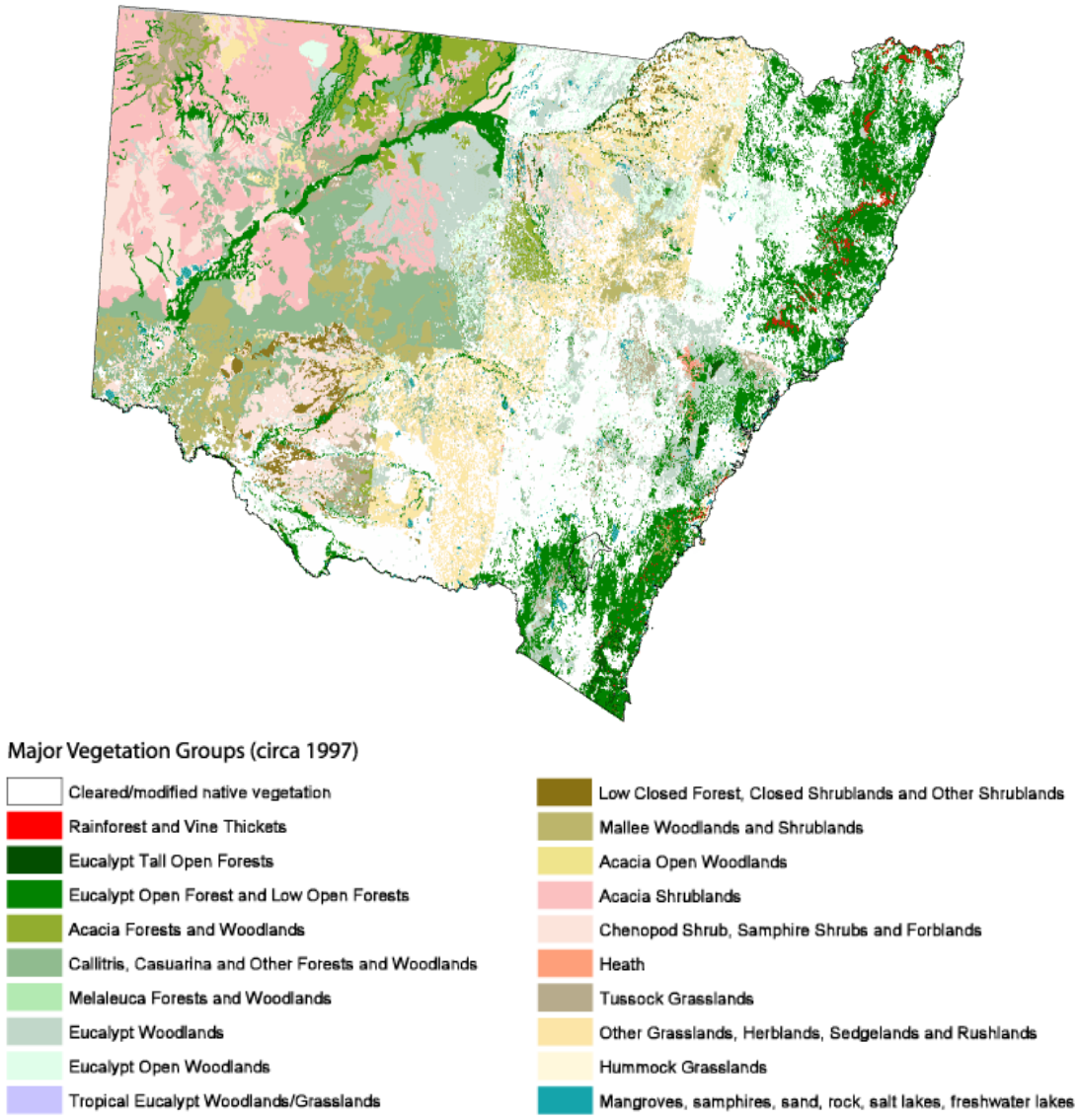
Vegetation in NSW is highly diverse, reflecting the highly varied nature of climatic and geological environments. Many of NSW vegetation communities also occur in the Australian Capital Territory, Queensland, Victoria and South Australia.

The arid far northwest of the state in dominated by acacia shrublands, and Chenopod shrub (saltbush and bluebush), samphire shrublands (Figure 3). Callistris, casuarina and other forests and woodlands are more abundant in the central far west. Mallee woodlands and shrublands occur in the far southwest of the state. Central and eastern NSW are dominated by grassland composed of native and 'derived' (tree or shrub cover has been removed by clearing or other factors) grasslands.

Eucalypt woodlands are found throughout the state but eucalypt open forests and low open forests principally occur along the coastal plains and ranges, but also in narrower strips bordering major inland river systems. Small patches of temperate and subtropical rainforest principally occur on or at the base of the eastern escarpment, with only isolated patches remaining on the broader coastal plain. Alpine and

sub-alpine vegetation in NSW exclusively occurs in the Southern Alps (Snowy Mountains), with the majority of these vegetation types being preserved within the Kosciuszko and Namadgi National Parks (Australia. Department of Environment and Heritage 2001b).

Figure 3: Major vegetation groups (c. 1997)



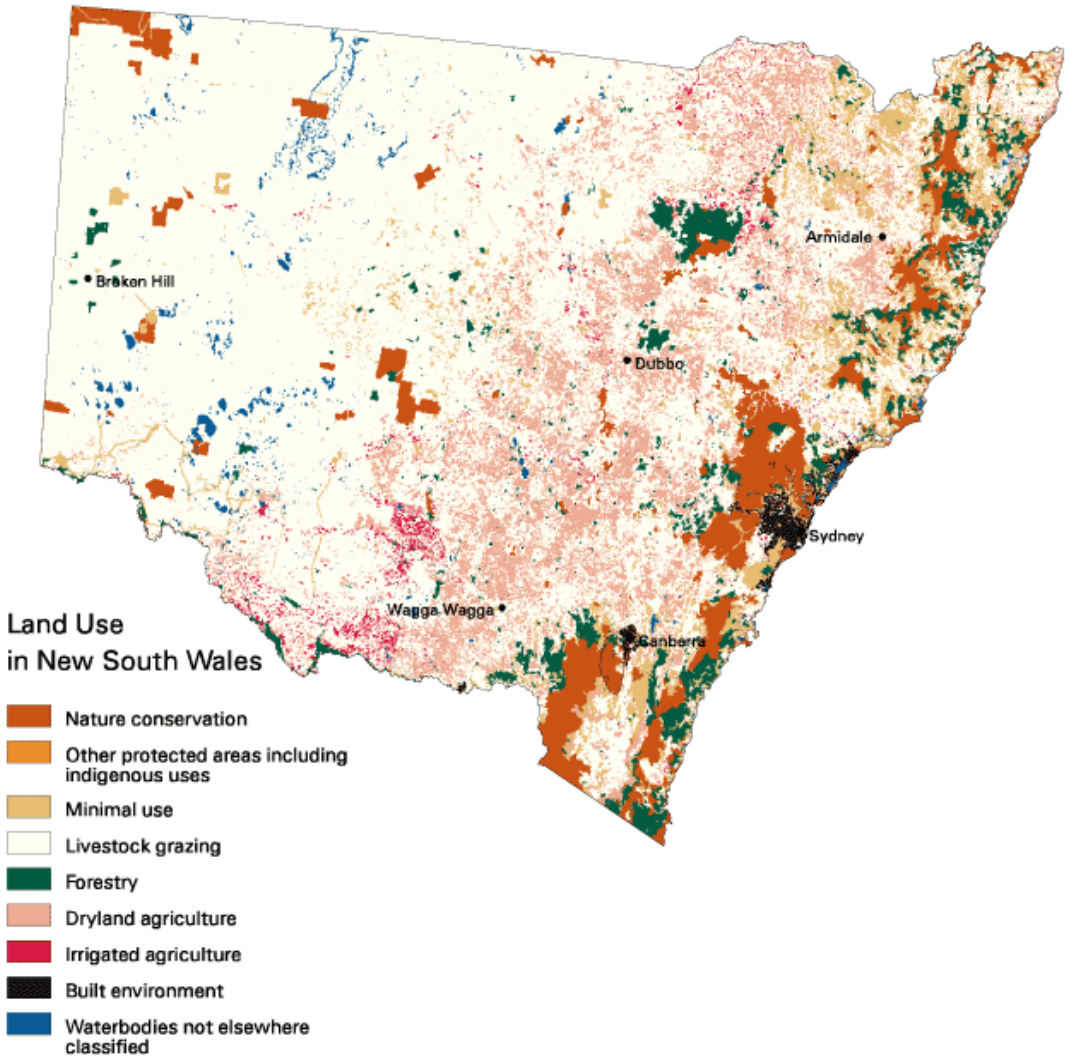
Source: Australia. Department of Environment and Heritage 2001b

Land use

As at 1996–97, nature conservation accounted for seven percent of the total area of NSW; although this is scattered throughout the state, the largest area conserved is located along the range and coastal plains, particular in the Southern Alps, southern highlands, around Sydney and along the northern coast and ranges (Figure 4). A further four percent, used for forestry, has a similar distribution to conservation areas, commonly lying on the margins of those domains. Dryland agriculture accounted for 11 percent of the state and principally occurs within a broad swathe that principally lies on the western slopes and

plains but also includes parts of the range. Irrigated agriculture is scattered throughout the state, but principally occurs along the major river systems of the south, including the Murrumbidgee and Murray. Livestock grazing is the principal land use in the west of the state, although this activity is also intermingled with other land uses in the eastern half of the state. Approximately, 68 percent of the state was used for livestock grazing as at 1996–97 (Australia. Department of Environment and Heritage 2001a).

Figure 4: Land use (c. 1996–97)

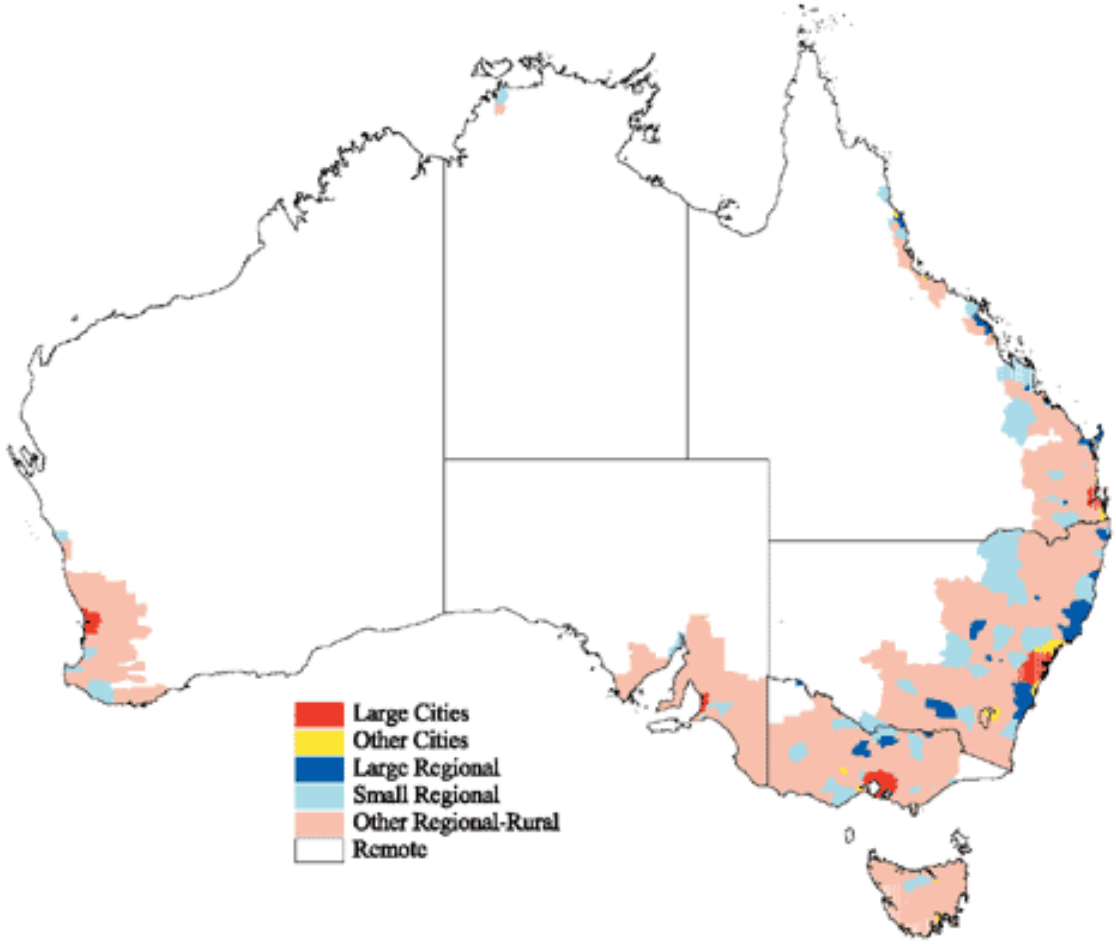


Source: Australia. Department of Environment and Heritage 2001a

Population

As at June 2006, NSW had a population of 6,827,700, accounting for one-third of Australia's total population (ABS 2006) – the overwhelming majority live on the eastern seaboard, principally within large metropolitan and regional centres (Figure 5).

Figure 5: Population distribution of Australia



Source: Australia. Department of Environment and Heritage 2001c

Approximately 63 percent of the NSW population lives in the Sydney region (includes Wyong–Gosford; ABS 2005a). Major cities outside, but within close proximity of, Sydney are Newcastle (on the Central Coast) and Wollongong (in the Illawarra). Larger urban settlements are distributed throughout regional NSW, but principally occur in the eastern third of state. Major regional centres include Albury, on the Victoria border; Broken Hill, in far western NSW); Dubbo, Orange and Bathurst, in the central west; Griffith, Queanbeyan, Leeton, Wagga Wagga and Goulburn, in the Southern Highlands and South West Slopes and Plains; Port Macquarie, Taree, Coffs Harbour, Grafton and Lismore in the North Coast–Northern Rivers region; Tamworth, Armidale and Inverell in the New England and North West region; and Nowra in the South Coast region (Figure 1). The population density, including the density of smaller towns and villages, is highest on the coast, and decreases inland (Figure 5).

The median age of the state's population is 36.8 years, marginally older than the national average (36.6 years). The lowest median ages occurred in Sydney's southwest, in the local government areas of Campbelltown (31.9 years), Blacktown (32.2 years), Penrith (32.3 years), Liverpool (32.3 years) and Camden (32.5 years). The lowest median ages outside of Sydney were in the northwest local government areas of Bourke (31.4 years) and Brewarrina (31.9 years), followed by Armidale–Dumaresq (33.1 years) and Wagga Wagga (33.5 years; ABS 2005a).

At 30 June 2005, 1.32 million children lived in NSW comprising 19.5 percent of the state's population. Consistent with the median age data, the highest proportion of children in the Sydney region occurred in the city's southwest. The lowest proportion occurred in the inner city. Outside of the Sydney region the highest proportions of children were located in the state's northwest, in the regional centres of Bourke, Brewarrina, Coonamble and Cobar. Low proportions of children occurred in the Richmond–Tweed statistical division (19.3%; 43,500 children), Great Lakes (north coast) (16.3%), Newcastle (16.8%) and Bombala (16.8%) in the snowy region (17.0%; ABS 2005a).

Bushfire regimes

The principal timing of bushfires in NSW varies according to the timing and reliability of rainfall, and hence across the state. The most adverse bushfire period in southwest NSW – including the Snowy Mountains, Riverina, and the Murray regions – occurs during summer, typically occurring at a similar time of the year to bushfire in Victoria, South Australia and parts of Western Australia (Figure 6). For the south coast of NSW, the central and northern tablelands and parts of the northwest, fires principally occur during both spring and summer, whereas for the North Coast and the Northern Rivers regions, fires most typically occur during spring. Bushfire regimes in the latter are more similar to those observed in southern Queensland. Severe bushfires in NSW are commonly linked to periods of drought. Nevertheless, bushfires can occur outside these times due to shorter-scale variations in weather conditions. Also, humans cause fires outside peak bushfire periods and conditions.

Figure 6: Timing of bushfire danger seasons in Australia

Source: Australian Bureau of Meteorology 2007c

Bushfire history

Over the last century NSW has experienced numerous deaths, loss of property and livestock, and large areas burned in bushfires. Major bushfires and bushfire seasons are outlined in Table 1, with selected instances discussed in more detail below. A discussion of the 2001–02 and 2002–03 fires is deferred until the end of the chapter, when data from each fire agency are discussed for these two years, collectively.

1939: 13 to 14 January – On the same day that the fires of Black Friday roared across Victoria, numerous fires broke out in southern NSW, including from Port Hacking to Palm Beach, west in the Blue Mountains, and along the south coast, including at Nowra, Mittagong, Goulburn, Braidwood and Bega. On 13 January 1939 temperatures in Sydney reached 45.3°C. These temperatures followed on the back of heat waves in the previous December that resulted in the deaths of 438 people across southeastern Australia (EMA 2006a). Thirteen people died as a result of the January bushfires in NSW; at least 400 homes were destroyed, with numerous losses of stock and other property (EMA 2006a).

1968: 1 November to 1 December – Fires burned for a month in and around Sydney, the Blue Mountains and the Illawarra region of NSW. The fire claimed the lives of 14 people, the highest recorded in a bushfire in NSW history. It also destroyed 200 buildings of which at least 150 were homes. Over a million hectares was burned (EMA 2006b).

1993–94: December and January – More than 800 fires burned 800,000 ha, affecting coastal areas and nearby ranges in areas from north of Sydney to the Queensland border and south of Sydney to Batemans Bay. These fires were notable as they simultaneously intruded into parts of the Sydney and nearby metropolitan areas, like never before. Approximately one percent of NSW was burned. Despite the severity of the fires, only four people died but 206 houses were destroyed, and 80 other premises were lost. However, in a subsequent report on the fires, 'A state ablaze: the January 1994 fires', the NSW Rural Fire Service states 'Despite the low level of loss, death and injury, there is no room for complacency. Fires similar to those of 1993–94 will occur again (EMA 2006c).

Indeed such seasons have occurred again in NSW, with four adverse seasons in the 10 bushfires seasons between 1993–94 and 2002–03. Collectively these fires resulted in 10 deaths, the loss of 411 houses, with over 2,200,000 ha burned. Almost half of this burned during 2002–03, when there were 151 days of severe fire activity recorded in a single season. The 2001–02 and 2002–03 seasons are discussed in more detail at the end of this chapter, and additional information can be found at NSWRFS (2001, 2003).

Table 1: Fire history of New South Wales

Date	No. of deaths	Area of fire (ha)	Losses	Location(s)
1915 November – 1916 January		Not known		Many districts, Holbrook, Howlong
1926 January – February		Not known	Property losses	Junee, Canberra, Albury, Rydal, Wagga Wagga
1926 October – 1927 December	8	>2,000,000		North Coast and Newcastle district, Canberra, Albury, Dubbo, Griffith
1938 December – 1939 January	13	73,000	Many houses, pine plantations	Dubbo, Lugarno, Snowy Mountains, Canberra
1944 November – December	2		150 houses, churches	Blue Mountains, Lochinvar
1951 November – 1952 January	11	>4,000,000		Worst affected district around Wagga Wagga and Pilliga in the north-west
1957 December – 1958	5	>2,000,000	158 houses, many businesses, shops, schools, churches and a hospital	Blue Mountains, Leura
1964–1965 March	5	530,000	Houses, farms, forests	Snowy Mountains, Southern Tablelands, Nowra, Sydney
1968 September – 1969 January	14	>2,000,000	161 buildings (80 houses)	South Coast (Sept.), much of the coastal and nearby range areas of the state
1969–70	1	280,000		Roto and Riverina areas
1972 December – 1973 January		300,000		Kosciouszko National Park, Eden, Queanbeyan, Burrinjuck Dam
1974–75	6	4,500,000	50,000 stock, 10,170 km fencing	Bourke to Balranald, Cobar Shire, Moolah–Corinya–most of the Western Division
1976–77		74,000	3 houses	Hornsby, Blue Mountains
1977–78	3	54,000	49 buildings	Blue Mountains
1978–79		>50,000	5 houses, heavy stock loss	Southern Highlands, south-west slopes
1979–80	13	>1,000,000	14 houses	Mudgee, Warringah and Sutherland Shires, majority of council areas, Goulburn and South Coast
1982–83	3	60,000	$12 million of pines	Blue Mountains, Sutherland and southern NSW
1984–85	5	3,500,000	40,000 stock, $40 million damage	Western Division
1986		10,000		Mount Kaputar National Park
1987–88	4	180,000		Bethungra, Warurillah–Yanco, southeastern part of Kosciouszko National Park, Sutherland, Penrith, Wellington
1990–91		>280,000	8 houses, 176,000 sheep, 200 cattle, hundreds of km of fencing	Local government shires of Hay, Murrumbidgee, Carrathool; Hornsby, Ku-ring-gai, Cessnock, Hawkesbury, Warringah, Wollondilly, Gosford, Wyong
1991–92	2	30 fires	14 houses	Baulkham Hills, Gosford City, Wyong Shire, Lake Macquarie
1993 December – 1994 January	4	>800,000 (>800 fires)	206 houses destroyed, 80 other premises destroyed	North Coast, Hunter, South Coast, Blue Mountains, Baulkham Hills, Sutherland, most of Royal National Park, Blue Mountains, Warringah–Pittwater
1997 November – 1998 January	3	>500,000 (250 fires)	10 houses destroyed	Hunter, Blue Mountains, Shoalhaven, Menai, Coonabarabran, Padstow Heights, South Windsor – Bligh Park
2001 December – 2002 January		744,000 (454 fires)	109 houses destroyed, 6,000 head of livestock	Across 44 local government areas in the Greater Sydney, Hunter, North Coast, mid north coast, Northern Tablelands, Central Tablelands areas
2002 July – 2003 February	3	1,464,000 (459 fires)	86 houses destroyed, 3,400 stock, 151 days of severe fire activity	81 local government areas in Greater Sydney, Hunter, North Coast, Northern Tablelands, Northern Rivers, northwest slopes, northwest plains, Central Tablelands, Southern Tablelands, Illawarra, South Coast

Source: Ellis, Kanowski & Whelan 2004

Fire services

Four major agencies provide fire services in NSW; the NSW Rural Fire Service, the NSW Fire Brigades, the National Parks and Wildlife Service, and State Forests of NSW.

The **New South Wales Rural Fire Service** (NSWRFS) incorporates 2,094 brigades and about 69,300 volunteers that provide fire services for 90 percent of the state, attending structural firefighting services in more than 1,200 towns and villages. During serious bushfire situations that are declared under section 44 of the *Rural Fires Act 1997*, the Commissioner of the Rural Fire Service has responsibility to ensure coordination of all agencies in NSW. For more information about the NSWRFS see <http://www.bushfire.nsw.gov.au>.

The **New South Wales Fire Brigades** (NSWFB) is the NSW government agency responsible for managing fire emergencies in major cities and towns across metropolitan and regional NSW. The NSWFB provides coverage for 90 percent of the state's population. As of 2005–06, the NSWFB had 338 fire stations, 6,546 firefighters and 5,500 community fire unit members. More information about the NSWFB can be found at <http://fire.nsw.gov.au>.

The **National Parks and Wildlife Service** falls under the umbrella of the NSW Department of Environment and Conservation and Climate Change (DECCC). Under the *Rural Fires Act 1997*, the National Parks and Wildlife Service is responsible for managing fires on all lands under its control, including detecting and suppressing fires and implementing risk prevention programs to protect life and property from fires. DECCC also helps suppress fires on adjacent lands, as may be required under plans prepared under the *Rural Fires Act 1997*. The location of National Parks and Wildlife's jurisdiction in NSW is broadly consistent with the areas defined as 'nature conservation' in Figure 4. More information about the NSW NPWS can be found at http://www.nationalparks.nsw.gov.au.

State Forests of New South Wales (SFNSW) has statutory responsibly 'to protect life and property from wildfire; to minimise the spread of wildfire from state forests and other land managed by State Forests; and to protect state forests and their environmental values from the damaging effects of wildfire'. SFNSW jurisdiction is broadly consistent with the areas defined as 'forestry' in Figure 4. More information about SFNSW can be found at http://www.dpi.nsw.gov/forests/

It should be noted that although individual agencies principally attend to fires within their jurisdiction, this is not exclusively the case. Fire agencies may attend fires on lands outside their jurisdiction when:

- there is potential for fires on neighbouring properties to pose a danger to the resources that that organisation is entrusted to protect
- large fire campaigns require the pooling of resources
- another fire agency seeks assistance.

One of the implications of these arrangements is that more than one agency may attend the same fire, resulting in a duplication of fire details across individual databases.

New South Wales Rural Fire Service analysis

Background about the NSWRFS dataset and its analysis

Important information about the NSWRFS dataset and the methodology employed in the analysis it is outlined below:

- Data was sourced from the NSWRFS.
- The data provided included vegetation (wildfires) fires only. Hence, all references to fire in this analysis refer exclusively to vegetation fires unless otherwise indicated.

- The dataset included fires from 1999–2000 and 2003–04.
- The database used Australian Incident Reporting System (AIRS) variables and codes.
- The cause of the fire was based on the ignition factor variable provided.
- Deliberate vegetation fires refer to all vegetation fires classified as incendiary (AIRS ignition factor code = 110 or 120) or suspicious (AIRS ignition factor code = 210 or 220).
- Natural fires refer to all fires where the ignition factor codes were 800 to 890, that is, fires that resulted from any natural condition or event. The breakdown of NSWRFS fires was; high wind 18 percent, high water including floods 0.1 percent, lightning 74 percent, and fires resulting from any other natural condition eight percent.
- Information about the form of heat of ignition was not included within the supplied database.
- Smoking-related fires included all fires where: ignition factor = abandoned or discarded materials (Ignition Factor code = 310).
- All fires attributed to children and discussed in the text were classified accidental in origin. This may only be a small subset of fires started by children, as malicious fires started by children are incorporated in the incendiary or suspicious categories and cannot be identified. Information about the age of the child was supplied.
- The regions used in the NSWRFS analysis were based on Australian Bureau of Statistics (ABS 2005b) tourism regions. The ABS defines tourism region based on smaller statistical areas that potentially crosscut suburbs and postcodes. In this study, assignation was based on the highest levels of concordance between individual suburbs and tourism regions. Hence, there is not an exact correspondence between tourism regions used in this analysis and ABS tourism regions.
- The dataset included information about the area burned.
- No information was available about fire restrictions or fire danger index.

For more detail about these methodologies see the methodology chapter.

Overview

Fires the NSWRFS attended can be summarised as:

- The NSWRFS recorded 23,664 vegetation fires across regional NSW between 1999–2000 and 2003–04. The lowest number (n=722) was recorded for 1999–2000 but it is uncertain if these data were complete given the substantially higher numbers recorded in subsequent seasons (Figure 7). Excluding 1999–2000 the lowest number of fires were observed during 2000–01 (n=3,289). The highest number was recorded during 2002–03 (n=7,349), although a large number of fires also occurred in 2001–02 (n=6,696). Both were particularly adverse seasons in NSW.
- The NSWRFS attends many different types of vegetation fire incidents from small grass fires through to large bushfires. However, almost 90 percent of all incidents attended were grassfires. The number of forest fires was exceptionally small, accounting for 2.3 percent of all fires attended. This is broadly similar to the number that occurred in heathland (1.9%). The proportion of deliberate fires was broadly similar across most vegetation types, although comparatively fewer fires in crops, vineyards and orchards resulted from this causes, and a high proportion of fires in hardwood plantations were deliberately lit.
- Deliberate causes were attributed to 18.5 percent of all fires (2.6% incendiary, 15.9% suspicious), representing 38 percent of known causes of fires attended. Fires of natural origin comprised 8.8 percent of all fires attended, comprising 18 percent of fires of known cause.

- A total of 1,173,114 ha were burned in fires the NSWRFS attended from 1999–2000 to 2003–04; 16 percent of this was burned by deliberate fires. These fires were principally identified as suspicious, as opposed to incendiary, in origin. A large proportion of all area burned by deliberate fires occurred in 2001–02. Natural fires were a critical factor in the large areas burned in both 2001–02 and 2002–03.

Cause

The cause of just over half of NSWRFS-attended vegetation fires from 1999–2000 to 2003–04 was listed as unknown. Non-deliberate causes accounted for 29.7 percent of all fires, and hence the majority of cases where causal attributions were made (Figure 8); accidental and natural causes were responsible for 14 and nine percent of fires, respectively. Incendiary causes were responsible in 2.6 percent of cases, but suspicious fires accounted for a further 15.9 percent of cases. Hence, deliberate causes – incendiary and suspicious fires combined – accounted for 38 percent of cases where causal attributions were made. This value is consistent with that observed in other jurisdictions.

The percentage of deliberate fires varied markedly between seasons, accounting for approximately 25 to 30 percent of fires in the 1999–2000 and 2000–2001 seasons, but 15 to 20 percent of fires from 2001–02 to 2003–04, when overall numbers were higher. Although there is an antipathetic relationship between the proportion of suspicious and unknown lightings, deliberate causes comprised just 35 to 37 percent of known causes from 2001–02 to 2003–04 as compared to 45 to 50 percent during the previous two years (Figure 9).

This value is somewhat lower than the value of roughly 60 percent deliberate recorded for fires that are subject to detailed fire investigation (AIC 2005). There are potentially many contributors to these disparities, as outlined below. For example, only a small number of fires are referred for investigation; deliberate causes may be over-represented within this subset as suspicious fires may be more likely to be referred for investigation. On the other hand, deliberate causes are likely to account for a higher proportion of ‘unknown’ causes as likely and obvious causes, including accidental and natural ignitions have, in many cases, already been eliminated as likely causes.

Specific ignition factors

Ignition factor: The factors responsible for ignition can be summarised into nine major categories based on the divisional category headings outlined with the AIRS codebook (Figure 10), except that incendiary and suspicious fires are combined into a deliberate category. These broadly resemble those used in Figure 8 but provide further discrimination with regard to the principle cause of non-deliberate fires; no further information is available about the ignition factor responsible for deliberate fires.

Overall, mechanical failure and malfunction, factors relating to design, construction, and installation and operational deficiencies accounted for a small proportion of fires the NSWRFS attended (Figure 10). ‘Other’ ignition factors – primarily fires resulting from rekindling of previous fires, separate or attached exposure, vehicle fires and other unclassified ignition factors – were collectively responsible for 9.4 percent of fires. Vehicle fires accounted for 8.8 percent of all non-deliberate fires, but were less numerous than fires resulting from rekindling (Figure 11).

Misuse of heat of ignition was responsible for 7.5 percent of all fires (Figure 10). All such fires were classified as accidental herein (for example, in Figure 8). These primarily arose from the inadequate control of an open fire, being singly the largest cause of accidental fires, and accounting for 17.6 percent of all non-deliberate fires (n=1,238; Figure 11). The misuse of heat of ignition category also included fires started by children and fires attributed to abandoned or discarded materials (e.g. cigarettes; see methodology chapter).

Fires started by children: Children up to 16 years of age were identified as being responsible for 96 non-deliberate fires (0.4% of all fires) the NSWRFS attended between 1999–2000 and 2003–04. Approximately 60 percent of those fires these were started by six to 12 year olds, with another one-third being attributed to 13 to 16 year olds (Figure 12). Only seven percent were started by children five years and younger.

Although the number of fires started by children in any one year was low, there was a strong correlation ($r=.97$; $p<.001$) between the number of non-deliberate child fires and the total number of fires within any one season. Hence, the highest numbers of non-deliberate child fires were recorded in 2001–02 and 2002–03 (Figure 13). In both instances, six to 12 year olds were the most frequent age group identified. This differs from the typical trend where the 13 to 16 year old group was the most commonly identified group.

Smoking-related fires: Approximately 0.7 percent ($n=169$) of fires the NSWRFS attended from 1999–2000 and 2003–04 were attributed to abandoned or discarded materials within the ignition factor variable. This figure is unlikely to be an accurate reflection of the total number of fires that were classified as smoking-related, as not all fires classified as smoking-related within the 'form of heat of ignition' variable within the AIRS database are classified as resulting from abandoned or discarded materials within the ignition factor variable (see methodology chapter).

The number of fires resulting from abandoned or discarded materials steadily increased during the observation period, with variations being largely independent of the fluctuations in total fire numbers (Figure 14). In 2003–04, fires of this cause contributed to 1.3 percent of fires the NSWRFS attended. Even this highest value was markedly lower than the rates the NSWFB recorded, but lies within the range reported for other rural fire agencies.

Vehicle fires

There are several ways that vehicles can cause a vegetation fire; for example, accidents involving a motor vehicle, the spillage of fuel, and exhaust systems. However, many fires in vegetation also arise when abandoned or stolen vehicles are set alight in vegetated areas. This may be because the vehicles have been left on a road verge or because heavily vegetated areas afford a lower risk of the offender being observed. While neither situation reflects an active attempt to set vegetation alight, the latter is genuinely an act of arson.

It is difficult to accurately document the number of vegetation fires that indirectly resulted from a motor vehicle fire and, with the exception of several land management agencies, fires resulting from the torching of abandoned or stolen motor vehicles have not been included within this report. Notably, agencies that use the AIRS database structure would principally document such fires as 'mobile property type fire' (type of incident code) as the vegetation fire is regarded secondary to the original fire. Information about mobile property-type fires was only available for four agencies and the inclusion of this data would potentially influenced the analysis for some agencies but not others. Moreover, although some information was provided about the type of location where the fire occurred ('Complex' or 'Property use') and the area burned, there is commonly a lack of information about whether the vehicle fire subsequently spread or had the potential to spread to neighbouring vegetated areas. For example, there is little information (without using more complex geospatial information) about whether a fire at a road complex occurred along a highway surrounded by thick bushland, or at the end of a street surrounded by pavement. Hence, if we only consider mobile property fires that occurred in parks, forests and reserves, we are likely to markedly underestimate the total number of mobile property fires that did or had the potential to result in a vegetation fire. The data included for some land management agencies highlights the ever-present danger that such practices can pose to natural resources (forestry and conservation). The brief discussion below also shows the potential enormity of the problem in urban and semi-urban environments.

The NSWFB attended almost 29,000 mobile property type fires from 1997–98 to 2001–02; it attended 55,730 wildfires during the same period. Of the 29,000 mobile property fires, 55.7 percent of them were either incendiary or suspicious in nature (Table 2). Approximately 62 percent of deliberate vehicle fires occurred at road complexes but the extent of vegetation in the area was unspecified in the database. A further nine percent of deliberate fires (approximately 1,500 fires in five years) occurred in parks, forests and reserves and 11 percent of deliberate fires occurred on unused property or on Crown land. A higher proportion of vehicle fires that occurred in 'parks, forests, reserves' or on 'unused property/Crown land' were deliberate when compared with mobile property fires along road complexes. To put this in perspective, if all incendiary and suspicious mobile type property fires that occurred in 'parks, forests, reserves' and 'on unused property/Crown land' were included within the wildfire analysis, the total number of incendiary and suspicious bushfires the NSWFB reported in any given season would have increased by 12 to 24 percent. This figure does not incorporate vehicles that were torched in vegetated areas, along roadways, etc. While it is recognised that only some of the deliberate vehicle fires subsequently spread to neighbouring vegetation, the potential problems posed by this practice cannot be underestimated.

Table 2: Mobile property type fires for selected agencies

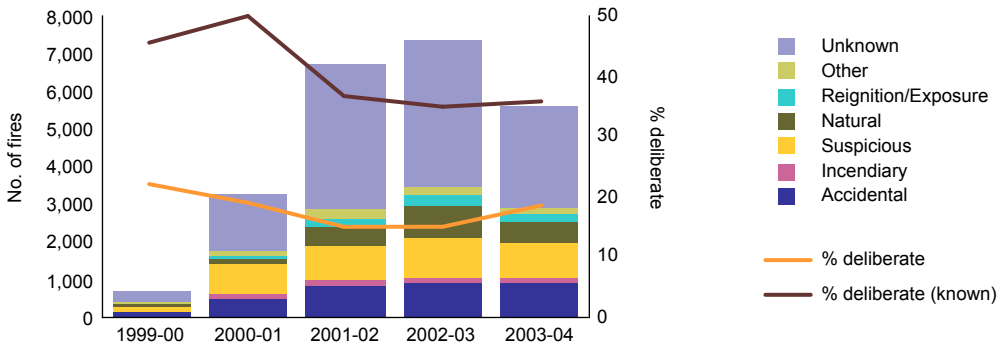
	Total no. mobile property-type fires attended 1997–98 to 2001–02[a]	% of these incendiary or suspicious	% of all (incendiary/ suspicious) vehicle fires that occurred in parks, forests, reserves	% of all (incendiary/ suspicious) vehicle fires that occurred in road complexes	% of all (incendiary/ suspicious) vehicle fires that occurred on unused property/Crown land
NSWFB	28,692	55.7	7.0 (9.2)	65.0 (61.7)	7.9 (11.1)
MFB[b]	7,960	44.4	5.6 (11.9)	71.0 (63.2)	2.9 (6.0)
QFRS[b]	8,803	10.7	3.4 (7.3)	57.7 (45.7)	8.5 (17.7)
FESA[b]	2,252	55.1	3.7 (5.5)	56.2 (47.7)	13.0 (20.0)

a: figures are incomplete for FESA and QFRS due to the gradual implementation of the AIRS database reporting scheme

b: MFB = Metropolitan Fire and Emergency Services Board (Melbourne, Victoria); QFRS = Queensland Fire and Rescue Service; FESA = Fire and Emergency Services Authority (Western Australia)

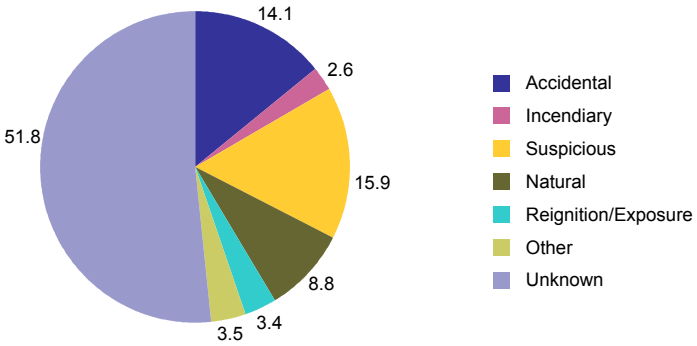
Source: NSWFB 1997–98 to 2001–02; MFB 1997–98 to 2001–02; QFRS 1997–98 to 2001–02; FESA 1997–98 to 2001–02

Figure 7: Cause of fires, by year



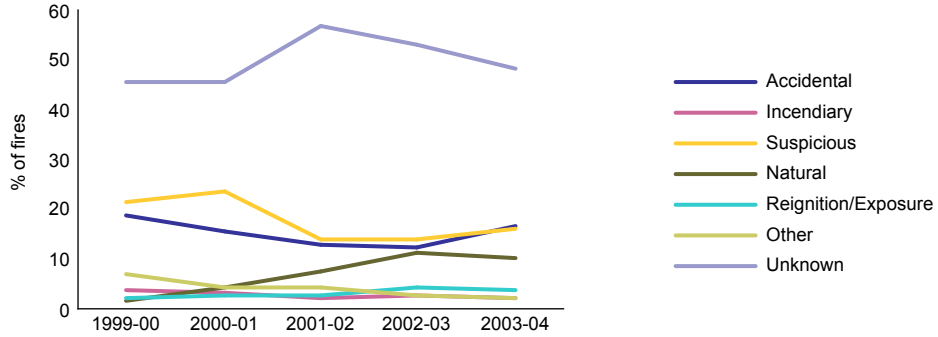
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 8: Cause of fires (percent)



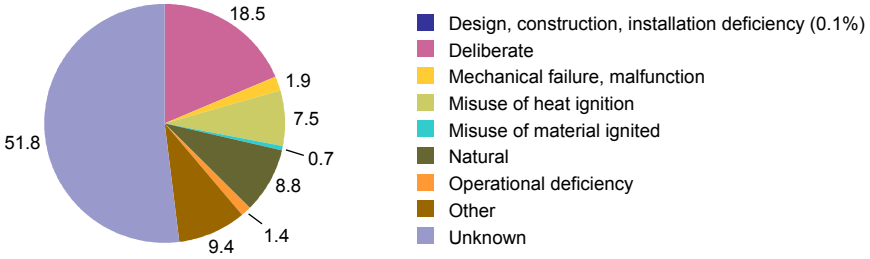
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 9: Cause, by year (percent)



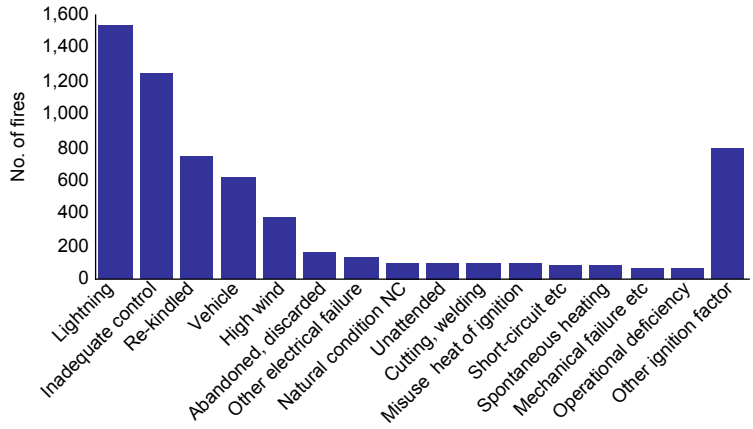
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 10: Ignition factor category (percent)



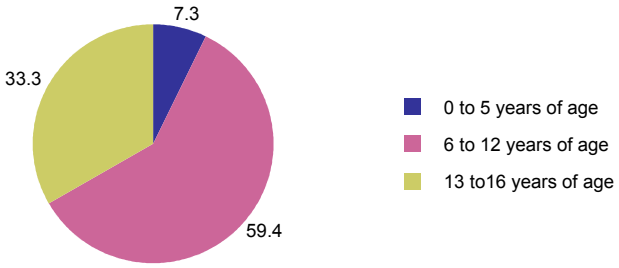
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 11: Non-deliberate fires, by ignition factor (number)



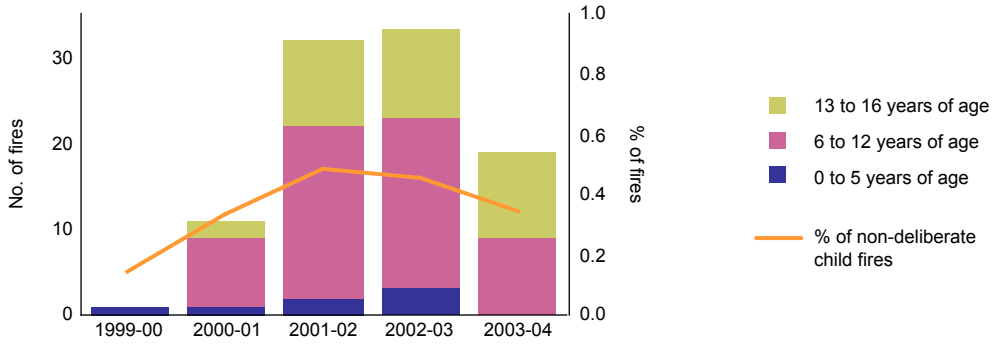
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 12: Non-deliberate child fires, by age (percent)



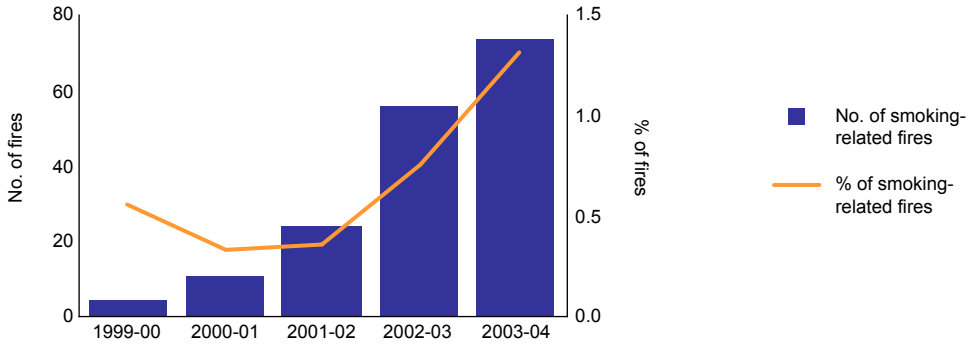
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 13: Non-deliberate child fires, by age and year



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 14: Smoking-related fires, by year



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Location

The location of fires the NSWRFS attended is examined in terms of the region in which they occurred, the concentration of fires within individual suburbs, and the tenure of land.

Region

Between one-fifth and one-quarter of **all fires** the NSWRFS attended occurred in the Sydney region (Table 3; Figures 15 and 16).

Table 3: Number of suburbs recording fire frequencies (all causes) within the indicated range

	Sydney	North Coast	Explorer Country	Hunter	Nthn Rivers	New Engl. NW	South Coast	Central Coast	Capital Country	Riverina	The Murray	Snowy Mtns	Illawarra	Blue Mtns	Outback
All fires	5,241	4,078	2,104	2,052	1,741	1,661	1,648	924	922	874	564	507	457	436	425
No. of suburbs															
Total	315	276	192	227	243	123	125	109	88	83	56	52	53	62	30
≥150	1	1	1												
100–149	7	2	2			1	1			1					
50–99	21	10	2	5	2	7	2	2	3	1		2	1		2
25–49	38	39	12	15	8	11	16	5	5	7	3	2	5	4	4
<25	248	224	175	207	233	104	106	102	80	74	53	48	47	58	24
Percentage of fires in region within suburbs with:															
≥150	4	6	9												
100–149	16	6	12			8	7			16					
50–99	29	17	9	18	6	27	8	12	18	8		21	21		35
25–49	25	31	21	24	16	24	32	18	17	27	20	14	37	33	30
<25	27	40	48	58	78	41	53	70	65	49	80	66	42	67	35

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

A further 18 percent occurred on the North Coast region, and seven to nine percent occurred each in the Explorer Country, Hunter, Northern Rivers, New England–North West, and in the South Coast regions (Table 3; Figure 16). The principal causes of vegetation fires varied markedly between regions, although in all instances considerable uncertainty arose from the high levels of unknown attributions.

Figure 15: Tourism regions of New South Wales

Source: ABS 2005b

The number of **deliberate fires** was strongly correlated with the total number of fires that occurred in each region (r=.95). Nevertheless, there was considerable variation in the percentage of fires that resulted from deliberate causes. The highest percentage of deliberate fires occurred in the Illawarra (40%), Blue Mountains (30%), South Coast (28%), Central Coast (26%) and Hunter (22%) regions. Deliberate fires only accounted for 18 percent of fires in the Sydney region. However, the cause of approximately two-thirds of fires in the Sydney region was unknown.

If we exclude unknown causes (that is, only those cases where causal attributions were made) it is evident that the highest rates of deliberate fires occurred in those regions with close proximity to Sydney; notably, deliberate fires constituted 45 to 62 percent of 'known' fire causes in the Illawarra, Central Coast, Sydney, Blue Mountains, South Coast and Hunter regions. Although most regional areas were characterised by a lower proportion of deliberate fires, high values were recorded for both the North Coast (45%) and the Outback (39%).

Natural fires were an important known cause of fires in the Explorer Country (25%), Snowy Mountains (21%), Capital Country (20%), New England–North West (18%) and the Murray regions (17%; Figure 17). In contrast, only three to four percent of fires in the Sydney, Central Coast and North Coast regions resulted from natural ignition factors.

The greatest numbers of **non-deliberate child fires** occurred in the Sydney, Explorer Country, Outback and North Coast regions, although the actual numbers did not exceed 20 in any one region, and therefore likely grossly underestimate the role of children in starting fires in all regions (Figure 18). The percentage of fires started by children in the Outback region (2.5%) was substantially higher than the regional average (0.5%).

The greatest number of **smoking-related fires** occurred in the North Coast and Sydney regions (Figure 19), with the number of smoking-related fires being broadly correlated with total fire number in each region (r=.88). The highest proportion of fires smoking-related fires occurred in the Capital Country, Snowy Mountains and Riverina regions. However, smoking-related materials contributed to less than two percent of fires in all regions.

Suburb

There is a predictable statistical relationship between the number of suburbs that recorded a fire and the total number of fires that occurred within that region (r=.92; p<.001), with fires being recorded in more suburbs in those regions that experienced the largest number of fires. This relationship also holds for deliberate fires, but the strength of the relationship is weaker (r=.77; p<.001). This may indicate that deliberate fires tended to be more concentrated; but caution is required in such an interpretation, as the generally low and sometimes variable levels of causal attribution will affect the results for deliberate fires.

Generally, suburbs recording the greatest number of fires (all causes) tended to occur in those regions that documented the greatest number of fires (Table 3; Figure 20). For example, the Sydney, North Coast and Explorer Country regions were the only ones to contain a suburb that experienced 150 fire or more in a five-year period. Suburbs recording 100 to 149 fires occurred in six regions (Figure 20); these included the Sydney, North Coast and Explorer Country regions, as well as one suburb each in the New England–North West, South Coast and Riverina regions. However, in comparison to the NSWFB, individual locations recording high numbers of fires accounted for a comparatively small proportion of all fires within that region. This reflects two separate factors. First, the NSWRFS data were examined at suburb level, whereas the NSWFB analysis was conducted at a postcode level. Second, fires the NSWRFS attended were more broadly dispersed; a natural reflection of the large geographical area that falls within its jurisdiction.

The **concentration of fires** within specific areas varied markedly between regions. These are discussed below.

Sydney: Eight suburbs in the Sydney region experienced more than 100 fires in total (all causes) in five years (Table 3), with four of those occurring in the Campbelltown statistical local area (SLA), three in the Penrith SLA, and one in the Hawkesbury SLA. Fifty or more deliberate fires were documented in one suburb. Five suburbs recorded approximately 25 deliberate fires in five years. Based on the available data, suburbs in the Sydney region that experienced 50 or more, 25 to 49, and 10 to 24 deliberate fires in five years accounted for six percent, 20 percent and 54 percent of all deliberate fires recorded by the NSWRFS in the Sydney region, respectively (Figure 21).

However, the generally low level of causal attribution documented for the Sydney region heavily influences the statistics for deliberate fires. On average only 19 percent of fires in suburbs recording 50 or mores fires in five years were identified as deliberate, but deliberate origins accounted for two-thirds of known causes in those suburbs, and up to 90 percent of known causes in those suburbs recording the highest numbers of fires overall. The highest rates actually recorded for deliberate fires (45%) occurred for two suburbs in the Campbelltown and Liverpool SLAs.

South Coast: One suburb in the Shoalhaven (Part A) SLA experienced more than 100 fires (all causes) in five years and between 40 and 70 fires occurred at six locations along the south coast (Figure 20). Of the latter, four of those were in the Shoalhaven (Part B) and two in the Eurobodalla SLAs.

High numbers (approximately 40 fires) were only recorded in the suburb that experienced more 100 fires overall. However, overall, the level of causal attributions was again low in most suburbs recording high numbers of fires, with typically only 15 to 30 percent of fires in each suburb being recorded as deliberate. However, deliberate causes commonly comprised between 40 and 70 percent of known causes in suburbs in which the NSWRFS attended more than five fires per year. There were six suburbs in the Shoalhaven (Part B) SLA, and one suburb in the Shoalhaven (Part A) SLA where the actual rate of deliberate fires was within this range. Many of these locations affected are associated with an influx of visitors, particularly during the Christmas–New Year period.

Illawarra: Fires in the Illawarra region were concentrated within a small number of suburbs. Approximately 60 percent of all fires attended by the NSWRFS in the Illawarra region, occurred in the six suburbs recording 25 fires in five years (Figure 20). Approximately one-fifth of all fires occurred in one suburb in the Shellharbour SLA that recorded 96 fires. Another two suburbs in that SLA recorded 40 and 45 fires. Between 48 to 64 percent of fires in these three locations were documented as deliberately lit. The concentrated nature of deliberate fires in the Illawarra region is exemplified by the observation that 40 percent of deliberate fires in the Illawarra occurred in two suburbs; approximately 70 percent occurred in five suburbs (Figure 21).

Hunter: Fires in the Hunter region tended to be more evenly distributed than many other areas. Notably, five suburbs recorded 50 or more fires in five years and another 20 documented 25 fires or more, but these locations only accounted for 18 and 42 percent, respectively, of all fires attended in the region (Figure 20). The highest total number of fires occurred in the Singleton, Cessnock and Muswellbrook SLAs. Higher numbers were also recorded in several suburbs within the Lake Macquarie SLA that were located close to the Sydney–Newcastle freeway.

Twenty to 25 deliberate fires were recorded in two suburbs in the Lake Macquarie SLA, but these locations accounted for a small proportion of deliberate fires in the region (Figure 21). Given that the cause of 50 to 70 percent of fires was often unknown in those suburbs recording the highest numbers of fires, actual rates of deliberate fires were likely significantly higher than the 22 percent indicated in Figure 17. Deliberate causes commonly accounted for 40 to 90 percent of known causes in individual suburbs within the Hunter region where there were 10 or more fires in five years.

North Coast: This region recorded the second highest number of fires of any region in the state. One location, in the Kempsey SLA, recorded in excess of 200 fires in five years, having the highest incidence of fires of any single location in the state (NSWRFS only). Another two locations recorded from 100 to 150 fires, with a further three – in the Coffs Harbour (Part B), Greater Taree, Great Lakes SLAs – documenting between 80 and 95 fires. However, high numbers of fires were not restricted to these locations, with the 13 locations recording 50 or more fires in five years accounted for just 29 percent of fires in the North Coast region. Locations recording 25 or more fires in five years accounted for 60 percent of all fires in the region.

The levels of causal attribution were highly variable across the North Coast region. This necessarily affected the trends observed for deliberate fires. For example, the cause of more than 80 percent of fires in one suburb that recorded 200 fires in total was listed as unknown; only 6.6 percent in that suburb were identified as deliberate. Twenty-four percent of fires in locations recording more than 30 fires in five years were deliberately lit, but the cause of 54 percent of fires in these locations was unknown. Deliberate causes were responsible for 52 percent and 44 percent of known causes for locations documenting more than 50 and more than 20 fires (all causes) in five years.

Northern Rivers: Low numbers of fires (all causes) occurred across the Northern Rivers region; only two locations – Grafton and Kyogle SLAs – recorded 50 to 60 fires in five years and only 10 locations recorded more than five fires per year. These 10 locations accounted for only 22 percent of fires in the Northern Rivers region.

Only 13.8 percent of fires in the Northern Rivers region were identified as deliberate, with two locations recording 10 or more deliberate fires in five years. However, the cause of 58 percent of fires in the region was unknown. Nevertheless, deliberate fires on average accounted for 41 percent of known causes of fires in locations recording 10 or more fires in total in five years.

Blue Mountains: No locations in the Blue Mountains region recorded more than 50 fires in five years. The highest numbers, approximately 40 fires, occurred at two locations in the Greater Lithgow and Oberon SLAs. The four locations that recorded more than 25 fires in five years accounted for one-third of fires in the region (Figure 20).

The highest number (n=28) and highest percentage (85%) of deliberate fires occurred at one location in the Blue Mountains SLA. However, this location was distinguished by having a high proportion of causal attributions (90% compared with typical values of 40 to 60%). Deliberate fires commonly accounted for 30 to 70 percent of known causes in individual suburbs recording 10 or more fires (all causes) in five years.

Explorer Country: Fires west of the Great Dividing Range were principally associated with major regional centres. Just over one-fifth of fires in the Explorer Country region occurred in the three locations that recorded 100 to 200 fires; namely Dubbo, Orange and Mudgee. A further three locations – Coonabarabran, Goulburn and Narromine – experienced 50 to 100 fires. The number and proportion of deliberate fires in Explorer Country was low, particularly given that the cause of 65 percent of fires was known. Only five suburbs in this region recorded more than 10 deliberate fires. Approximately 60 percent of all deliberate fires in Explorer Country occurred in the 12 locations that recorded five or more deliberate fires in five years. The incidence of natural fires is high across the region, with natural fires accounting for one-third to half of all fires for individual locations.

The Murray: Albury, Deniliquin and Jindera were the only locations in the Murray region that recorded more than 25 fires. Collectively, these three locations accounted for one-fifth of fires in the Murray region. Overall, the number of fires and the number of deliberate lightings was low. Albury was the only location to record more than 10 deliberate lightings. However, again the cause of almost half of all fires was unknown.

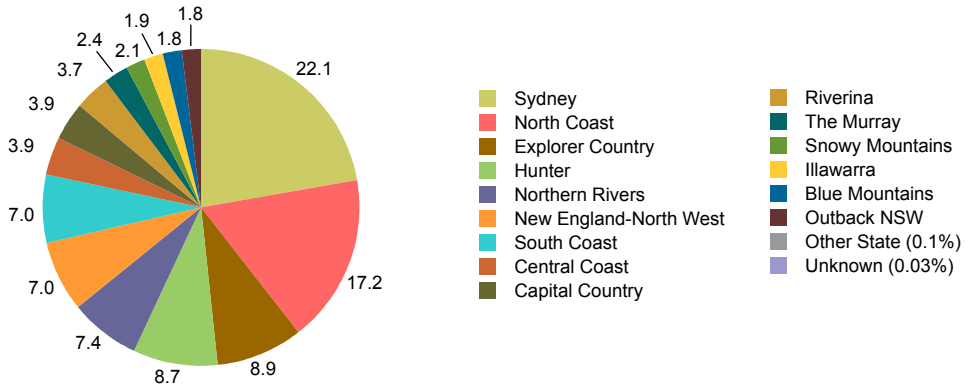
Snowy Mountains: Twenty percent of fires in the Snowy Mountains region occurred in two locations in the Cooma and Tumbarumba SLAs. These were the only locations in this region to record 50 fires in total in five years. Another two locations, both in the Tumut SLA, recorded 25 fires during the five-year period. The number and proportion of deliberate lightings was low; only three locations recorded five to 10 deliberate fires in five years. Most fires of known cause in this region resulted from accidental and natural causes.

New England–North West: The highest number of fires in the New England–North West region occurred at one location in the Inverell SLA. Fires in this location accounted for eight percent of fires in the New England–North West region. Approximately 40 percent of fires within that location resulted from accidental causes, with 44 out 55 accidental fires stemming from the inadequate control of a fire. More than 50 fires were observed in eight locations in the New England–North West region. These were primarily associated with the major urban centres of Inverell, Tingha, Tamworth, Narrabri, Armidale, Moree, Ashford and Gilgai. These locations accounted for 35 percent of fires in the district. Six locations in the New England–North West region recorded 10 or more deliberate fires. These accounted for almost half the deliberate lightings in the region. Overall, the proportion of deliberate fires was low, accounting for just 22 percent of known causes.

Outback: Two locations in the Outback region – in the Wentworth and Bourke SLAs – recorded in excess of 50 fires, collectively accounting for 35 percent of fires attended in the region. The six locations in the Outback that recorded greater than 25 fires accounted for 65 percent of fires in the region (Figure 20). More than 25 deliberate fires were recorded in a single location within the Wentworth SLA. This suburb was also characterised by a high concentration of accidental and unknown fires. Only one other location – in the Cobar SLA – recorded greater than 10 deliberate fires. Overall there were low levels of causal attribution across the region.

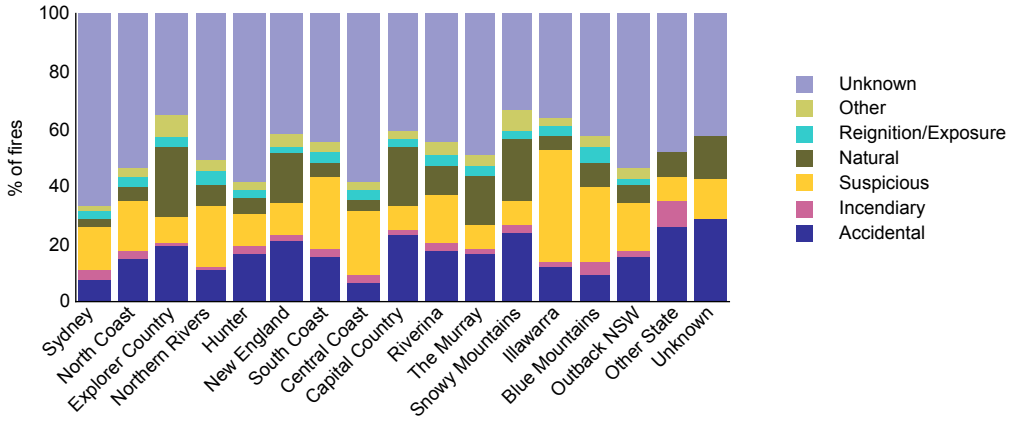
Non-deliberate child fires: There was only one case where more than five child-fires were recorded in the same suburb. This occurred in the Outback region.

Figure 16: Fires of all causes, by region (percent)



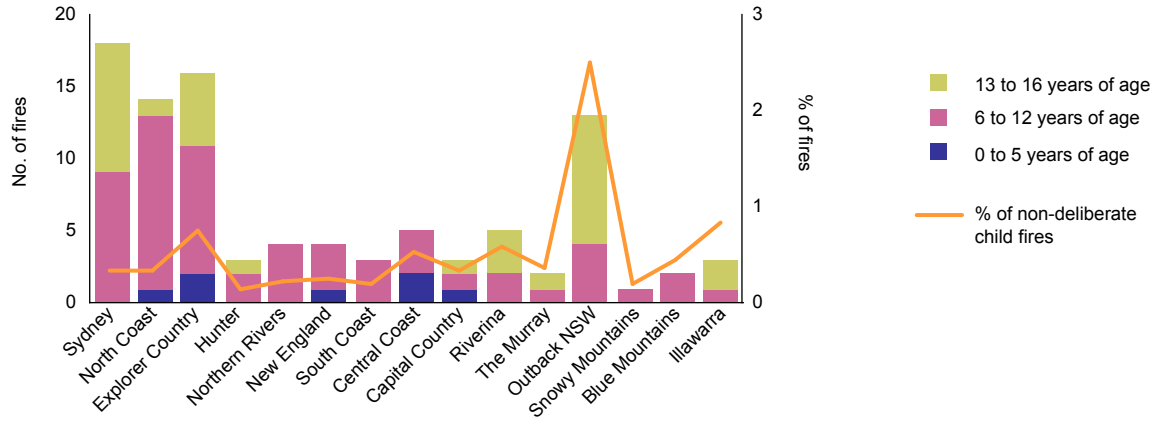
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 17: Region, by fire cause (percent)



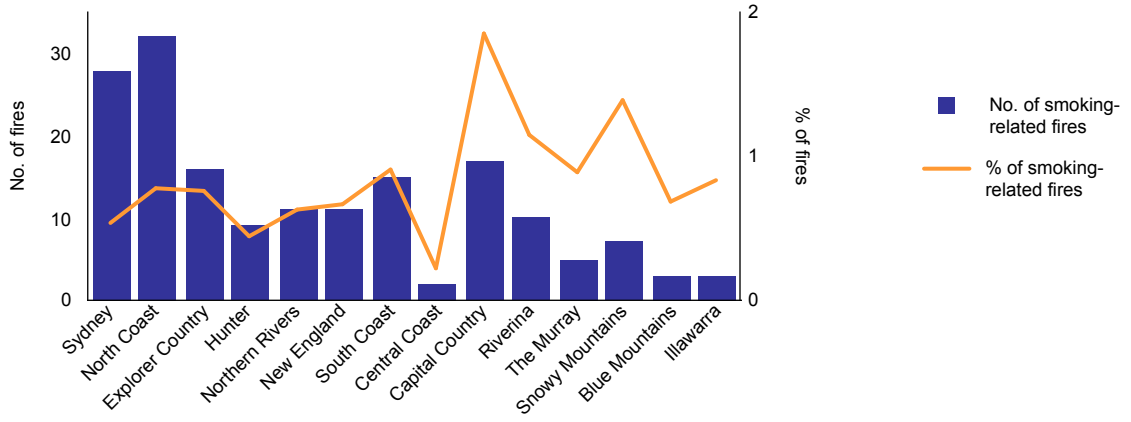
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 18: Non-deliberate child fires, by age and region



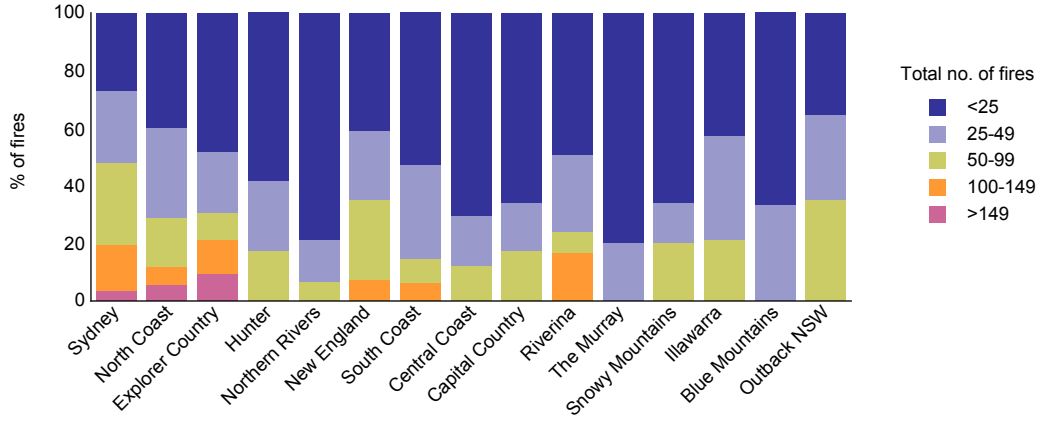
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 19: Smoking-related fires, by region



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

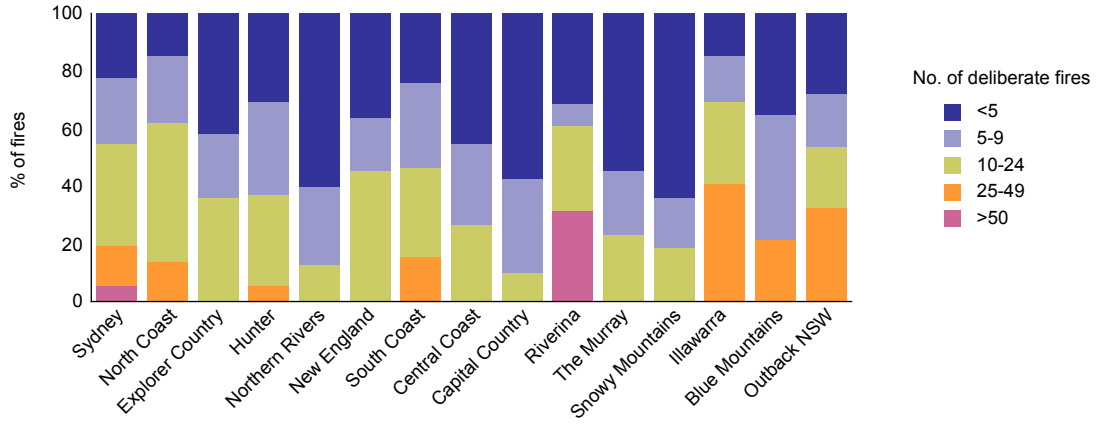
Figure 20: Fire frequency distributions, by region (percent)[a]



a: percentage of fires in each region that occurred within postcodes that recorded numbers of fires (all causes) within the specified ranges for a five-year period

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 21: Deliberate fire frequency distributions, by region (percent)[a]



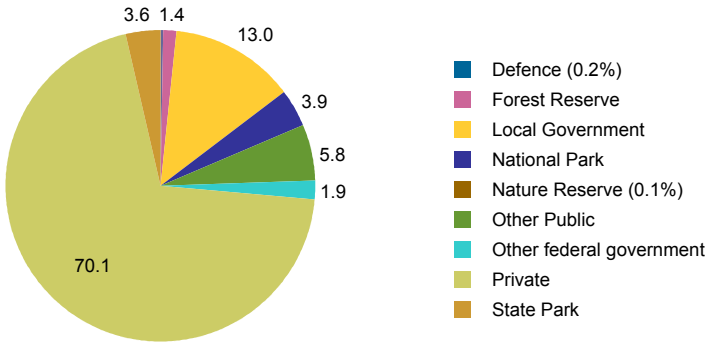
a: percentage of deliberate fires in each region that occurred within postcodes that recorded numbers of fires (all causes) within the specified ranges for a five-year period

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Tenure

The tenure of land on which fires occurred was only documented in 36 percent of cases. The majority of these were on private land, followed by local government, and other public land, national parks and state forests (Figure 22).

Figure 22: Land tenure (percent)[a]



a: only includes the 36 percent of cases where tenure was identified

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Timing

The timing of fires is examined by week of the year, day of the week and time of the day.

Week of the year

Two distinct phases of activity are observed within the NSW bushfire seasons. The first occurs from mid August to mid October, the second from mid December to the end of January. Both the devastating fires of 2001–2002 and 2003–03 occurred during the latter interval. The NSWRFS attended the greatest

number of fires (all causes) during the August to October peak (Figure 23). This trend is in marked contrast to that observed for the NSWFB.

The general distribution described above represents an amalgamation of trends as the timing of fires is influenced by many different factors. One of the most important is cause. Accidental fires typically peak during mid August, although progressively smaller peaks occurred in December–January and April–May. In contrast, natural fires principally occurred during the December–January period. The incidence of deliberate fires tended to be high during both periods.

Deliberate causes constituted the highest proportion of deliberate fires during the December–January peak, coinciding with some most devastating fires in NSW recent history. However, this largely reflects the fact that the levels of causal attribution were also markedly higher during December–January than during August–October, and any suggestion that deliberate firesetting actually increases during this potentially more adverse period should be regarded with caution.

The intimate relationship between vegetation fires and weather is clearly evidenced by the close correspondence between increased numbers of fires (Figure 24) during periods of low rainfall within individual seasons (Figure 25, Figure 26, Figure 27). The increase in numbers of fires in August coincides with onset of dry conditions in late winter and early spring across most of the state, but subtle differences were evident between seasons.

In 2000–01, spring fires were curtailed by the late October–November rains, which occurred over most of eastern NSW. A small increase in fire activity was subsequently evident around the Christmas–New Year period. These fluctuations were evident for deliberate, non-deliberate, and unknown fires alike (Figure 28).

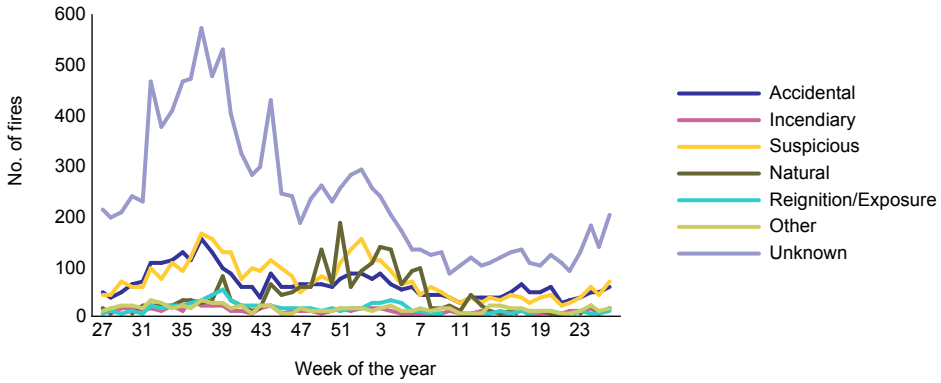
Low spring and summer rainfall occurred over much of NSW in 2001–02. This was concomitant with high numbers of fires from mid August onwards. Three distinct periods of high total fire numbers occurred in 2001–02: August, late September to mid November and late December to late January. The latter was associated with devastating fires in the Sydney and surrounding regions. In contrast to 2000–01, there were marked differences in the levels of causal attributions of fires across the season. Lower rates of causal attribution were evident during the August–October period compared to the December–January period (Figure 29). Despite this, there were strong parallels between fluctuations in non-deliberate and deliberate fires across the season. A spike in the number of deliberate fires was evident in the last week of December, when fire conditions were particularly adverse, but otherwise the number of deliberate fires remained comparatively low during the December–January period. The 2001–02 bushfire season was curtailed by February rains across most of eastern parts of the state.

High numbers of fires were evident as the 2001–02 season progressed, although again the most extensive and destructive fires occurred during the December–January period. July 2002 to February 2003 was coincident with exceptionally low winter, spring and summer rainfall conditions across most of NSW – a manifestation of the 2002–03 El Niño-like conditions. Notable disparities between this and previous seasons included the markedly earlier start to the season and the consistently high, as opposed to spiked, distribution of fire numbers. There were marked differences in the levels of causal attributions across that season, with the level of ‘known’ attributions increasing as the bushfire season progressed (Figure 30). However, in contrast to 2001–02 the ratio of deliberate to non-deliberate fires decreased as the bushfire season progressed; deliberate fires were noticeably less frequent than non-deliberate fires from November to February.

Strong parallels are evident between the 2003–04 and 2000–01 fire seasons; a distinct spike in spring fires (August to early October), with a smaller spike during the Christmas–New Year period. Low summer fire numbers were commensurate with moderate but consistent spring and summer rainfall. The most unusual aspect of 2003–04 was the subsequent increase in fire numbers during the April to June period. This was commensurate with abnormally low autumn and early winter rainfall.

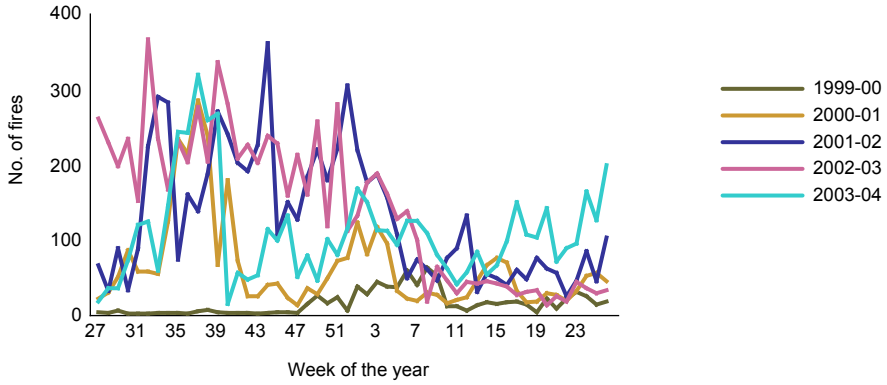
The distribution of fires varied markedly across the state, reflecting different climatic regimes across the state, but also regional differences in the principal causes of fires. The majority of fires in the South Coast, North Coast and Hunter regions occurred from August to October (weeks 32 to 45; Figure 31). The majority of fires in the Sydney region also occurred from August to October, but more fires occurred during December–January. The overwhelming majority of fires the NSWRFS attended in the Explorer Country occurred from December–January, in part a reflection of the high incidence of natural fires in that region at that time. Fires in the Northern Rivers region principally occurred during the drier months of winter and spring.

Figure 23: Week of the year, by cause (number)



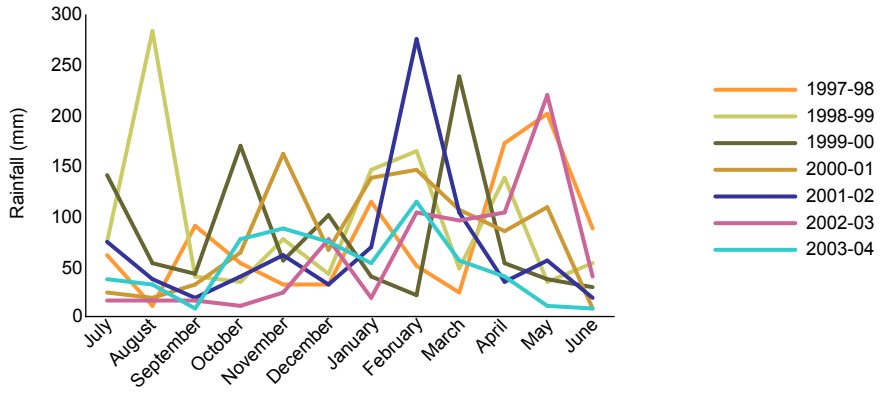
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 24: Vegetation fires each year, by week of the year (number)



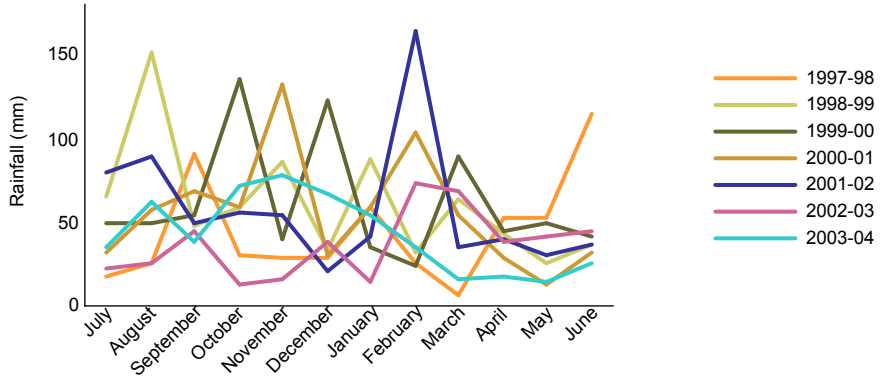
Source: NSWRFS 2000–01 to 2003–04 [computer file]

Figure 25: Metropolitan West, district average rainfall, 1997–98 to 2003–04 (number)



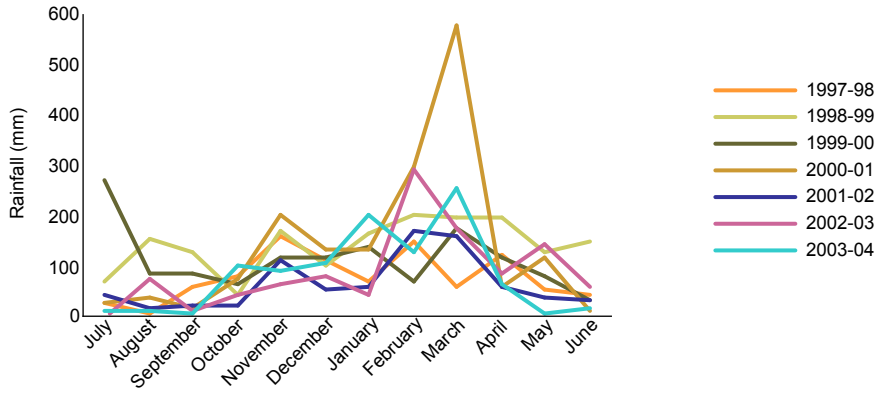
Source: Australian Bureau of Meteorology [computer file]

Figure 26: Southeast Tableland, district average rainfall, 1997–98 to 2003–04 (number)



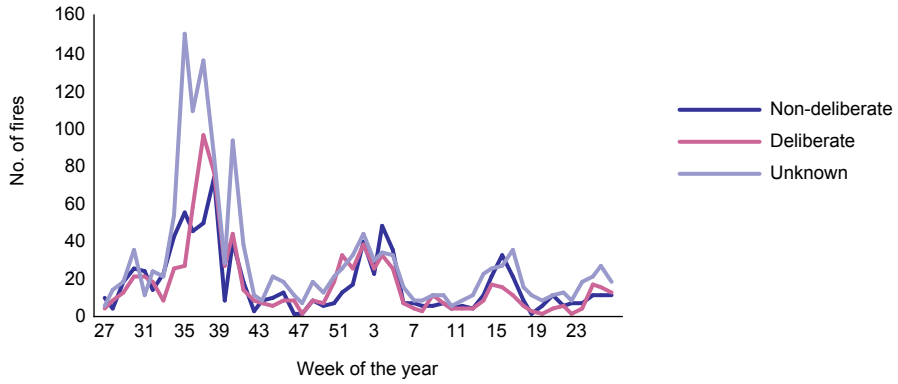
Source: Australian Bureau of Meteorology [computer file]

Figure 27: Lower North Coast, district average rainfall, 1997–98 to 2003–04



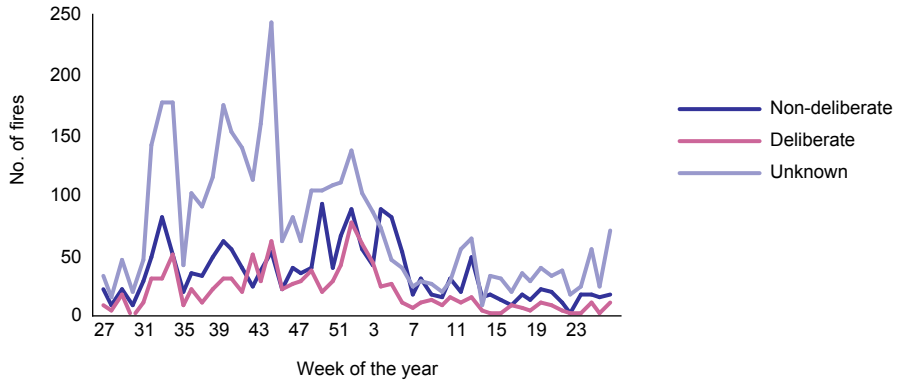
Source: Australian Bureau of Meteorology [computer file]

Figure 28: Week of the year, by cause for 2000–01 (number)



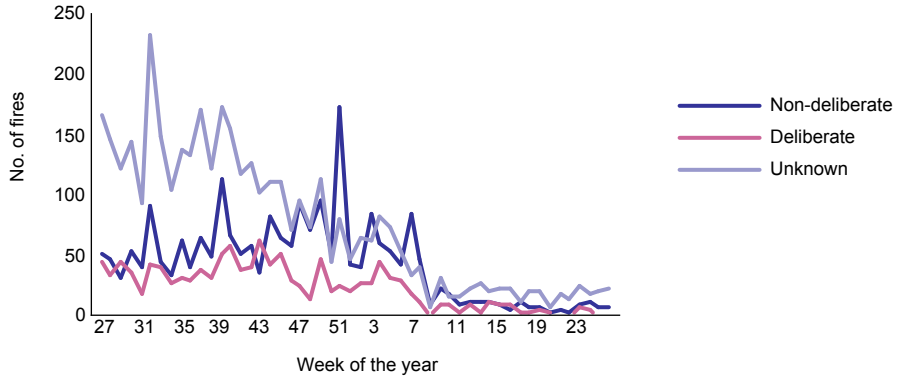
Source: NSWRFS 2000–01 [computer file]

Figure 29: Week of the year, by cause for 2001–02 (number)



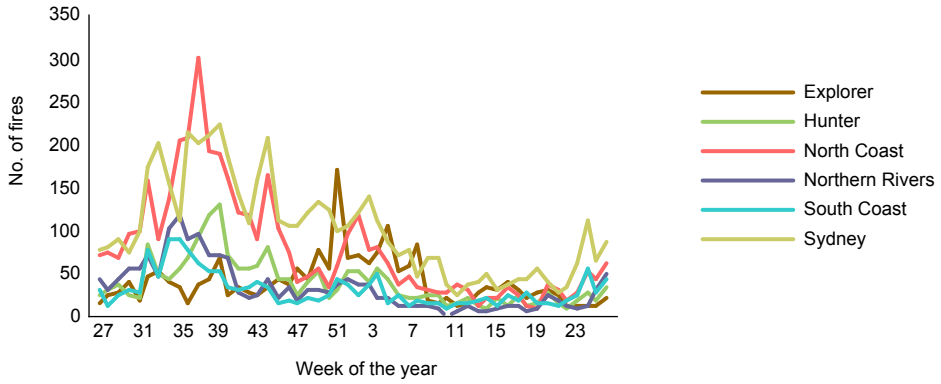
Source: NSWRFS 2001–02 [computer file]

Figure 30: Week of the year, by cause for 2002–03 (number)



Source: NSWRFS 2001–02 [computer file]

Figure 31: Week of the year, by region (number)



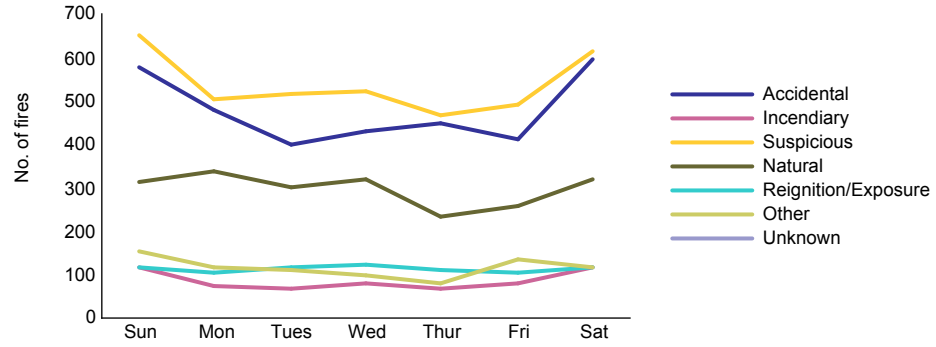
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Day of the week

On average, the NSWRFS was 30 percent more likely to attend fires on Saturday and Sunday than on the average weekday. However, the likelihood of weekend fires was cause-specific. Notably, fires identified as incendiary were approximately 50 to 55 percent more likely to occur on a weekend whereas suspicious fires were only 23 and 30 percent more likely to occur on Saturday and Sunday respectively (Figure 32). Accidental fires were the only non-deliberate causal category to record a weekend effect, being 33 to 37 percent more likely to occur on Saturday and Sunday. Fires of unknown cause were also likely to be 33 to 38 percent more likely on weekends, highlighting that the majority of these fires resulted from human causes, be that accidental or deliberate in nature.

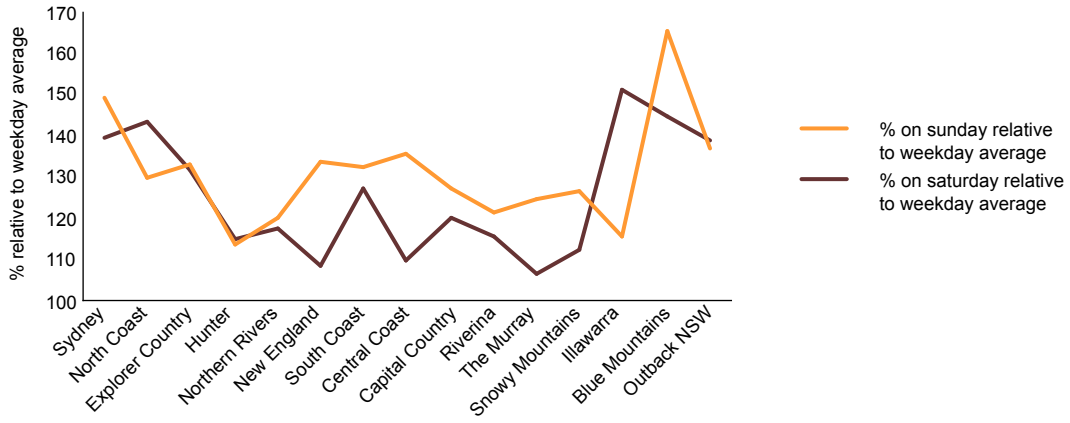
The tendency for the numbers of fires to increase on weekends was observed across all regions of NSW, although the degree to which this manifested was variable (Figure 33). Notably, high proportions of weekend fires were particularly evident for Sydney, the Blue Mountains, Illawarra, North Coast, and Outback regions. In the Blue Mountains, fires were 45 percent more likely to occur on Saturday and 65 percent more likely to occur on Sunday than on the average weekday. In the Sydney region, 39 and 49 percent of fires occurred on Saturday and Sunday respectively. Overall, lower weekend biases occurred in more distant regional areas. Outback NSW was a notable exception. Some regional differences in the tendency for Sunday versus Saturday fires were also evident.

Figure 32: Day of the week, by cause (number)



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 33: Weekend fires relative to the weekday average, by region[a]



a: regions arranged in order of decreasing total fire number

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Time of day

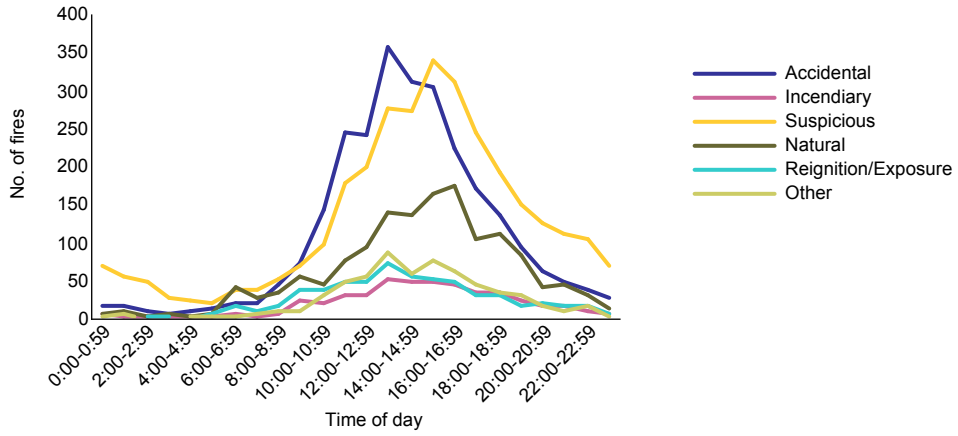
Data on the time of day was available for 78 percent of fires but detection time and cause was only known in 38 percent of cases. The timing of fires varied subtly between causal categories (Figure 34). Peak numbers of fires resulting from accidental, other and reignition/exposure occurred between 1 and 2 pm, whereas the highest number of natural fires occurred between 3 and 5 pm. As observed elsewhere, the trend for suspicious fires differed somewhat to that observed for accidental fires, with peak numbers occurring around 3 to 5 pm. There was also a greater incidence of deliberate fires during the night.

Thirty-two percent of suspicious fires occurred between 6 pm and 6 am, compared to 18 percent of accidental fires. Similarly, 13 percent of suspicious fires occurred between 10 pm and 6 am as compared with five percent of accidental fires. Interestingly, there were no clear discernible differences between the timing of incendiary and accidental fires, possibly indicating that suspicious and incendiary fires derive from different causal subsets.

The proportion of all deliberate daytime fires (8 am to 6 pm) that occurred between 4 and 6 pm varied substantially across regions, from a low of 21 and 25 percent in the Central Coast and Snowy Mountains respectively, up to 41 and 42 percent in the Murray and Outback regions (Figure 35). Between 34 and 37 percent of all daytime deliberate fires in the Sydney, Explorer Country, Illawarra, Riverina and Blue Mountains regions occurred within this timeframe.

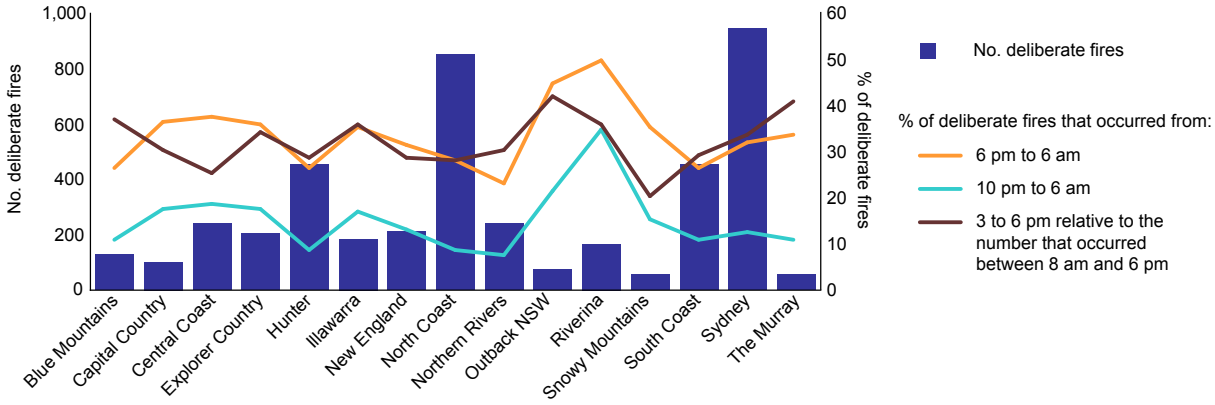
The Riverina and Outback regions recorded the highest proportion of deliberate fires between the hours of 6 pm and 6 am. The Riverina also experienced a substantially higher proportion of fires that occurred between the hours of 10 pm and 6 am. A low percentage of deliberate NSWRFS-attended fires in the Hunter, Northern Rivers and South Coast regions occurred between 6 pm and 6 am.

Figure 34: Time of day, by cause (number)



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 35: Deliberate fires, by time of day for each region



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Area burned

The area burned by fire was only available in 40 percent of cases. Large fires typically accounted for the greatest total area burned and are statistically more likely to be recorded than small fires. Hence, estimates based on the absolute areas burned are likely to be quite accurate.

The size distribution of fires the NSWRFS attended is largely in accord with that observed elsewhere; the majority of fires were small, and the total number of fires decreased with increased size, albeit with the characteristic humps for the 10 to 49.9 ha and the 100 to 499 ha categories. Of those fires where the size was known, 40 percent burned less than one hectare and three-quarters burned less than 10 ha.

Although this general distribution was evident irrespective of cause (Figure 36), there were subtle differences in size distribution of fires based on cause (Figure 37). Overall, the proportion of natural fires increased with increased fire size. The largest natural fire occurred in January 2003, in the Snowy Mountains region. This was the only fire of any cause during the 1999–2000 to 2003–04 period to exceed 100,000 ha. There were 33 natural fires greater than 1000 ha, 12 fires of between 2,000 and 5,000 ha, and eight greater than 10,000 ha.

The proportion of accidental fires remained comparatively constant across of area categories up to 50,000 ha. The largest accidental fire, which was caused by inadequate control of an open fire, burned 30,000 ha in the Hunter region during November 2001. All other non-deliberate fires were comparatively small. The largest fire resulting from 'other' causes burned 2,000 ha in the New England–North West region. The largest fire resulting from the rekindling of a fire occurred in the Northern Rivers region in January 2003.

Although there was some tendency for suspicious and incendiary fires to be underrepresented within the moderate-sized fire categories, deliberate causes accounted for an unusually high proportion of greater than 5,000 ha fires. The overwhelming majority of large deliberate fires occurred during 2001–02. The largest recorded incendiary fire burned 10,000 ha in the Northern Rivers region in March 2002. Another four suspicious fires burned 10,000 ha or more in NSW during the 2001–02 season. The largest suspicious fire occurred in the Hunter region on 21 December 2001 and burned 82,000 ha. During the subsequent week another two suspicious fires burned 21,300 ha to the west of Kempsey (North Coast) and 10,000 ha in the New England–North West region. Another fire of unknown cause burned a further 10,000 ha in the Hunter region between Christmas and New Year in 2001–02. The only other large suspicious fire burned 10,000 ha on the North Coast during September 2002.

A total of 1,173,114 ha were burned in fires the NSWRFS attended in the 40 percent of fires for which area data was available. The greatest total area burned in any one season occurred during 2002–03 (Figure 38). This was followed closely by 2001–02.

Statistics about the total area burned are strongly influenced by large fire events. For example, in 2001–02, 10 fires burning 10,000 ha or more accounted for 77 percent of the total area burned. Due to the higher than normal incidence of large suspicious fires, suspicious causes were a significant factor in the total area burned in 2001–02. Similarly, almost 60 percent of the 2002–03 total was burned in a single fire in the Snowy Mountains fire of January 2003; and, collectively, the five natural fires that burned in excess of 10,000 ha (including the Snowy Mountains fire) were responsible for 71 percent (391,906 ha) of the total area burned in 2002–03.

Overall, 52.9 percent of the total area burned in fires the NSWRFS attended from 1999–2000 to 2003–04 resulted from natural causes (Figure 39). The overwhelming majority of these occurred during 2002–03, and to a lesser extent 2001–02 (Figure 38).

Incendiary and suspicious fires accounted for 1.4 and 15 percent of the total area burned during the five-year period, respectively. Approximately 145,000 ha were burned by deliberate fires in 2001–02, accounting for 30 percent of the total area burned in that year. Deliberate fires burned just over 30,000 ha in 2002–03, but owing to the large area burned by natural fires, this accounted for only six percent of the total area burned.

More than half the total area burned in NSW was burned in the Hunter and Snowy regions (Figure 40); a result of the very large fires that occurred in those regions during 2001–02 and 2002–03. Between six and 10 percent of the total burned occurred each in the Capital Country, New England, North Coast, and Sydney regions.

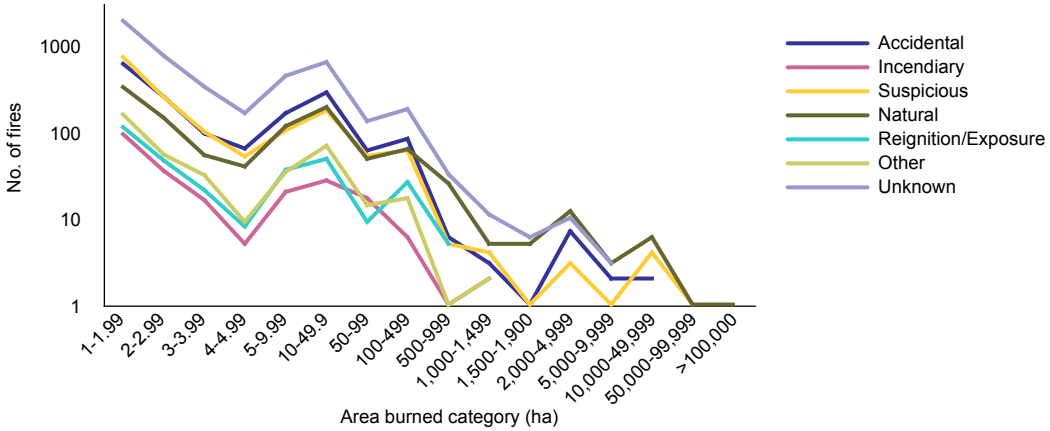
Natural fires were responsible for burning the greatest proportion of land in the Blue Mountains Capital Country, Explorer Country, Illawarra, Outback, Snowy Mountains and Sydney regions (Figure 41). Suspicious fires accounted for 40 to 45 percent of the total area burned on the North and South Coast regions, 35 percent of the land burned in the Hunter and 20 to 30 percent of land burned in the Central Coast, Northern Rivers, and New England–North West regions.

Three-quarters of the total area burned in fires NSWRFS-attended was in national parks with a further 6.4 and 3.9 percent being located in state parks and forest reserves respectively (Figure 42). This highlights

the potential overlaps that exist between the NSWRFS and NSW NPWS and, to a lesser extent, the SFNSW databases.

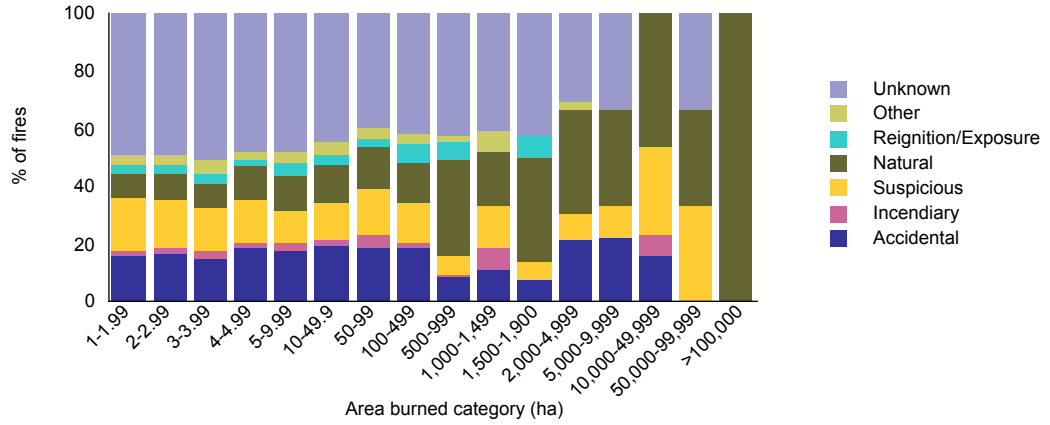
More than half the area burned was in native grasslands (Figure 43). The 28 percent 'other' refers to alpine vegetation burned during 2002–03. Approximately eight percent of the total area burned was in native eucalypt forests. A high proportion of the total area burned in mallee, native Eucalypt forests, softwood plantations and other (primarily alpine vegetation) were as a result of natural causes (Figure 44). In contrast, accidental causes were responsible for the greatest areas burned in crops, vineyards and orchards, other grasslands and unknown vegetation categories. Deliberate fires formed a higher proportion of the total area burned in native grasslands, 'other forests', and to a lesser extent in heathland, other grasslands and unknown vegetation types. A single fire of 'other' causes (unspecified) was the only known cause of land burned in plantation hardwood forests.

Figure 36: Area burned category (hectares), by cause (percent)



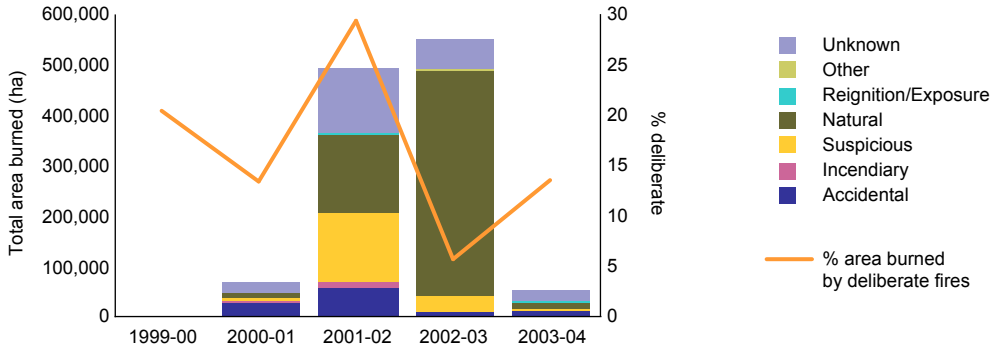
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 37: Area burned category, by cause (percent)



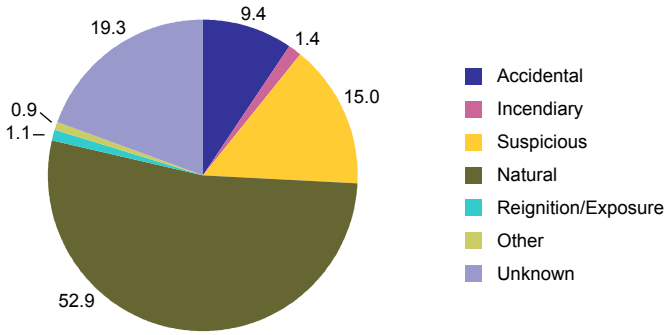
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 38: Area burned, by cause each year



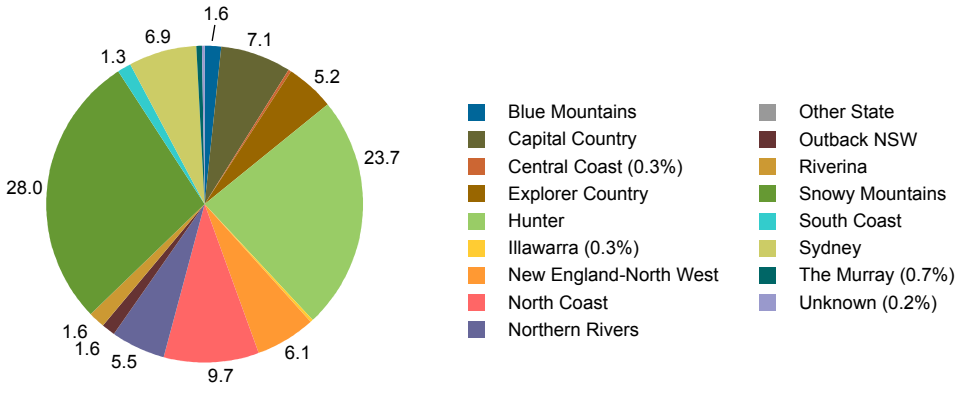
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 39: Total area burned, by cause (percent)



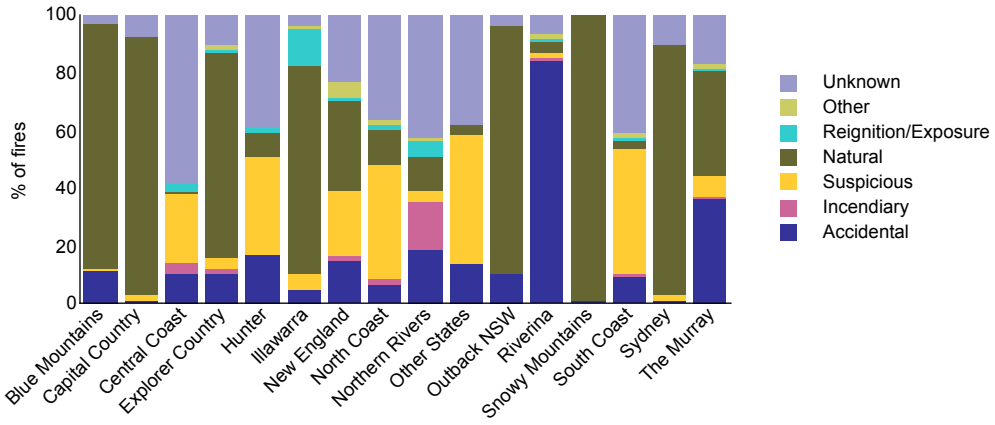
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 40: Total area burned in each region (percent)



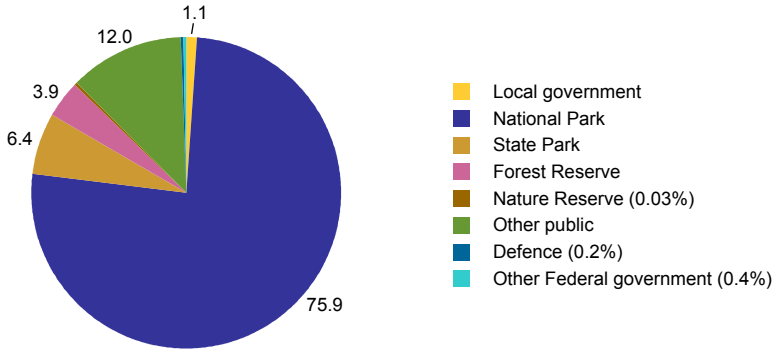
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 41: Area burned in each region, by cause (percent)



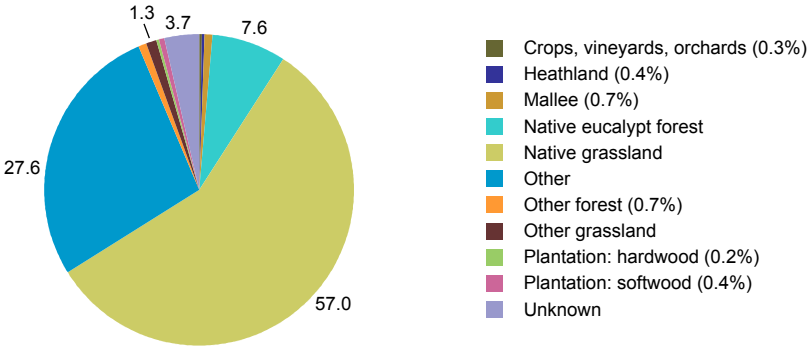
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 42: Total area burned, by tenure (percent)



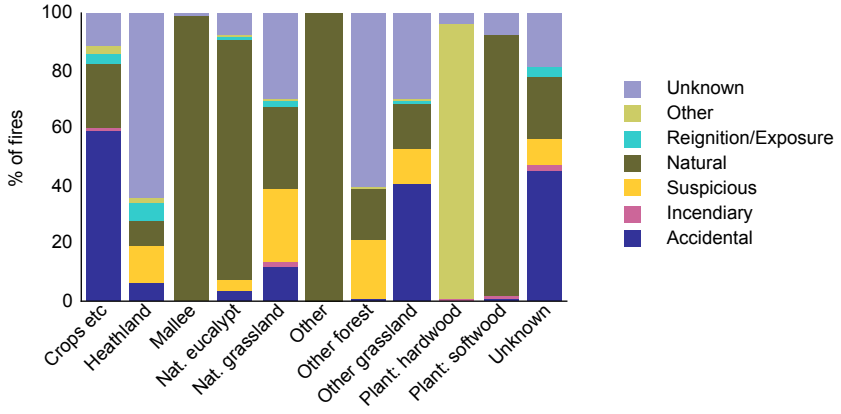
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 43: Total area burned, by vegetation-type (percent)



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 44: Total area burned in each vegetation type, by cause (percent)



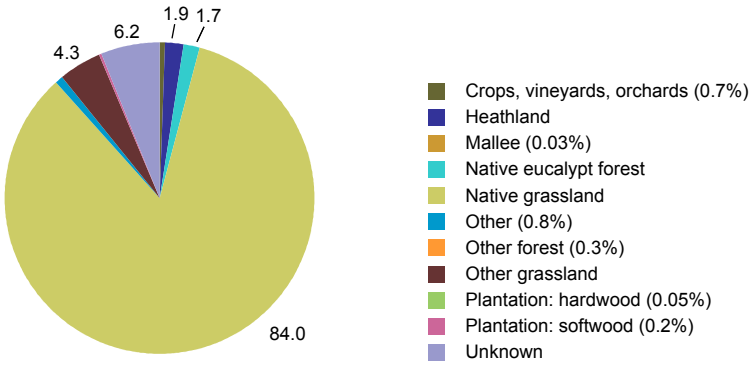
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Vegetation

The overwhelming majority of fires the NSWRFS attended were in native grasslands (84%; Figure 45). Fires in heathland and native eucalypt forests accounted for 1.9 and 1.7 percent of fires. Approximately 0.3 percent of the fires attended occurred in either hardwood or softwood plantations.

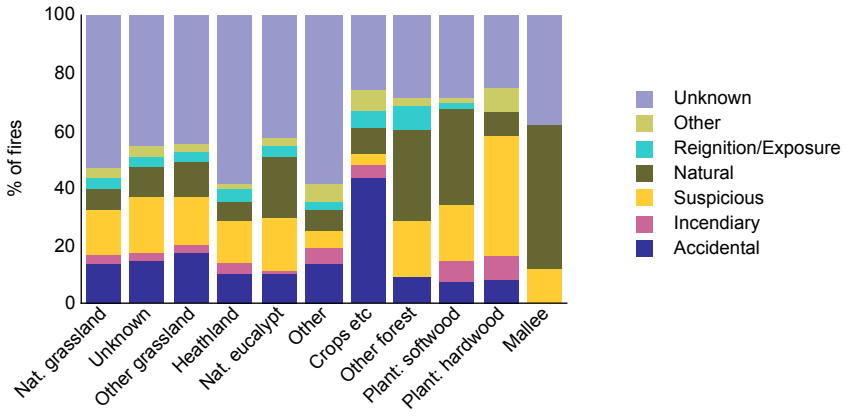
The proportion of deliberate fires was remarkably uniform across strongly contrasting vegetation types, although a considerably lower proportion of fires within the crops, vineyards, orchards, and 'other' vegetation categories resulted from this cause (Figure 46). In contrast, almost half of all fires in hardwood plantations arose from this cause. Natural causes accounted for a comparatively high proportion of fires in native eucalypt forests, 'other forests', softwood plantations and mallee. Nevertheless, the greatest number of fires resulting from this cause occurred in native and other grasslands.

Figure 45: Vegetation type (percent)



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 46: Vegetation type[a] by cause (percent)



a: Vegetation categories arranged in order of decreasing fire frequency

Source: NSWRFS 1999–2000 to 2003–04 [computer file]

New South Wales Fire Brigade analysis

Background about the NSWFB dataset and its analysis

Important information about the NSWFB dataset and the methodology employed to analyse it is outlined below:

- Fire data were sourced from Australasian Fire Authorities Council (AFAC).
- The database included data from 1997–98 to 2001–02.
- The dataset provided included fires of all causes (structural, vehicle, vegetation and other). Only vegetation fires (AIRS wildfires; Type of Incident code 160 to 179) were analysed. Hence, all references to fire refer to vegetation fires, and do not include other fire categories.
- The data were classified using Australian Incident Reporting System (AIRS) classification codes.
- The cause of fires was defined using the ignition factor variable.
- Deliberate fires include all fires classified as incendiary (AIRS ignition factor code = 110 or 120) or suspicious (AIRS ignition factor code = 210 or 220).
- Natural vegetation fires refer to all fires where the ignition factor codes were 800 to 890, which incorporate any fire resulting from a natural condition or event. For the NSWFB the breakdown of specific causes of natural fires was: high wind 27.3 percent, lightning 30.1 percent, high water (including flood) 0.9 percent, and any other natural condition (not classified [NC]/insufficient information to classify further [IO]) 41.5 percent.
- The dataset included the form of heat of ignition variable.
- Smoking-related fires were classified on the basis of: 'Form of heat of ignition'='Heat from smokers' materials' (AIRS codes 300 to 390). The cause of smoking related fires was: 82 percent accidental, 6 percent incendiary, 7 percent suspicious, and 4 percent unknown.
- All fires started by children were identified within the database as resulting from children playing and are therefore considered non-deliberate or accidental in origin. No information was available about the number of malicious fires started by children, as these fires are classified as incendiary or suspicious, and cannot be delineated from other fires included within these categories.

- The database included information about 'type of incident'.
- Regions used in the NSWFB analysis are based on ABS (2005) tourism regions. However, there is not an exact correspondence between tourism regions used in this analysis and ABS tourism regions. In this study, assignation was based on the highest levels of concordance between postcode (provided) and tourism regions, but ABS tourism regions were constructed from smaller statistical areas that potentially crosscut suburb and postcode boundaries.
- Statistical subdivisions (SSDs) and statistical local areas (SLAs) were used to examine the distribution of fires in specific areas of NSW. Although the general structure and terminology used for SSDs and SLAs follows ABS guidelines (ABS 2001a), fundamental differences exists between the SSD and SLA used in this report and that defined by the ABS. SLA were generated from the highest levels of concordance between postal areas and SLAs using ABS (2001b) guidelines. In contrast, ABS-defined SLAs commonly crosscut postal areas and postcodes.
- The dataset supplied did not include information about the area burned.
- No information was available about the fire danger or fire restrictions at the time the fire occurred.

For more detail about these methodologies see the methodology chapter.

Overview

Fires the NSWFB attended can be summarised as follows:

- NSWFB records indicate attendance at 55,730 vegetation fires for the seasons encompassing 1997–98 to 2001–02, representing an average of over 11,000 fires per year. Actual attendances varied between a low of 7,623 in 1998–99 and 8,034 in 1999–2000 up to 14,347 in 2001–02 (Figure 47). These yearly variations were in keeping with the observations from other NSW fire agencies.
- The NSWFB attended a wide variety of incident types ranging from small vegetation fires through to very large bushfires. Sixty percent of all fires attended were grassfires, with a further 17 percent delineated as scrub, bush, and grass mixtures; another 18 percent were small vegetation fires. These types of incidents accounted for the bulk of vegetation fires attended in any one region, although the proportions of individual categories varied between regions. Forest and wood fires (greater than one hectare) comprised less than one percent of all fires attended overall, but up to five percent of fires attended in the Blue Mountains region. Overall, the proportion of deliberate fires was remarkably similar across different incident types. It is not possible to determine how many of the fires were, or had the potential (under adverse conditions) to develop into, a bushfire, although some inferences can be made.
- Deliberate causes accounted for 37 percent (14.6% incendiary, 22.6% suspicious) of all fires the NSWFB attended. This represents 56 percent of known causes of fires.
- Forty-two percent of all fires the NSWFB attended occurred in the Sydney region, with a comparatively high number also occurring in the Hunter, Illawarra, North Coast and the New England–North West regions. High rates of deliberate fires were observed across all areas that record high numbers of fires.

Cause

The cause of fires the NSWFB attended was assigned to two-thirds of all fires. Incendiary causes accounted for 14.6 percent of all fires, with deliberate fires being suspected in a further 22.6 percent of cases (Figure 48). Deliberate (incendiary and suspicious combined) fires accounted for 37 percent of all fires, representing 56 percent of cases where cause was attributed.

The percentage of deliberate fires decreased from 40 to 45 percent in 1997–98 and 1998–99 to 33 to 34 percent from 1999–2000 to 2001–02 (Figure 47), but this was counterbalanced by a higher proportion of fires of unknown causes for the latter two seasons. The highest number of deliberate fires occurred in 1997–98, followed by 2001–02 and 2000–01.

Comparatively few NSWFB-attended fires were the resulted of natural causes, accounting for just one percent of all fires attended. This compares with 8.8 percent for the NSWRFS. Accidental causes were attributed to 26 percent of all NSWFB fires.

Specific ignition factors

Form of heat of ignition: The form of heat of ignition was attributed in 60.7 percent of cases. Open flames or sparks were responsible for 50 percent of all fires (Figure 49), being singly the largest cause of both non-deliberate and deliberate fires (Figure 50). Other important causes of non-deliberate fires included smoking-related materials, fires started by hot object or friction and to a lesser extent fires started by natural or electrical sources.

Fires started by children: Non-deliberate fires started by children 16 years or younger accounted for 15.5 percent of all fires the NSWFB attended from 1997–98 to 2001–02. In the majority of cases (42%) the age of the child was unknown (Figure 51). Of those where the age was recorded, most were lit by 13 to 16 year olds (37% of non-deliberate child fires) and to a lesser extent 6 to 12 year olds (20% of non-deliberate child fires). Children five years of age or younger accounted for only 0.5 percent of non-deliberate vegetation fires started by children.

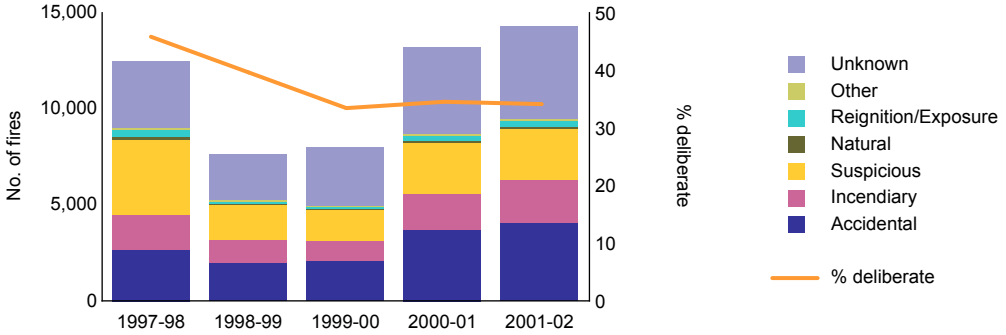
The highest number of non-deliberate child fires was recorded during 2000–01 and 2001–02 (Figure 52). Although the total number of fires started by children broadly followed the yearly fluctuation in total fire frequencies, the proportion of fires attributed to children climbed from 11 percent in 1987–88 to 17 and 19 percent during 2000–01 and 2001–02 respectively (Figure 52). It is unclear to what extent this reflects a change in the methods of recording (as potentially indicated by the high proportion of fires started by children of unknown age in 1997–98), differences in children being sited at the scene of fires, or genuine increases in the extent of children lighting fires. Excluding 1997–98 season, the proportion of fires started by individual age groups remained stable over the observation period.

As for fires generally, the vast majority of fires started by children resulted from misuse of an open flame (Figure 53), with the use of matches clearly outweighing lighters in documented cases (Figure 54). Overall, the proportions of fires children started with lighters decreased with increasing age. Unlike many jurisdictions, there was a surprisingly large array of heat of ignition factors attributed to children five years or younger.

Smoking-related fires: The NSWFB attended 3,328 fires from 1997–98 to 2001–02 where the heat of ignition was attributed to smoking-related materials, representing six percent of all fires the NSWFB attended during this five-year interval (Figure 49). Smoking-related fires were the second greatest cause of ignition after open flames and sparks. As a result of the methodology adopted in this study, 82 percent were classified accidental; six percent incendiary; seven percent suspicious; and four percent were unknown (Figure 50).

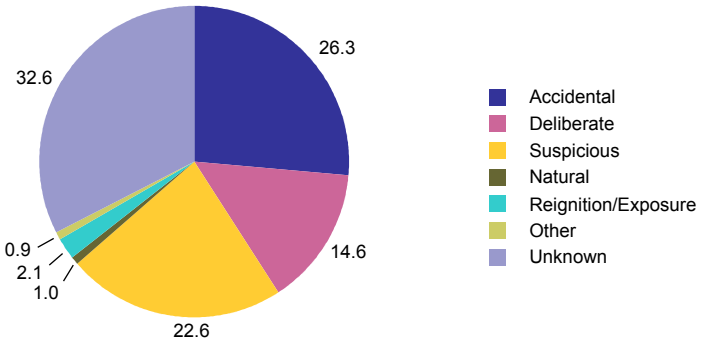
The number of fires started by smoking-related materials largely varied in accord with total fire numbers, ranging from a low of approximately 470 fires in 1998–99 and 1999–2000 to a high of 954 fires in 2001–02 (Figure 55). However, the proportion of fires attributed to smoking-related materials increasing from 5.0 percent in 1997–98 to 6.6 percent of fires in 2001–02 (Figure 55).

Figure 47: Cause, by year



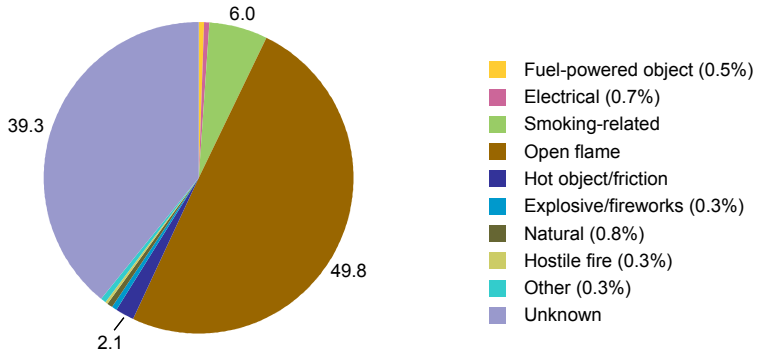
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 48: Cause (percent)



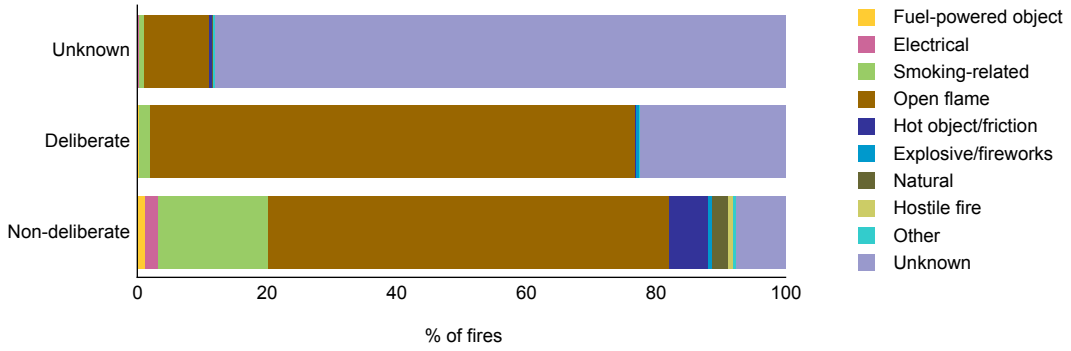
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 49: Form of heat of ignition (percent)



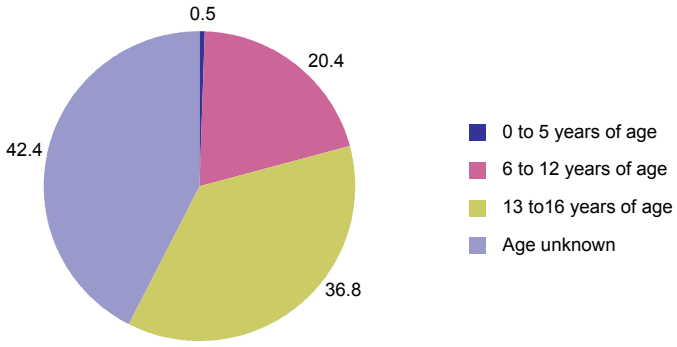
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 50: Form of heat of ignition, by cause (percent)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 51: Non-deliberate child fires, by age (percent)

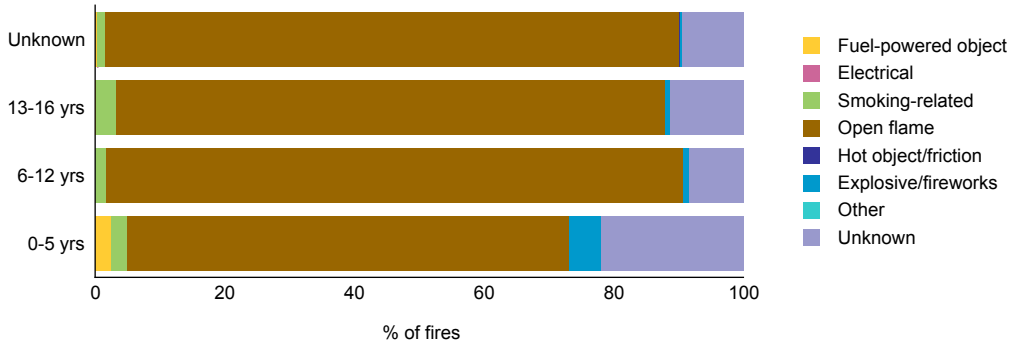


Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 52: Non-deliberate child fires each year, by age

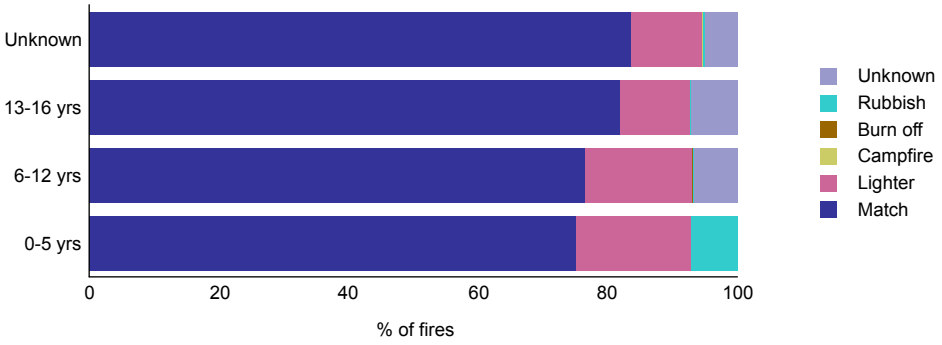
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 53: Non-deliberate child fires, by form of heat of ignition, by age group (percent)



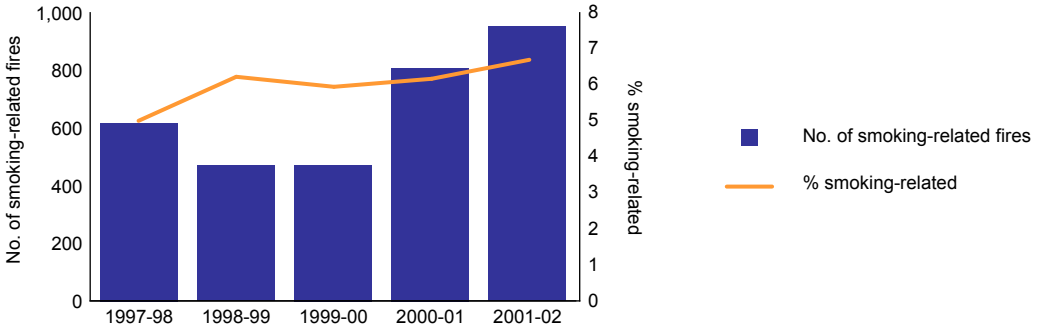
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 54: Non-deliberate child fires, by form of heat of ignition in cases resulting from an open flame or spark (percent)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 55: Smoking-related fires, by year



Source: NSWFB 1997–98 to 2001–02 [computer file]

Location

Information about the location of fires includes the regional distribution of fires, the distribution of fires at a postcode level within individual regions as well as details about the type of complexes where fires occurred.

Region

Regions used in the analysis of the NSWFB data are based on the 2005 ABS tourism regions (as used for the NSWRFS data; Figure 15). Forty-two percent of all vegetation fires the NSWFB attended occurred in the Sydney region. Other regions to experience high numbers of vegetation fires included the neighbouring Hunter (13%), and Illawarra regions (7%; Figure 56).

Overall, there was excellent correlation between the number of deliberate fires and the total number of fires in each region ($r=.99$; $p<.001$). Nevertheless, some variation was evident in the actual percentage of fires recorded as deliberate, particularly for regions with low total numbers of fires. The highest percentage of deliberate fires occurred in the Outback (55%), Illawarra (47%), North and Central Coast regions (44%), and the Hunter (40%; Figure 57). The lowest proportion of deliberate fires occurred in the Capital Country (15%), South Coast (16%) and Northern Rivers (21%) regions. However, the latter were also three regions that recorded among the lowest rates of 'known' causes (30 to 50%). Deliberate fires typically accounted for 40 to 65 percent of 'known' causal attributions (deliberate and non-deliberate combined) in most regions. Exceptions included the Outback where the rate was 83 percent, and the Capital Country region, which had rates of 30 percent.

More than half of all non-deliberate child fires the NSWFB attended occurred in the Sydney region (Figure 58). A further 10 percent occurred in the Hunter, 7.7 percent in the New England–North West and 6.6 percent in the Illawarra. Overall there was a strong correlation between the number of non-deliberate child fires and the total number of fires documented in individual regions ($r=.99$; $p<.001$). However, non-deliberate child fires accounted for the highest proportion of fires in the Sydney and New England–North West regions (20%), whereas in regions where the total fire number was less than 1,300 (in five years), non-deliberate child fires accounted for only four to nine percent of all fires (Figure 59).

The vast majority of smoking-related fires also occurred in the Sydney region (57%), followed distantly by the Illawarra (11%) and Hunter (9.5%) regions (Figure 60). The percentage of smoking-related fires was highest in the Illawarra (9.3%), Sydney (8.1%), and the Murray (8.6%) regions. In contrast, only one to 1.5 percent of all fires in the New England–North West, Blue Mountains and Outback originated from smoking-related materials (Figure 60).

Postcode/statistical local area

This section examines the distribution of fires, generally, and deliberate fires specifically, between postcodes within individual regions. It should be recognised that the data for many regional areas is likely complicated by the fact that both the NSWFB and the NSWRFS may attend fires in the same postcode. The following trends are based on NSWFB data only, and therefore represent the trends that primarily occur in major urban centres within each region.

Sydney: The NSWFB attended over 23,000 fires in total (all causes), in over 200 postcodes across the Sydney region during the five-year period. However, the geographical distribution of fires was extremely heterogeneous, with a number of regions and/or postcodes accounting for a disproportionately high number of all fires.

Nine postcodes in the Sydney region experienced in excess of 500 fires in the five-year period, 15 that recorded 200 to 499, and 22 where there were 100 to 199 fires in five years. Postcodes that recorded greater than 500, 200 to 499, and 100 to 199 fires accounted for 42 percent, 19 percent and 11 percent of all fires in the Sydney region, respectively. Collectively, postcodes recording in excess of 20 fires per year accounted for approximately three-quarters of all fires in the region.

The distribution of vegetation fires within postcodes and SSDs in the Sydney region is summarised in Table 4. Based on the distribution of fires, these SSD can be subdivided into three general groups; those

experiencing greater than 3,000, 1,000 to 1,400 and less than 700 fires of all causes in five years. Characteristics of SSD within these categories are further discussed below.

SSDs that experienced high total fire numbers (greater than 3,000 in five years) include the Outer South Western, Fairfield–Liverpool, Blacktown and Outer Western SSDs (Figure 61). Not surprisingly, many postcodes within these regions also recorded elevated numbers of fire. Three postcodes in the Outer South Western SSD and two postcodes each in the Fairfield–Liverpool, Blacktown, and Outer Western SSDs recorded in excess of 500 fires in five years. These were the only postcodes in the Sydney region where the NSWFB recorded fire numbers within this range. These SSDs also had a comparatively high number of postcodes within the 200 to 500 and 100 to 200 categories, when compared with other SSDs within the Sydney region. Although fires were heterogeneously distributed across each of these SSDs, higher total numbers of fires were a broad characteristic of each region. Typically, the small number of postcodes that recorded 500 or more fires and 200 or more fires in five years in each SSD accounted for 50 to 75 percent and 80 percent of all vegetation fires in these SSDs, respectively (Figure 62).

SSDs that recorded moderate numbers of fires (1,000 to 1,400 fires in five years) included the Canterbury–Bankstown, Central Western, St George–Sutherland, and the Central Northern SSDs (Figure 61). Postcodes within this range typically recorded a maximum of 100 to 199 fires in the five-year period, although one postcode in the Central Western region SSD recorded just over 200 fires during this period. Twenty to 50 percent of all fires in these four SSDs occurred in postcodes experiencing an average less than 15 fires per year (Figure 62).

SSDs that recorded low numbers of fires (less than 700 fires in five years) included the Northern Beaches, Eastern Suburbs, Lower Northern and Inner Western SSDs (Figure 61). Postcodes within these areas recording an average of 20 or more fires per year (more than 100 fires in total) were either absent or exceptionally rare. A notable exception was a single postcode in the Eastern Suburbs SSD, which recorded in excess of 200 fires in five years. Fires within that postcode accounted for one-third of all fires in the SSD (Figure 62).

The number of deliberate fires is strongly linked to total fire frequencies. Those SSDs that recorded in excess of 3,000 fires in total, namely Outer South Western Fairfield–Liverpool, Blacktown and Outer Western, recorded approximately 1,200 and 2,200 deliberate fires in five years. Collectively, these high fire SSDs accounted for three-quarters of all deliberate NSWFB-attended vegetation fires. Individual postcodes within these SSDs recorded very high numbers of deliberate fires. Notably, three postcodes in Outer South Western Sydney recorded 200 or more deliberate fires, and a further two experienced 20 to 40 deliberate fires per year. In Fairfield–Liverpool and Blacktown SSDs two suburbs were within both the greater than 200 and the 100 to 199 deliberate fire categories. In Outer Western Sydney, three postcodes recorded 200 or more deliberate fires, and one postcode, 100–199 fires.

Collectively, the 10 postcodes that recorded 200 or more deliberate fires in five years represented just one-fifth of all postcodes to have recorded a vegetation fire of any cause in the five year interval but accounted for 58 to 78 percent of all deliberate fires recorded in those SSDs (Figure 63). Moreover, these 10 postcodes accounted for half of all deliberate fires recorded in the Sydney region, and one-fifth of all deliberate fires the NSWFB attended across the state.

Those SSDs experiencing 1,000 to 1,400 fires in total, recorded between 320 and 440 deliberate fires in five years. At a maximum, there were only one or two postcodes that documented more than 50 deliberate fires in total. The SSDs with less than 700 fires in total observed between 63 and 186 deliberate fires in five years. In three of the five SSDs, no postcode experienced an average of greater than five deliberate fires per year (Figure 63).

Overall, the percentage of deliberate fires within each SSD increased as the total number of fires increased. The proportion of deliberate fires in SSDs experiencing less than 700 fires in five years was on

average 20 to 25 percent. This compares with an average of 40 percent in SSDs experiencing more than 3,000 fires (Figure 61). This increase in the proportion of deliberate fires with increasing total number of fires was also evident at a statistical local area level (Figure 64), but breaks down to some extent at a postcode level, due to the inherent statistical limitations that are introduced at this level (Figure 65). Nevertheless, even at a postcode level, the minimum percentage of deliberate fires increase with increasing fire frequency, yield a net increase in the average reported value.

Illawarra: Two postcodes in this region experienced in excess of 500 fires in five years, with a further seven recording 200 to 499 fires. However, a high incidence of fires was evident across most parts of the region, with 14 of the 17 postcodes recording a fire experiencing more than 100 fires in five years (Figure 66).

The Illawarra region was characterised by a high number and high proportion of deliberate fires. Three postcodes recorded more than 200 deliberate fires, and a further six postcodes experienced more than 100 to 200 deliberate fires. Deliberate fires accounted for 47 percent of all fires in the Illawarra region, although locally (four postcodes) the rate was 70 to 80 percent (Figure 66). While there was moderately strong correlation between total fire number and the numbers of deliberately lit fires (r=.86) for postcodes in the region, the highest percentage of deliberate fires was not always observed in postcodes with the highest total fire numbers, suggesting that factors other than deliberate lighting played a role in the increased prevalence of vegetation fires in some Illawarra postcodes.

South Coast: Only one postcode, in the Shoalhaven–Part A SLA, experienced 200 to 500 fires in five years; another recorded between 100 and 200 fires (Shoalhaven–Part B SLA). These two major urban centres accounted for 49 and 17 percent of the fires the NSWFB attended in the South Coast region, respectively.

The percentage of deliberate fires in the South Coast region was low (16%), a reflection of the fact that causal attributions were made in a less than one-third of cases. One postcode in the Shoalhaven–Part A SLA accounted for two-thirds of all recorded deliberate fires in the South Coast region.

Hunter: Four postcodes in this region recorded in excess of 500 fires in total in five years, including two postcodes each within the Lake Macquarie and Cessnock SLAs. The majority of all fires in the Hunter region occurred in these two SLAs (Figure 67). A further 12 postcodes in the Hunter region recorded 200 to 499 fires, but just three had 100 to 199 fires in five years. Although high numbers of fires were observed across parts of this region, 32 postcodes observed less than 100 fires in five years.

Both postcodes in the Lake Macquarie region that recorded in excess of 500 fires also experienced in excess of 400 deliberate fires in five years, with half of all fires in the Lake Macquarie SLA being deliberately lit (Figure 67). A further six postcodes in the Hunter region experienced 100 to 300 deliberate fires in five years. However, this likely markedly underestimated the significance of deliberate fires in the Hunter region, as cause of fires was unknown in up to 40 to 80 percent of cases. For example, the cause of 441 out 568 fires (78%) in one postcode was unknown.

Central Coast: Nine of the 11 postcodes in the Central Coast region that recorded a fire recorded in excess of 95 fires in five years. Of these, one (in the Gosford SLA) had greater than 500, five that had 200 to 500 and two recorded 100 to 199 fires.

The incidence of deliberate lighting in the Central Coast region was also high. Two postcodes documented greater than 200 deliberate fires (one each in the Gosford and Wyong SLAs) and four that experienced 100 to 200 deliberate fires. Forty-five percent of fires in the region were recorded as resulting from deliberate causes, and typically 30 to 50 percent of fires in any one postcode in the Central Coast region were listed as deliberate. Nevertheless, the rate locally (in the Wyong SLA) reached 79 percent. The latter was observed in a postcode with among the lowest rates of unknown attributions (7%). Given

that the cause of 30 to 60 percent of fires in most postcodes was unknown, the actual percentage of deliberate fires on the Central Coast may be higher than the 30 to 50 percent indicated above.

North Coast: One postcode in the Kempsey SLA recorded in excess of 1,000 fires in five years (Figure 68), having among the highest number of fires outside the Sydney region. This is consistent with the high numbers of fires reported by the NSWRFS in the same area. A further five postcodes in the North Coast region recorded 200 to 499 fires, and three experienced 100 to 199 fires.

Eighty percent of all fires in the Kempsey SLA were deliberate, and this SLA accounted for 60 percent of deliberate fires reported for the North Coast region. A high percentage of deliberate fires (48%) also occurred in the Port Stephens SLA, whereas the Hastings, Greater Taree and Nambucca SLAs all had comparatively high numbers of accidental fires. The proportion of unknown causes was also highly variable across the region.

Northern Rivers: Only one postcode in the Northern Rivers region recorded greater than 500 fires in five years (Figure 69). This occurred in the Coffs Harbour–Part B SLA, in the southern portion of the region, bordering the North Coast region. The level of causal attribution and the dominant cause of fires were highly variable across the Northern Rivers. Both the Coffs Harbour–Part B and the Tweed–Part A SLAs, areas that document the highest incidence of fires, recorded a high number of accidental fires, a small proportion of deliberate fires, and had a high percentage of fires of unknown causes. The highest percentage of deliberate fires occurred in the Richmond Valley (Pt A; 65%) and Tweed (Pt B; 53%) SLAs.

Blue Mountains: Two postcodes in the Blue Mountains region recorded 200 fires in five years; a further two experienced 100 to 200 fires. Deliberate fires typically constituted 20 to 30 percent of fires in a given postcode, but two postcodes recorded rates as high as 60 percent. Although no postcode in the Blue Mountains region recorded more than 80 deliberate fires, there were high levels of unknown attributions in many postcodes.

New England–North West: Three postcodes in this region recorded in excess of 500 fires in total in five years; one postcode (Moree Plains SLA) recorded in excess of 1,200 fires. This was among the highest number of vegetation fires recorded in a single postcode in the state. The NSWRFS also documented a high incidence of fires in this area. A further two postcodes, in the Armidale Dumaresq–City and Tamworth SLAs, recorded greater than 500 fires.

More than 500 deliberate fires occurred at one postcode in the Moree Plains SLA; and more than 300 occurred in one postcode in the Tamworth SLA. Approximately 50 to 60 percent of all fires in these two regions were deliberate in origin. In contrast, 3.5 percent of fires in the Armidale Dumaresq–City SLA were deliberate; a reflection of the low levels of causal attribution in that area (approximately 10%).

Explorer Country: Only one postcode, in the Dubbo–Part A SLA, recorded in excess of 500 fires in five years. The Orange and Bathurst SLAs recorded 200 to 300 fires in the five-year period, and Parkes and Wellington SLAs recorded 100 to 200 fires. The Dubbo–Part A SLA recorded in excess of 100 deliberate fires (n=251); 42 percent of fires in that location were deliberately lit. The highest percentage of deliberate fires was documented for the Wellington SLA (72%).

Capital Country: Only two postcodes in this region recorded in excess of 100 fires; Wingecarribee and Mulwaree SLAs. However, in both cases the number of fires did not exceed 130 in five years. Overall, the number of deliberate fires in Capital Country was low. However, the cause of one-third to three-quarters of all fires in the postcode was listed as unknown.

Riverina: Thirty-eight percent of all fires in the Riverina occurred in one Wagga Wagga–Part A SLA postcode. A further 29 percent occurred in one Griffith SLA postcode. Both postcodes recorded 400 to 600 fires in total. Deliberate causes accounted for 31 and 58 percent of fires in these two postcodes, respectively. These were the only two postcodes in the Riverina where the number of deliberate fires exceeded 100.

The Murray: Albury was the only SLA in the Murray region to record more than 400 fires, with 39 percent of fires in this SLA being deliberately lit. More than 100 fires were also recorded in the Deniliquin SLA; 21 percent being deliberate lit with the cause of 45 percent being unknown.

Outback: The NSWFB attended more than 500 fires in the Bourke SLA, of which approximately 95 percent were deliberately lit. High rates of deliberate fires (64%) were also recorded in the Brewarrina SLA. The NSWFB attended in excess of 500 and in excess of 100 deliberate fires in the Bourke and Brewarrina SLAs, respectively. More than 200 fires in total occurred in the Broken Hill postcode. Of these only one-fifth were deliberately lit but the cause of approximately 60 percent of fires in that centre was unknown.

Non-deliberate child fires: There was a strong overlap between locations that recorded a high number of non-deliberate child fires, and those that recorded a high number of fires generally. Notably, the number of non-deliberate child fires is moderately strongly correlated with the total number of fires within each SSD, SLA (r=.93) and postcode (r=.89).

Twenty-two postcodes recorded in excess of 100 fires started by children (non-deliberately) over a five-year period; 11 occurred in the Sydney region, three postcodes each from the Outer Western Sydney, Outer South Western and Fairfield–Liverpool SSD, and two from the Blacktown SSD. Notably, two postcodes recorded in excess of 100 child fires per year; these were in the Outer South Western Sydney and Blacktown SSDs. There were 130 postcodes (26% of postcodes recording a fire) where non-deliberate child fires contributed to 15 percent or more fires in that postcode – higher than the state average – but the rates were commonly much higher (up to 40%) in those postcodes recording in excess of 20 non-deliberate child fires per year. Notably, 47 postcodes across NSW (approximately 10% of all postcodes recording a fire) that recorded non-deliberate child fires accounted for at least one-quarter of all fires in the postcode.

The Campbelltown SLA was the only SLA to record an average of more than 200 non-deliberate child fires per year. Between 100 and 200 fires per year were also recorded in the Penrith, Blacktown South, Liverpool, and Wollongong SLAs. The highest numbers of fires within individual SLA outside of the Sydney region included:

- 20–40 child fires per SLA per year: Wollongong, Lake Macquarie, Moree Plains, Wyong.
- 10–19 child fires per SLA per year: Inverell, Newcastle–Remainder, Cessnock, Wagga Wagga, Coffs Harbour, Greater Taree, Dubbo and Hastings–Part A SLAs.

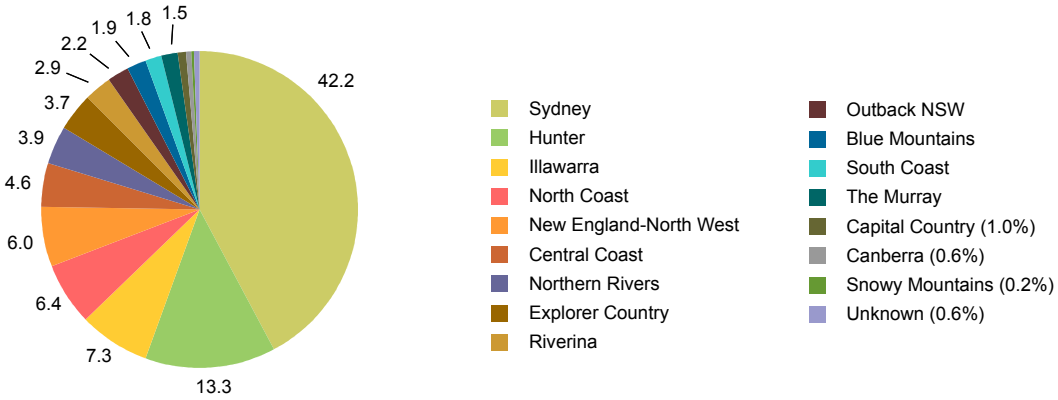
Table 4: Distribution of fires within postcodes within SSDs in the Sydney region

	Outer South Western		Fairfield–Liverpool		Blacktown		Outer Western		Canterbury–Bankstown		Central Western		St George–Sutherland		Central Northern		Northern Beaches		Inner Sydney		Eastern Suburbs		Lower Northern		Inner Western	
No. fires	5,129		3,979		3,808		3,182		1,315		1,171		1,145		1,104		687		648		549		538		253	
No. of postcodes	15		10		10		12		18		13		23		26		19		25		16		18		13	
	No.[a]	**%**	**No.[b]**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
TF≥500	3	76	2	53	2	59	2	51																		
200–499	2	11	4	33	4	30	3	35			1	19									1	41				
100–199	3	9	3	11	2	10	2	10	2	24	4	42	3	44	2	26	1	15								
75–99	2	3	1	2			1	3	8	53	3	22	1	8	2	17	3	37			1	15			1	31
50–74	1	1							1	4	1	4	2	11	3	17			3	29	1	9	3	37		
25–49					1	1	1	1	6	17	4	13	8	27	8	28	6	32	6	39	3	16	6	40	3	34
<25	4	0.2			1	0.1	3	1	1	2			9	11	11	13	9	16	16	33	10	19	9	23	9	36
Deliberate fires																										
No. deliberate	2,208	1,558	1,623	1,197	438	393	326	341	186	126	118	110	63													
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
>200	3	78	2	58	2	60	3	73																		
100–199	2	12	2	21	2	18	1	9																		
75–99	1	4	1	5	4	21	1	8																		
50–74	2	5	2	8			1	5	1	15	2	29	2	37	1	17										
25–49			3	9			1	4	7	54	5	48	1	13	3	29	2	35			2	56				
<25	3	1			2	1		2	10	31	6	23	19	51	21	54	17	65	23	100	11	44	18	100	12	100

a: no. refers to the number of postcodes with total fires/deliberate fires in the specified range

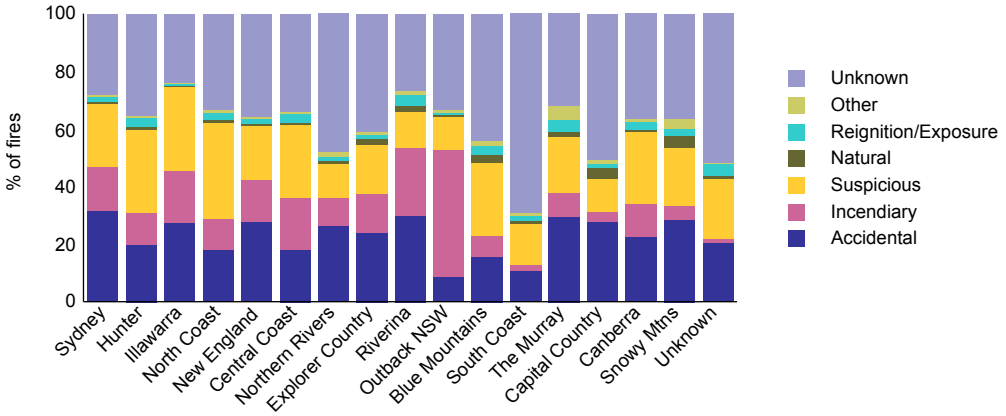
b: % refers to the proportion of all fires in the SSD that occurred within suburbs within the specified range

Figure 56: All vegetation fires, by region (percent)



Source: NSWFB 1997–98 to 2001–02 [computer file]

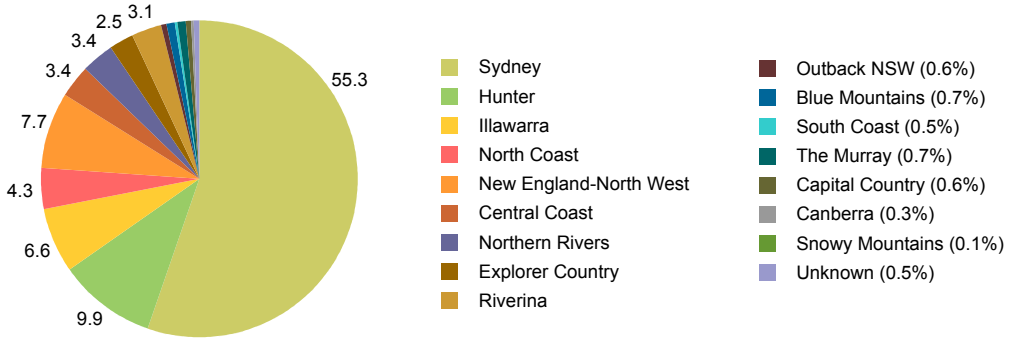
Figure 57: Region[a], by cause (percent)



a: Regions arranged in order of decreasing total fire number

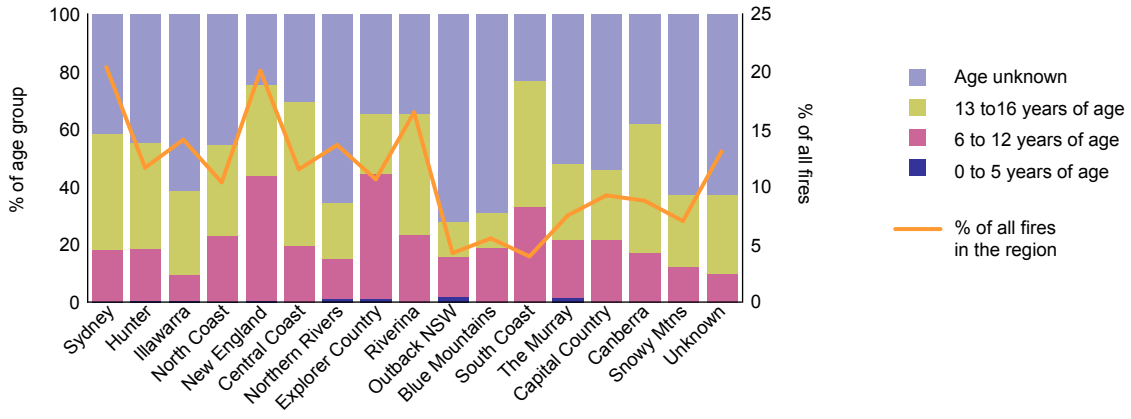
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 58: Non-deliberate child fires, by region (percent)



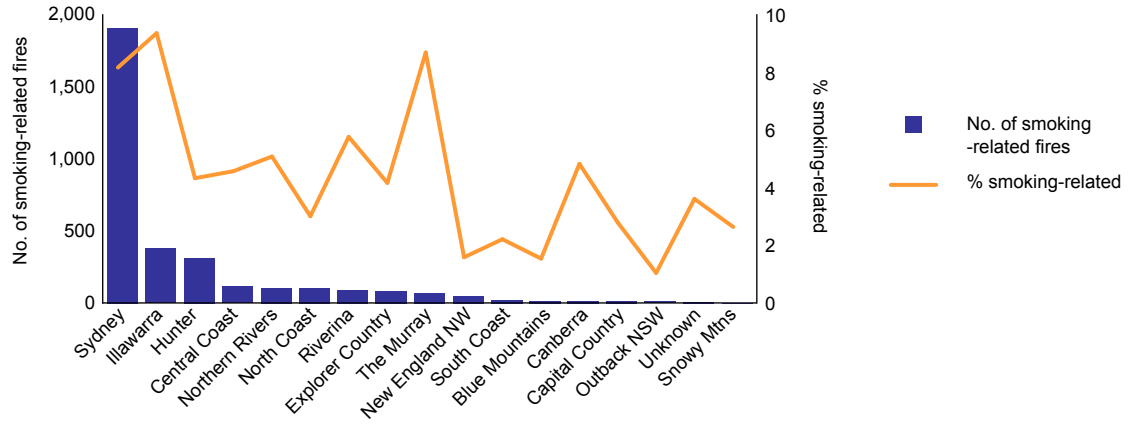
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 59: Non-deliberate child fires, by child's age for each region



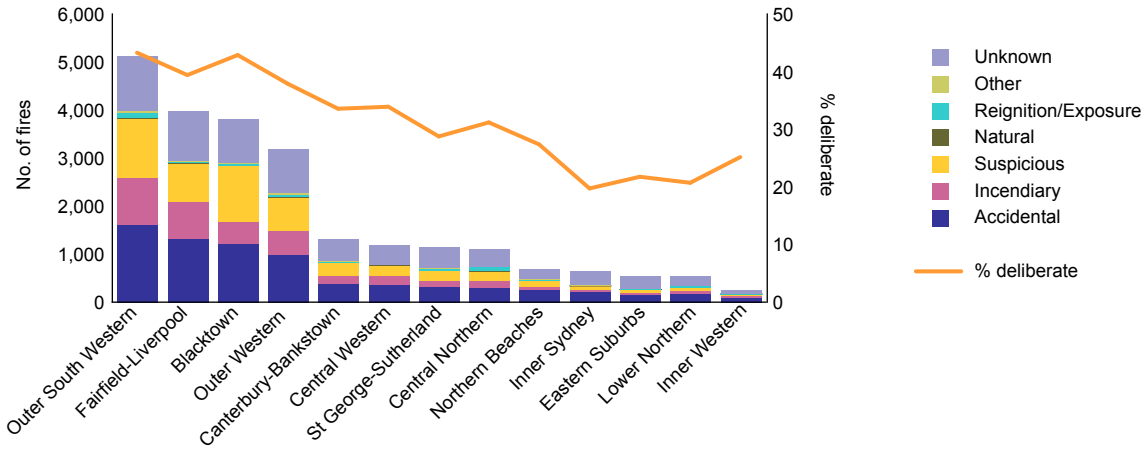
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 60: Smoking-related fires, by region



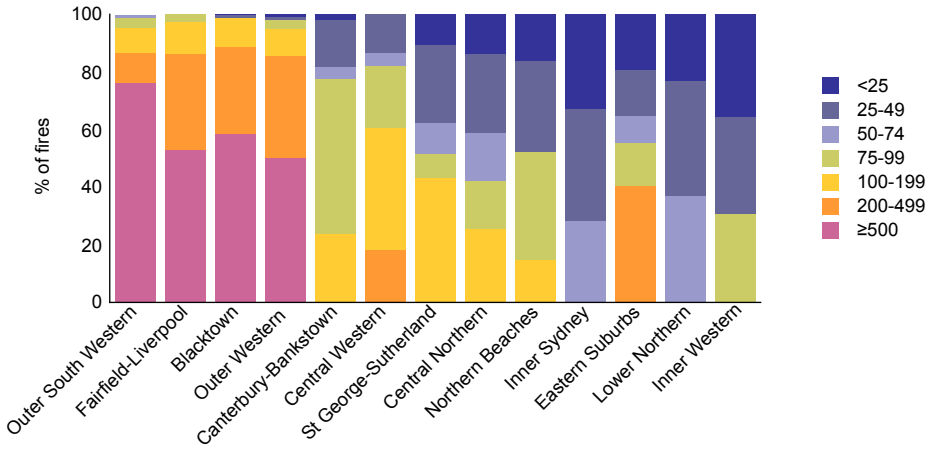
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 61: Cause of fire, by SSD in the Sydney region



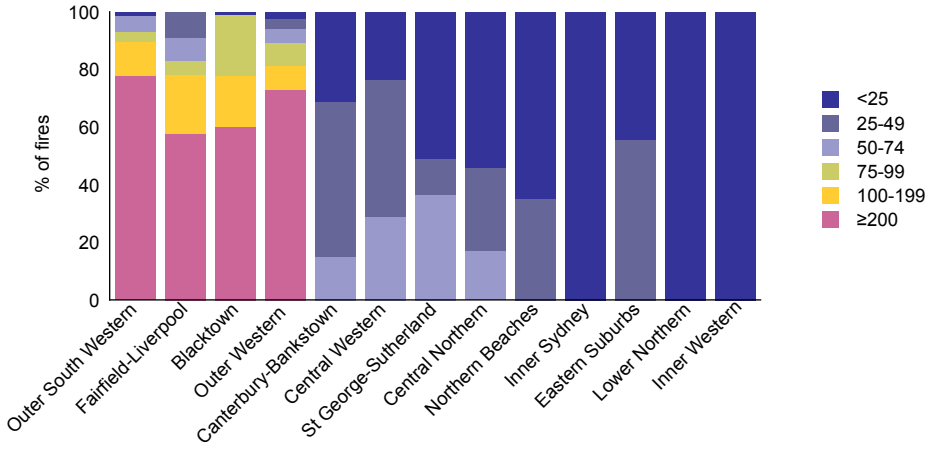
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 62: Sydney region, distribution of all fires within postcodes in each SSD (percent)



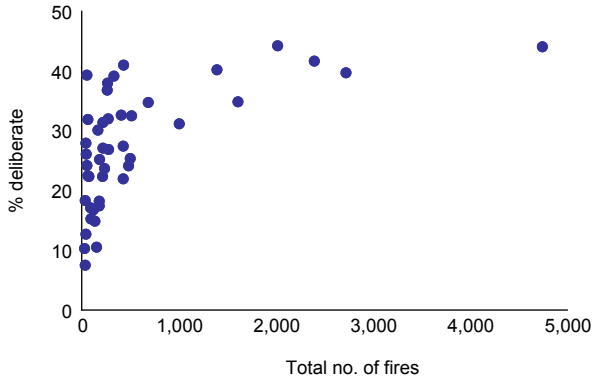
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 63: Sydney region, distribution of deliberate fires within postcodes in each SSD (percent)



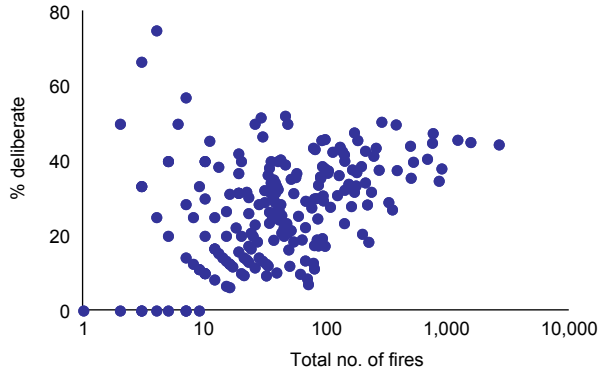
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 64: Percentage deliberate and total fire number, by SLA



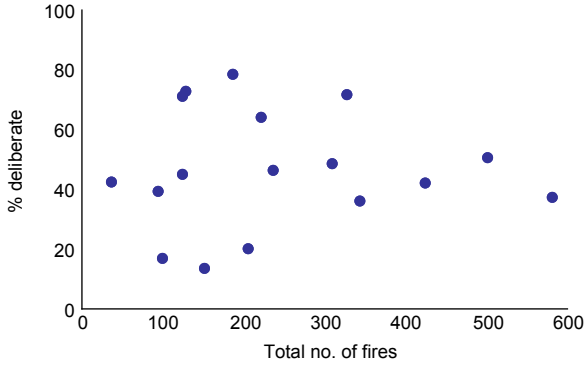
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 65: Percentage deliberate and total fire number, by postcode



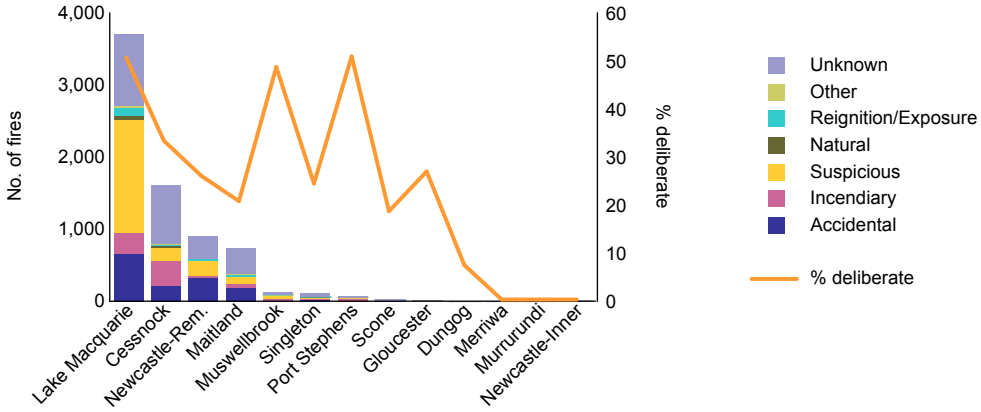
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 66: Percentage deliberate and total fire number by postcode in the Illawarra region



Source: NSWFB 1997–98 to 2001–02 [computer file]

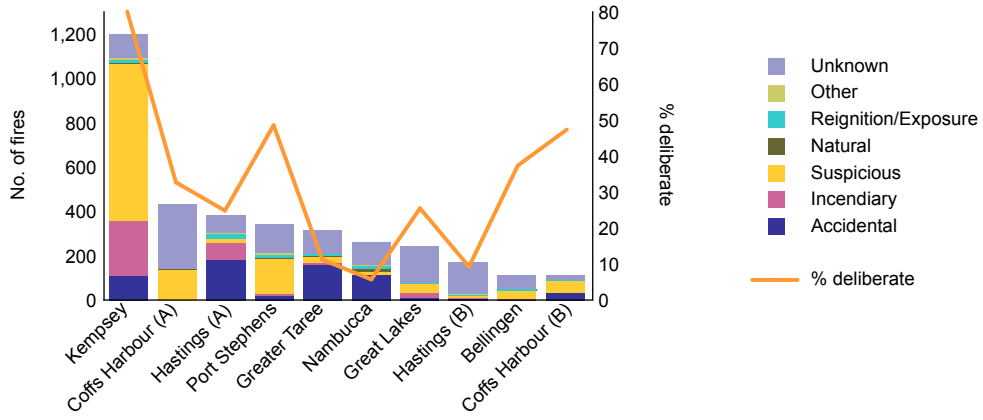
Figure 67: Cause, by SLA in the Hunter region[a]



a: Newcastle-Rem. = Newcastle-Remainder

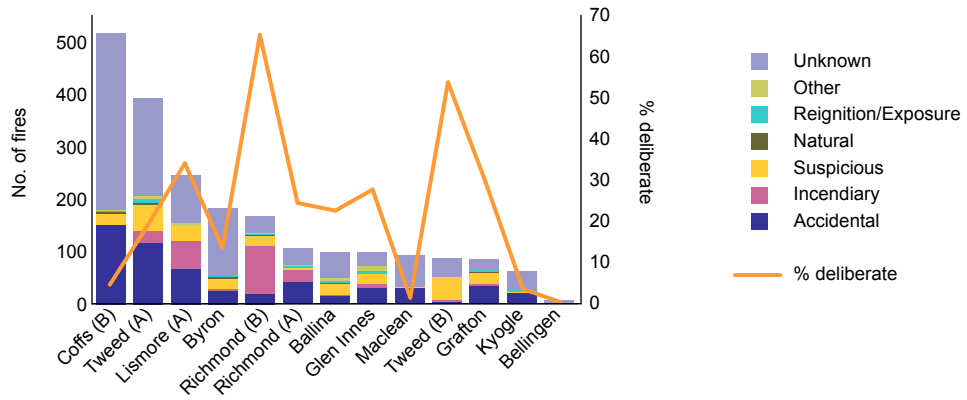
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 68: Cause, by SLA in the North Coast region



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 69: Cause, by SLA in the Northern Rivers region[a]



a: Coffs = Coffs Harbour; Richmond = Richmond Valley

Source: NSWFB 1997–98 to 2001–02 [computer file]

Complex

The majority of vegetation fires the NSWFB attended occurred on unused property or Crown land (35%). Other locations where fire frequently occurred included parks, forests and reserves (23%), road complexes (5%) and public recreation complexes (5%; Figure 70).

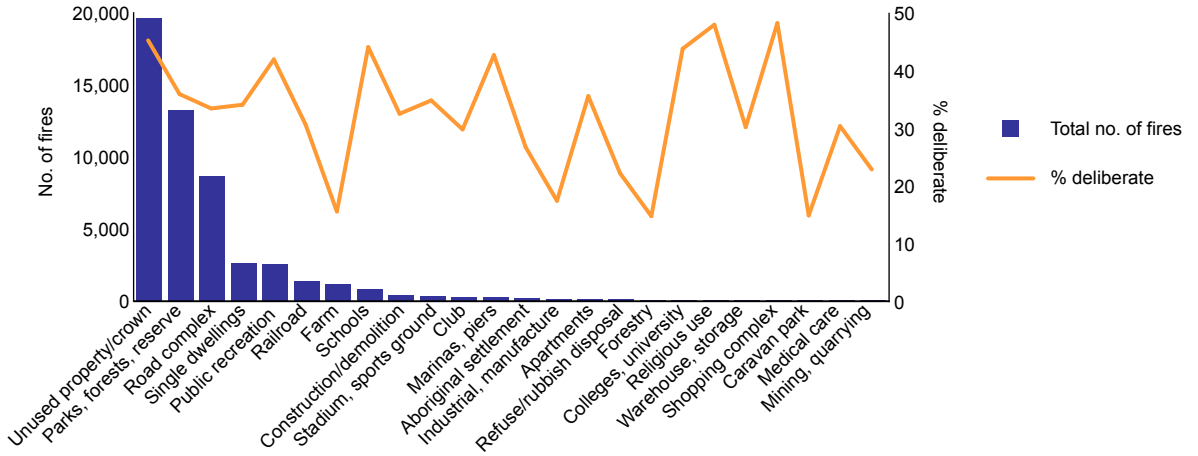
In those complexes experiencing an average of 10 or more fires per year, the percentage of deliberate fires was highest at shopping centres and religious buildings (48%), unused property or Crown land (45%), schools, colleges and universities (44%). The proportion of deliberate fires in complexes experiencing an average of 10 or more fires per year was lowest (15 to 17%) for forestry complexes, caravan parks, farms and industrial/manufacturing areas.

Most non-deliberate child fires also occurred on unused property or Crown land, parks, forests, reserves, and near road complexes (Figure 71). Non-deliberate child fires accounted for the highest proportion of fires in Aboriginal settlements (20%), at schools (17%), in parks, forests, reserves, at marinas/piers, and

on unused property and Crown land (16%), for complexes experiencing an average of six or more child fires per year. The diversity of localities where children lit fires and the proportion of fires occurring near road complexes increased with age (Figure 71). This was to some degree paralleled by a decrease in the number of fires occurring at single dwellings.

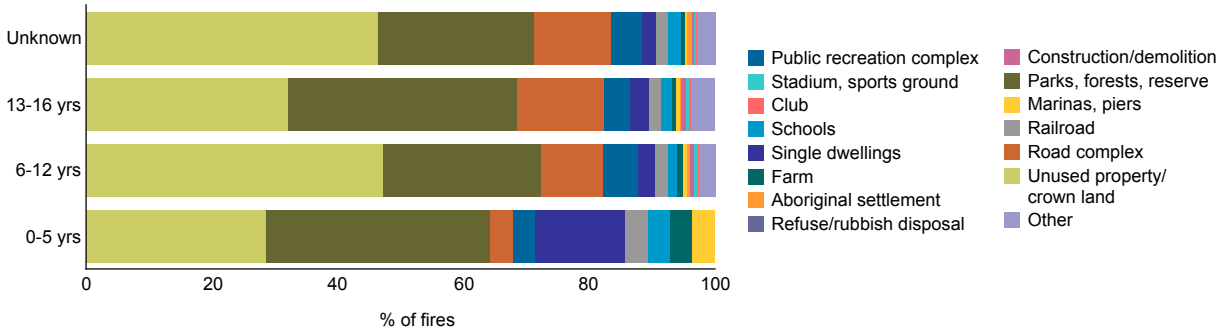
Not surprisingly, 40 percent of all fires resulting from abandoned and discarded materials were associated with road complexes (Figure 72). Another 20 percent occurred in parks, forests and reserves, and 16 percent were on unused property or Crown land.

Figure 70: Total fire number and percent deliberate, by complex type



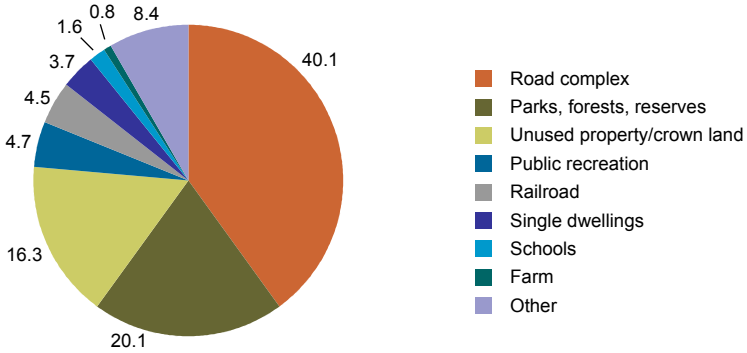
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 71: Non-deliberate child fires, by child's age and location (percent)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 72: Discarded or abandoned materials, by complex type (percent)



Source: NSWFB 1999–2000 to 2003–04 [computer file]

Timing

The timing of fires is examined by week of the year, day of the week and time of the day.

Week of the year

NSWFB-attended fires peaked during two distinct intervals, from mid August to mid November (late winter and spring) and in mid-December–January, coincident with the Christmas school holidays. The latter began at week 49 and ended at week 4 or 5, with the maximum occurring during week 52 (Figure 73). This dual-spiked pattern was evident for all human-caused fires, including incendiary and suspicious fires.

This dual-peaked pattern is similar to that observed for the NSWRFS data. The most notable discrepancy relates to relative size differences in the August–October and December–January peaks, with the latter being markedly greater for the NSWFB than for the NSWRFS. These differences may pertain to differences in the seasons analysed, differences between the principal causes of fires in rural and urban areas (higher contributions of child and smoking-related fires, as noted above), as well as differences in relative contributions from regions with differing patterns of fire regimes (for example, the higher proportion of fires in the Sydney region will lead to more December–January fires relative to August–October fires, see below).

Seasonal trends: As noted for the NSWRFS data, the timing of fires by week of the year varied markedly between seasons. In 1997–98, low spring rainfall associated with an El Niño event resulted in high fire numbers early in the season. Although the number of fires each week dropped slightly as the season progressed, the numbers of fires remained elevated until the middle of April (Figure 74). In contrast, during 1998–99, the number of fires remained low until early to middle October, peaked in early January, before rapidly decreasing. In 1999–2000, the number of fires remained low until late December, climbed through January and February before rapidly decreasing. In 2000–01 two significant spikes in activity occurred, coincident with the August–November and December–January peaks respectively. In 2001–02 fire numbers remained high from mid July through to mid January, with three spikes in activity at weeks 34, 44 and 52. The latter precisely coincided with the spikes in the NSWRFS data.

These results highlight the highly unpredictable nature of the bushfire season in NSW, ultimately a reflection of the lack of conformity in the amount and timing of spring and summer rainfall (Figure 25 to Figure 27). Note that August–October peaks were specific to those years characterised by a lack of

adequate winter and/or spring rainfall, whereas a spike in mid to late summer fires are typical of most seasons. It is the number of the August to October fires that was the largest single contributor to differences in the number of fires observed between seasons in the NSWFB data. Interestingly, the most destructive December–January fires occurred in years where high numbers of fires were recorded in August–October.

Regional trends: As observed for the NSWRFS data, the timing of fires varied between regions. There were strong similarities between the time of the year fires occurred in the Sydney (Figure 75), Hunter (Figure 76), Central Coast (Figure 77), and Illawarra (Figure 78) regions, and it is this pattern that dominates the trend observed for the NSWFB data generally. Nevertheless, subtle differences were evident between these regions. Increased numbers of fires were evident in December–January in most seasons in the Sydney region, but were most pronounced during 2001–02 (Figure 75). In that season 344 fires occurred during the last week of 2001. Twenty-two percent of those were identified as being either incendiary or suspicious in origin. In contrast, the Central Coast and Hunter regions recorded several short but intense spikes in fire numbers throughout 2000–01 and 2001–02. The number of fires during these weeks markedly exceeded that observed in any other years. The pattern for the Illawarra most closely resembled that observed for the Sydney region, although it is noted that the increase in fire numbers that occurred during week 52 of 2001 (Christmas–New Year fires of 2001) was proportionally greater in the Illawarra region than in the Sydney region. Disturbingly, approximately 45 percent of fires during that week were likely to have been deliberately lit but this value is consistent with the high proportion of deliberate fires recorded in the Illawarra generally. A large spike in fire numbers was also observed in the South Coast region during December 2001, but an increase in fire numbers during late December–January was a feature common to most seasons on the South Coast.

The Blue Mountains region not only recorded a lower number of fires but these have a markedly different distribution from those of the neighbouring Sydney region. The highest number of fires typically occurred in the first half of the season, before the Christmas–New Year period (Figure 79). However, a marked spike in fire numbers occurred during week 52 of 2001. Approximately one-quarter of all fires during that week resulted from reignition or exposure with the cause of a further half of fires being unknown.

In contrast to the patterns outlined above, the majority of fires in the Murray (Figure 80) and Riverina regions occur around the December–January period every year. To a lesser degree this also occurred in the Explorer Country, although there is greater variability between seasons in that region. The Capital Country most consistently experienced the greatest number of fires around Christmas, but high number of fires (but low overall) also occurred through late winter to early autumn.

The number of fires in the Northern Rivers (Figure 81) and North Coast regions (Figure 82) was highest in the more adverse bushfire seasons. Most fires in these two regions occurred during late winter and spring, coincident with lower than normal rainfall during these periods (Figure 27). Nevertheless, higher than normal numbers of fires also occurred during December–January 2001–02, and to a lesser extent 2000–01 (principally the Northern Rivers region).

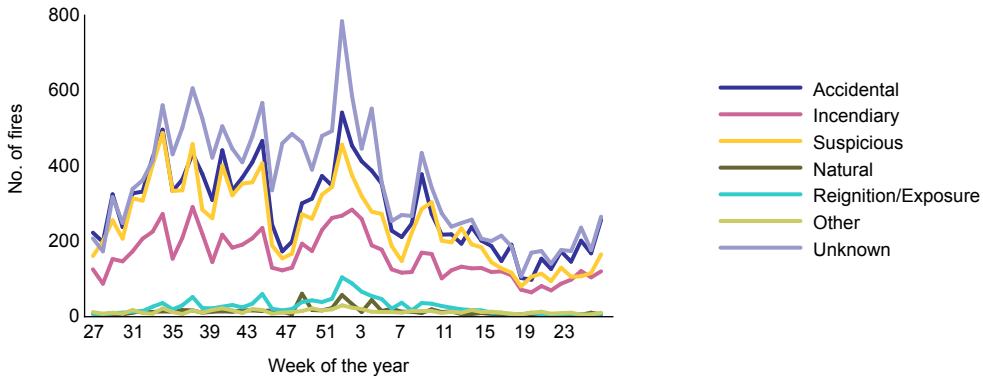
Fires in the Outback were less governed by seasonal trends. The greatest number of fires occurred in 2000–01, with spikes in deliberate fire activity occurring in early October, mid January and early March. Fires in the New England–North West did not follow a consistent seasonal pattern with increased fire numbers potentially occurring in any month of the year, and the pattern being highly variable from season to season.

Non-deliberate child fires: Overall, the distribution of non-deliberate child fires throughout the year parallels that observed for fires generally, but particularly the trend observed for the Sydney region. That is, the majority of fires occurred between mid August and mid November with an additional peak during the Christmas school holidays, and to a lesser extent in early autumn (Figure 83).

Some differences where noted between age groups. The pattern for 13 to 16 year olds paralleled that observed for fires generally. A similar trend was evident for fires started by children of unknown age. In contrast, non-deliberate fires started by children aged 6 to 12 years were more evenly spread throughout the year, although a greater prevalence of fires did occur during the bushfire season.

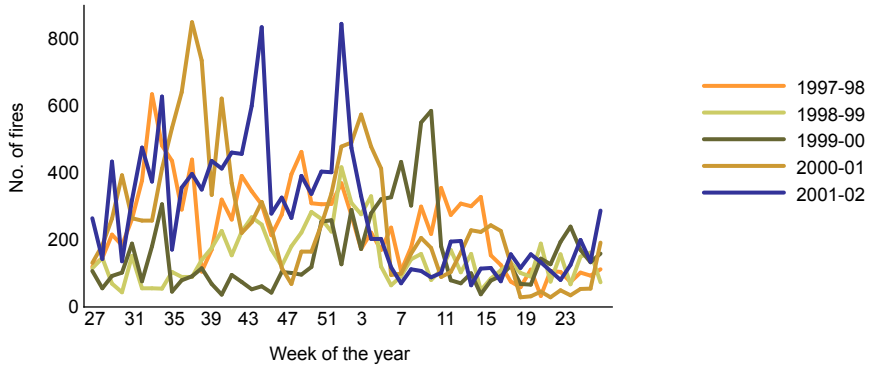
The timing of non-deliberate child fires strongly paralleled the general timing of fires within individual regions. For example, child fires in the Riverina principally occurred around Christmas–New Year, whereas child fires in the New England–North West region occurred throughout the year (Figure 84). However, some differences were noted. Overall, the number of fires attributed to children was lower during December–January than August–November. This differs from the general trend, and possibly not what might be expected for a school holiday period. However, child fires on the South Coast were most likely to occur over the Christmas–New Year period, being negligible during late winter and spring period, but this again differed from the general trend observed for the South Coast.

Figure 73: Week of the year, by cause (number)



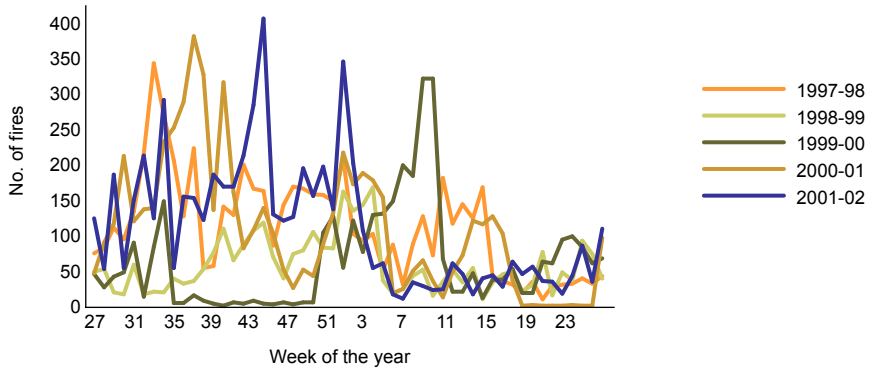
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 74: Week of the year, by year (number)



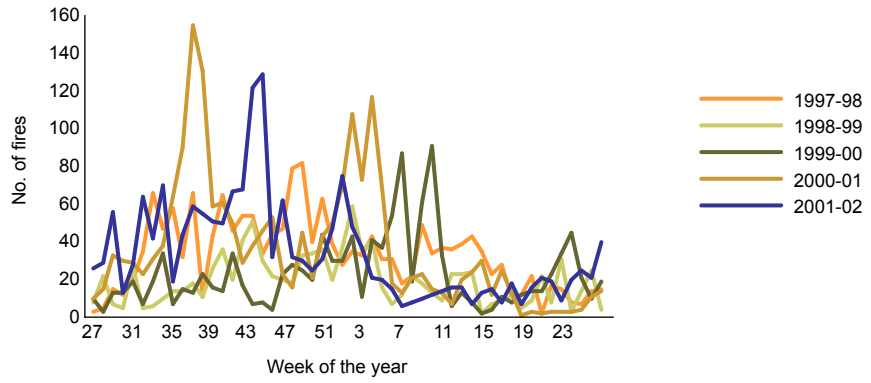
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 75: Week of year, by year for the Sydney region (number)



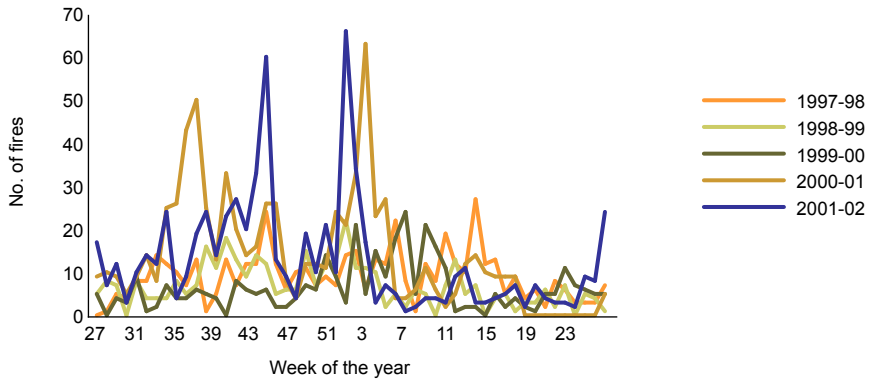
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 76: Week of year, by year for the Hunter Region (number)



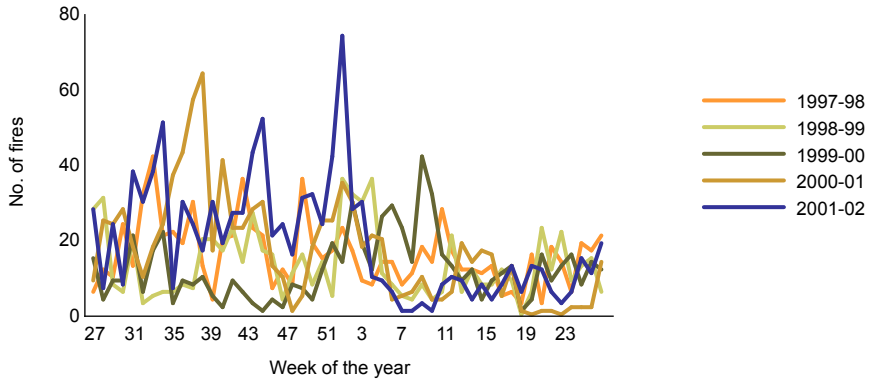
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 77: Week of year, by year for the Central Coast region (number)



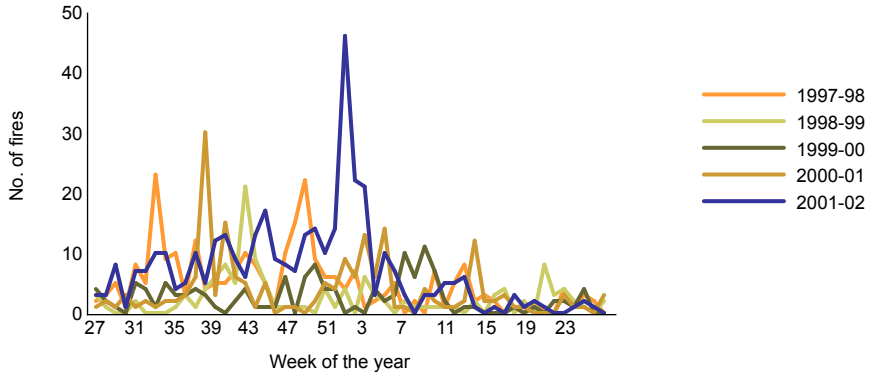
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 78: Week of year, by year for the Illawarra region (number)



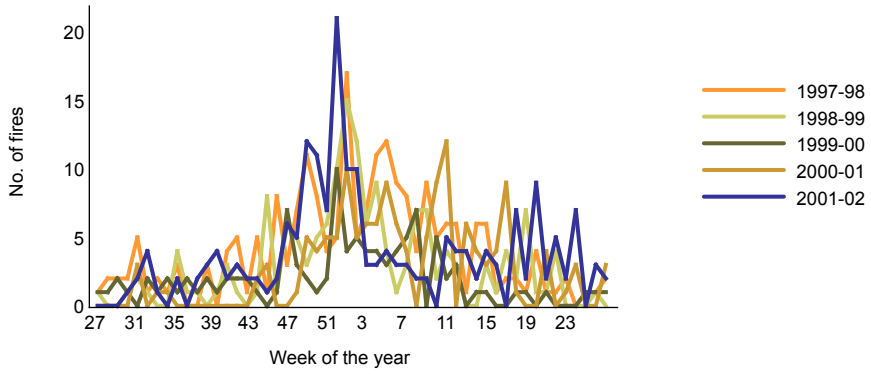
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 79: Week of year, by year for the Blue Mountains region (number)



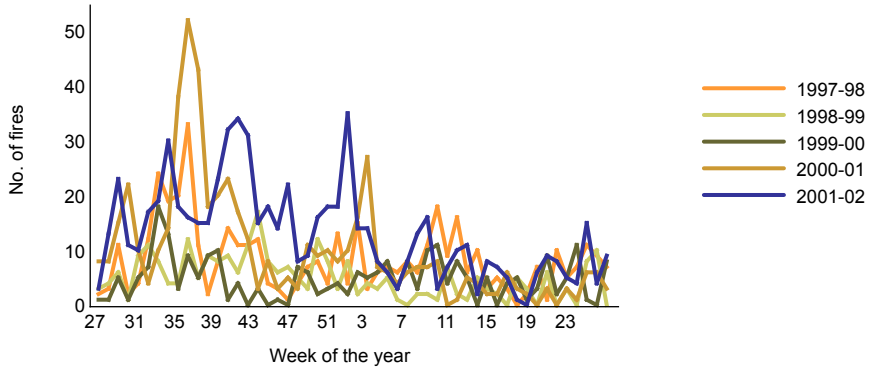
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 80: Week of year, by year for the Murray region (number)



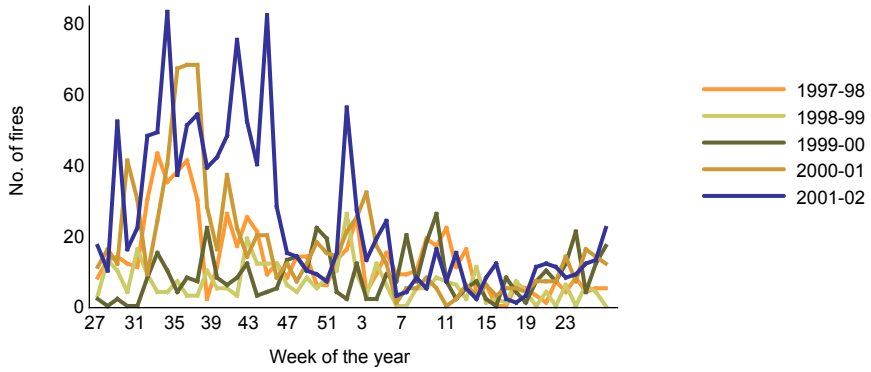
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 81: Week of year, by year for the Northern Rivers region (number)



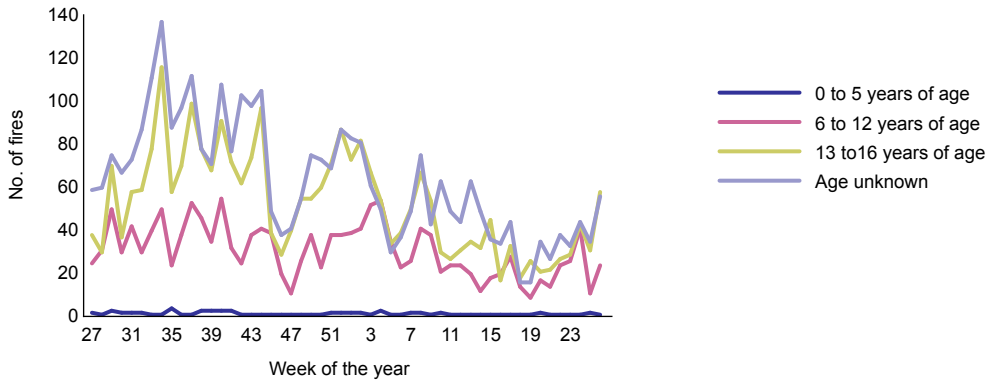
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 82: Week of year, by year for the North Coast region (number)



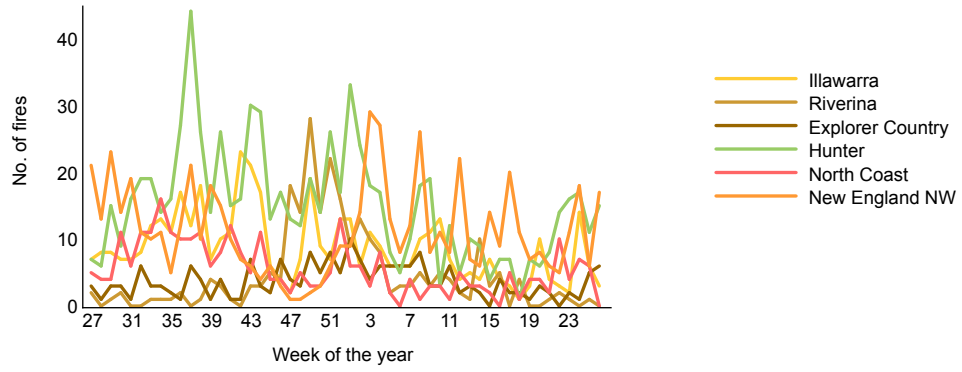
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 83: Non-deliberate child fires, by week of the year and age group (number)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 84: Non-deliberate child fires, by week of the year for selected regions (number)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Day of the week

Overall, fires the NSWFB attended were 30 percent more likely to occur on Saturday and 28 percent more likely to occur on Sunday than on the average weekday. The tendency for increased number of fires on weekends was evident for all human-related causal categories (Figure 85). Incendiary fires were approximately 40 percent more likely to occur on Saturdays and Sundays relative to the weekday average. Suspicious fires were 29 to 32 percent more likely on Saturdays and Sundays. Similar values were evident for accidental fires (29 to 34%). Fires resulting from natural causes, reignition or exposure and other causes did not display any bias by day of the week.

All regions of NSW recorded higher numbers of fires on weekends relative to weekdays with the exception of the Snowy Mountains, but the extent of that increase was variable (Figure 86). For the majority of regions across NSW, fires were 30 to 40 percent more likely to occur on Saturday and Sunday relative to a weekday. However, in the Riverina region fires were 50 percent more likely on a Saturday or Sunday relative to a weekday. In the Capital Country and Outback regions 50 percent more fires occurred on Sunday but only 20 to 30 percent more occurred on Saturday, relative to the average weekday. Surprisingly, the proportion of weekend fires was among the lowest in the Sydney (23 and 27% respectively) and the Central Coast (16 and 25% respectively) regions; regions that overall experienced high numbers of fires. This is contrary to the trend observed in many other jurisdictions, where the strongest weekend bias occurred in those regions encompassing the major metropolitan centre.

Non-deliberate child fires were more likely to occur on weekends for all age groups except the children younger than six years old. Overall, fires started by children were 36 percent more likely to occur on Sunday and 42 percent more likely to occur on Saturday than during a weekday. This is similar to the trend observed generally.

Time of the day

The detection time of fires was available for 60 percent of NSWFB-attended fires. Overall, fire numbers peaked between 3 pm and 7 pm, and most typically within the 4 to 5 pm window (Figure 87). In contrast to observations from many other jurisdictions, there was no offset between the peak in deliberate and non-deliberate fires on a statewide basis. This reflects the observation that the peak in accidental fires is somewhat later for the NSWFB than for other jurisdictions.

Fires occurring between 6 pm and 6 am did not form a distinct night peak in the NSWFB data; rather there was a 'shoulder' on the daytime curve for times after 7 to 8 pm. This shoulder was greater for incendiary and suspicious fires than for accidental fires, consistent with observations elsewhere that a higher proportion of night-time fires result from deliberate causes. Approximately 33 percent of all recorded incendiary and suspicious fires occurred between 7 pm and 5 am, compared to a value of 26 percent for accidental fires. The rate of 31 percent for unknown fires is comparable to that observed for deliberate fires, suggesting that many fires of unknown cause may be deliberate in origin. The greatest proportion of deliberate NSWFB-attended night-time fires occurred on Friday night–Saturday morning and Saturday night–Sunday morning (Figure 88). This was most evident between midnight and 6 am.

The distribution of deliberate daytime fires also differed between the weekends and weekdays. Notably, the daytime peak on weekends was both higher and broader than for weekdays; the daytime peak on weekdays was skewed toward later times than its weekend counterpart with peak numbers occurring between 4 and 7 pm as opposed to 2 and 5 pm.

While the trends described above represent the dominant case, it is evident that the predominant timing of deliberate fires varied between regions (Figure 89 and Figure 90). For example, only 22 to 28 percent of fires in the Snowy Mountains, Hunter, North Coast, Northern Rivers, New England–North West and Central Coast regions occurred between 7 pm and 5 am. This compares to values of 31 to 34 percent for the Sydney, South Coast and Blue Mountains regions and 40 to 48 percent in the Illawarra, Capital Country, Murray, Riverina, and Explorer Country and Outback regions.

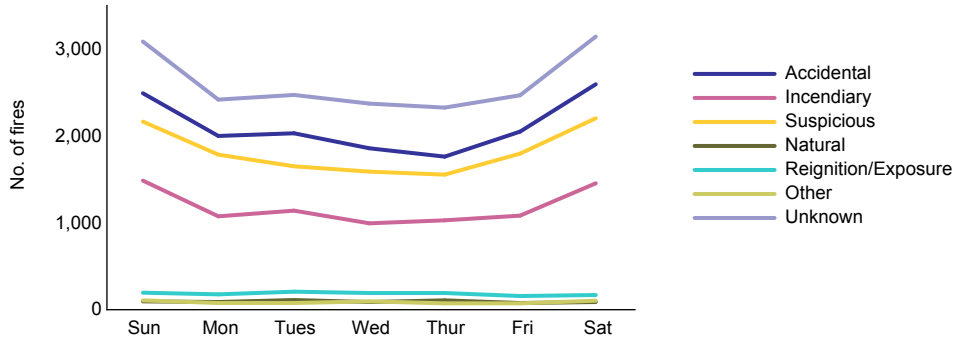
Although an increased number of deliberate fire were set between 7 pm and 5 am on Friday night–Saturday morning and Saturday night–Sunday morning in the Sydney region as a whole (Figure 91), this was not uniformly manifest across all districts within that region. Night-time fires were proportionally of greater significance in areas like the Central Western, Central Northern and Canterbury–Bankstown SSDs – areas characterised by lower fire numbers – than in the Fairfield–Liverpool, Outer South Western, Outer Western and Blacktown SSDs –areas in which there was a high incidence of fires overall (Figure 92). More specifically, only 27 percent of fires in the Outer South Western Sydney SSD occurred between 7 pm and 5 am. Comparatively smaller differences were evident between the numbers of fires on weekends and weekdays in that region (Figure 93). In contrast, 43 percent of fires the Canterbury–Bankstown region occurred between 7 pm and 5 am, but unlike the general trend for the Sydney region, night-time fires were common on most nights of the week except Tuesday and Wednesday nights.

Similarly, fires between 7 pm and 5 am were also common on most night of the week in the Illawarra region. Moreover, fires on Friday night–Saturday morning were more likely to occur earlier than on Saturday night–Sunday morning in the Illawarra region (Figure 94). Night-time fires in the Riverina also occurred on most nights of the week.

The disparity between these trends illustrates that general patterns of deliberate fires cannot necessarily be translated to individual cases and individual instances need to be evaluated to understand the types of factors underlying deliberate firesetting in each location.

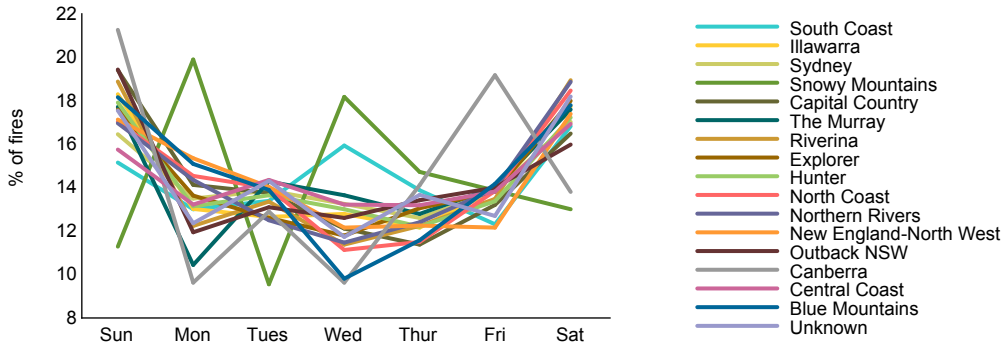
The majority of non-deliberate child fires occurred during the day, peaking between the hours of 3 and 6 pm, but there were clear disparities between the trends observed on weekdays and weekends (Figure 95). Non-deliberate child fires on weekdays peaked during a narrower interval that was somewhat later (3 to 7 pm) than on weekends. One-quarter of all fires attributed to children occurred between the hours of 7 pm and 5 am. Overall, there were strong parallels between many of the trends observed for non-deliberate child fires and those observed for deliberate fires. This may reflect the fact that the deliberate category includes malicious fires started by children less than 16 years of age. Not surprisingly, the proportion of night-time fires was greater for 13 to 16 year-olds (32%) than for 6 to 12 year-olds (15%; Figure 96), with more night-time fires occurring on Friday night–Saturday morning and Saturday night–Sunday morning.

Figure 85: Cause, by day of the week (number)



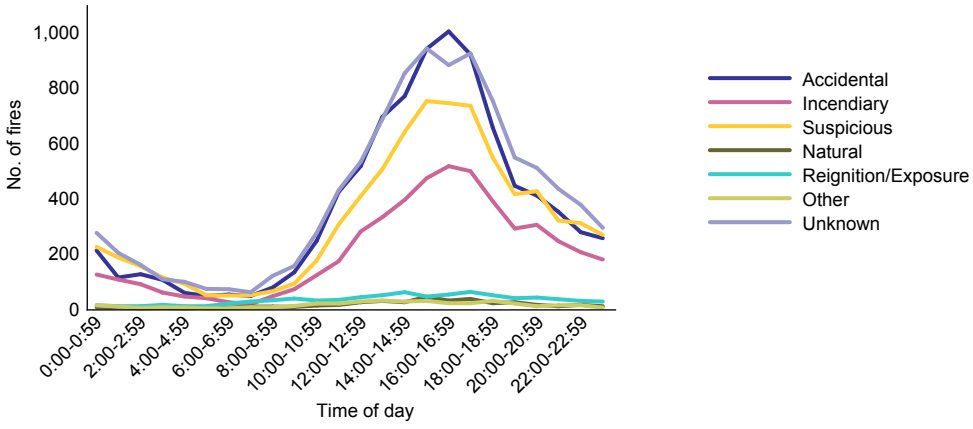
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 86: Fires in each region, by day of the week (percent)



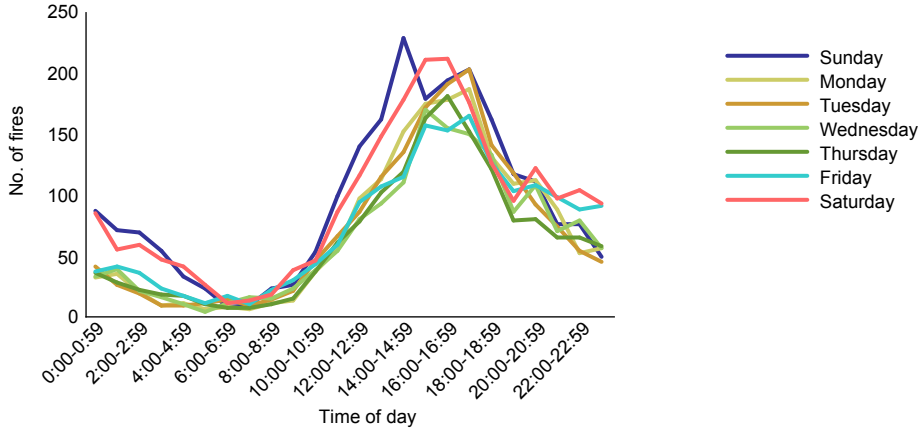
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 87: Time of day, by cause (number)



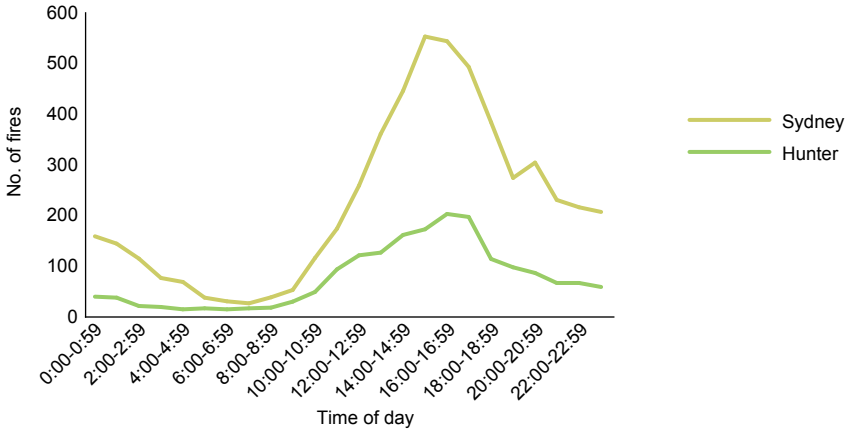
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 88: Deliberate fires, by time of the day and day of the week (number)



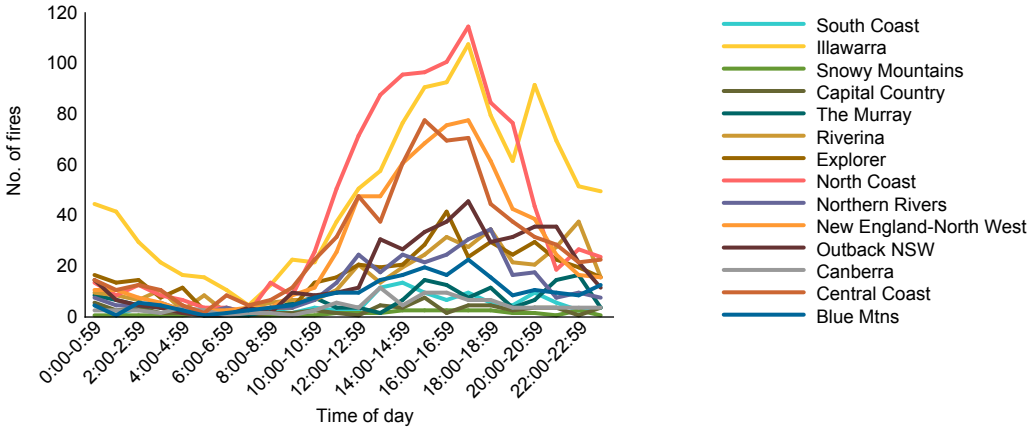
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 89: Deliberate fires, by time of day in the Sydney and Hunter regions (number)



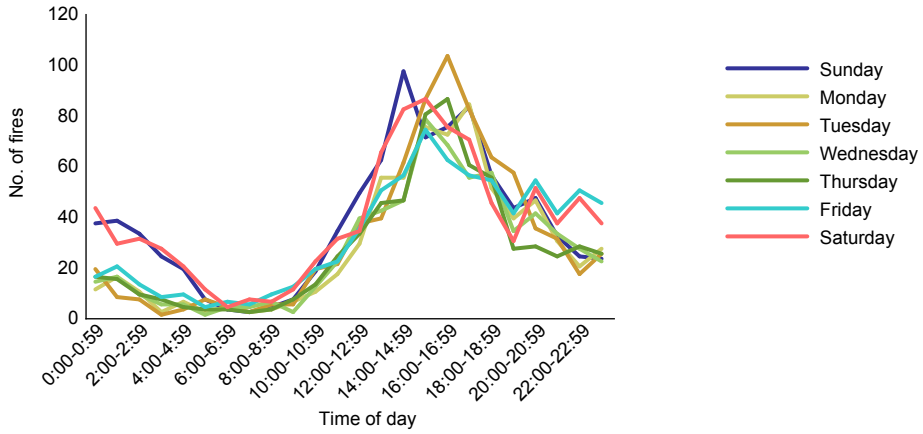
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 90: Deliberate fires, by time of day in other regions (number)



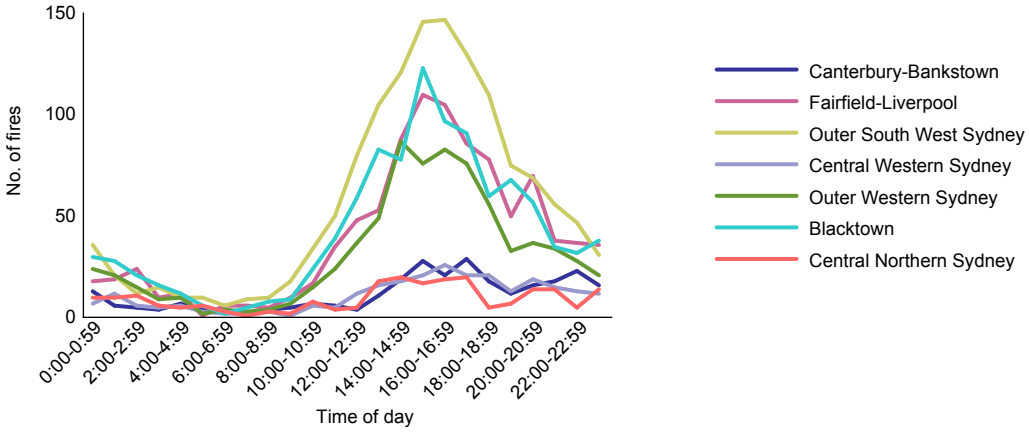
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 91: Deliberate fires, by time of day and day of the week for the Sydney region (number)



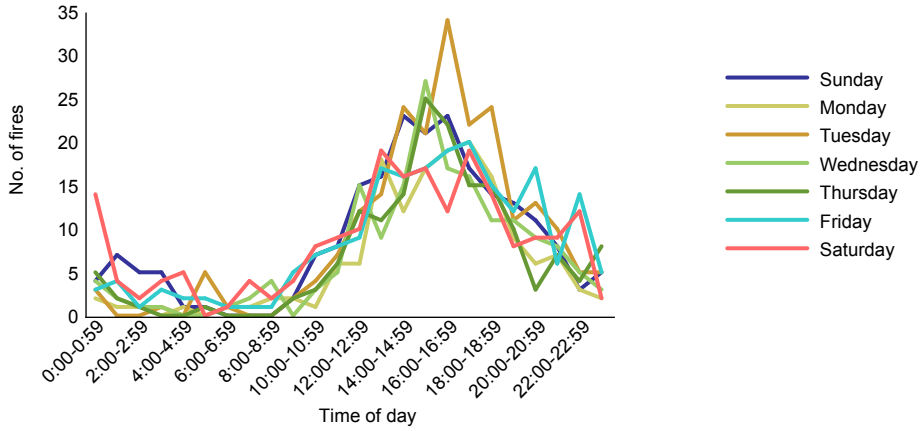
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 92: Deliberate fires, by time of day for selected Sydney SSDs (number)



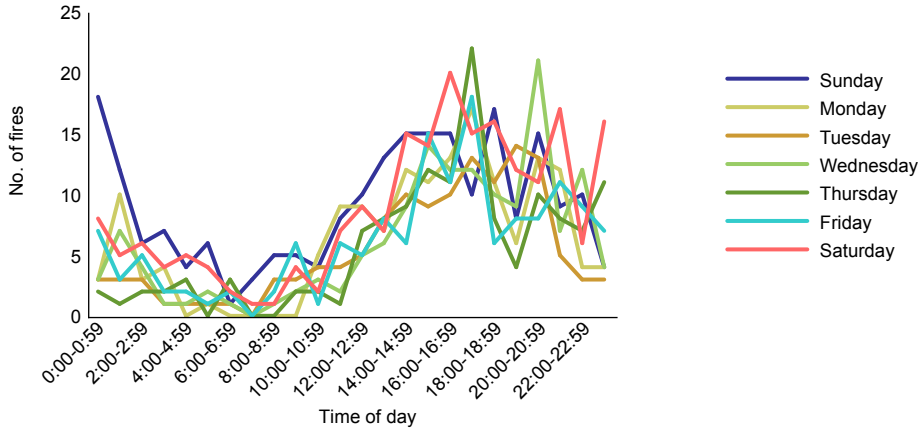
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 93: Deliberate fires, by time of day and day of the week for the Outer South Western SSD (number)



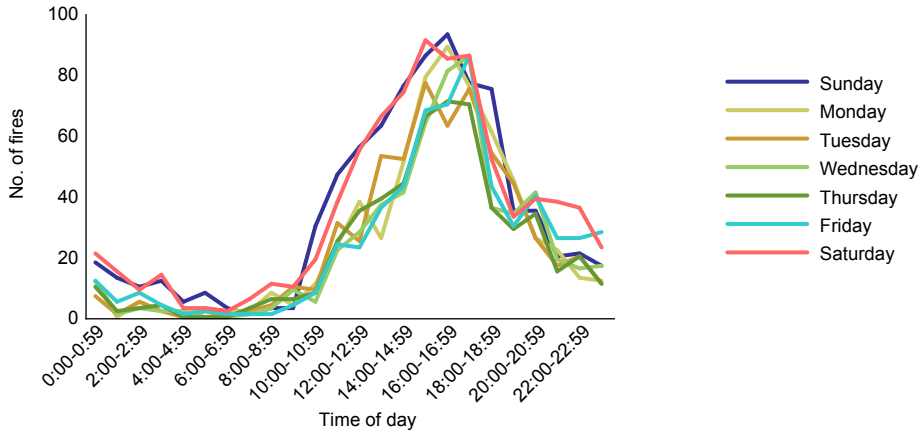
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 94: Deliberate fires, by time of day and day of the week for the Illawarra region (number)



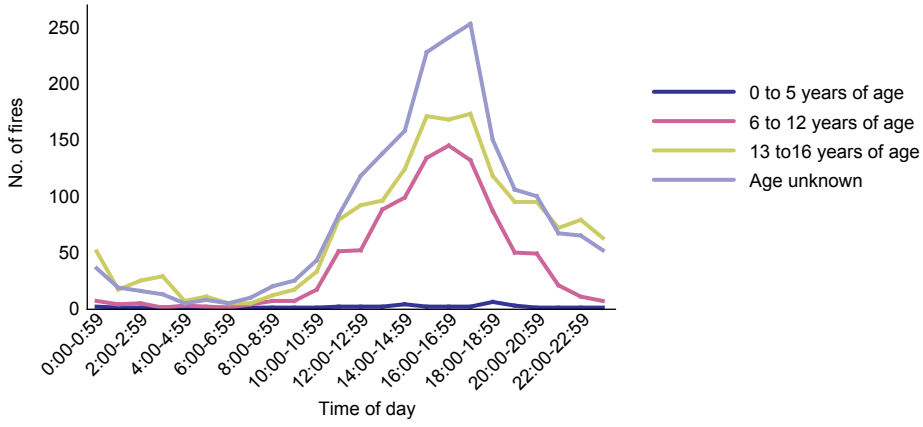
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 95: Non-deliberate child fires, by time of day and day of the week (number)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 96: Non-deliberate child fires, by time of day for different age groups (number)



Source: NSWFB 1997–98 to 2001–02 [computer file]

Type of incident

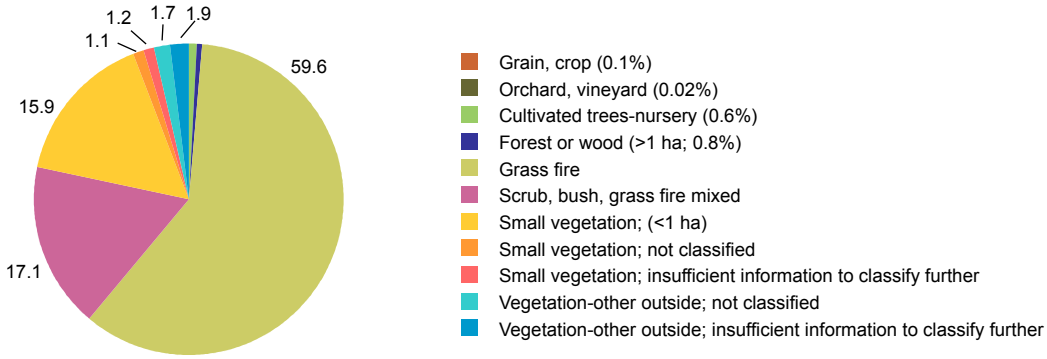
Approximately 60 percent of all vegetation fires the NSWFB attended were grassfires. A further 17 percent were scrub, bush and grass fire mixtures, and 18 percent were classified as small vegetation fires (Figure 97).

The proportion of deliberate fires was remarkably uniform across incident types, although it is noted that comparatively fewer grain and crop fires and subtly greater proportions of orchard, vineyard and nursery fires were classified deliberate. Overall, deliberate causes accounted for 49 to 64 percent of known causes for individual incident type categories (Figure 98).

Grass, scrub, bush grass mixtures and small vegetation fires were the dominant categories of incident types attended across all regions in NSW, although the relative proportion of these categories varied in detail (Figure 99). The highest proportion of small vegetation fires was recorded for the North Coast (29%), and the Riverina and Sydney regions (21%). In contrast comparatively fewer fires (8 to 9%) in the Blue Mountains, Illawarra and New England–North West regions were classified as small vegetation fires. Grassfires accounted for 71 to 81 percent of all fires in both the Illawarra and New England–North West regions, but also in the Murray and Outback regions. The highest proportions (25 to 30%) of scrub bush, grass mixed fires occurred in the Central Coast, Hunter and Blue Mountains regions. Forest fires accounted for the greatest proportion of fires in the Blue Mountains (5%) and to a lesser extent the Hunter, South Coast, and Snowy Mountains regions. In all other regions forest fires comprised one percent or less or all vegetation fire incidents attended.

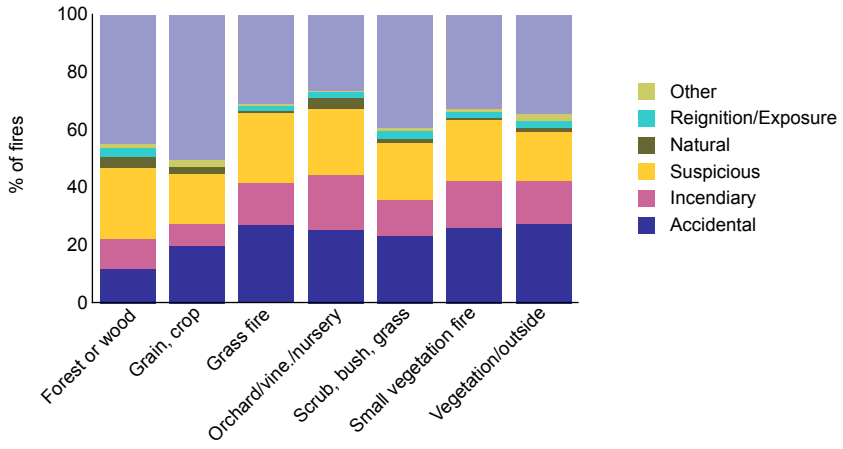
Although it is not possible to determine how many of the fires were, or had the potential (under adverse conditions) to develop into a bushfire, it is recognised that the number of forest fires grassfires, mixed scrub, bush and grass fires was strongly correlated with the total number of vegetation fires attended in each region (r=1.00; p<.001). Even if grassfires were excluded, the number of mixed grass, scrub and bush fires and forest fires combined were significantly correlated (r=.87; p<.001) with the total number of vegetation fires attended in each region. The inference is that, overall, the types of incidents that may reasonably have constituted a bushfire, or had the opportunity to develop into a bushfire given sufficient vegetated areas and adverse conditions, varied surprisingly little between urban centres in different regions, and following, those regions that experience the greatest number of vegetation fires overall can be expected to experience the greatest number of bushfires.

Figure 97: Type of incident (percent)



Source: NSWFB 1997–98 to 2001–02 [computer file]

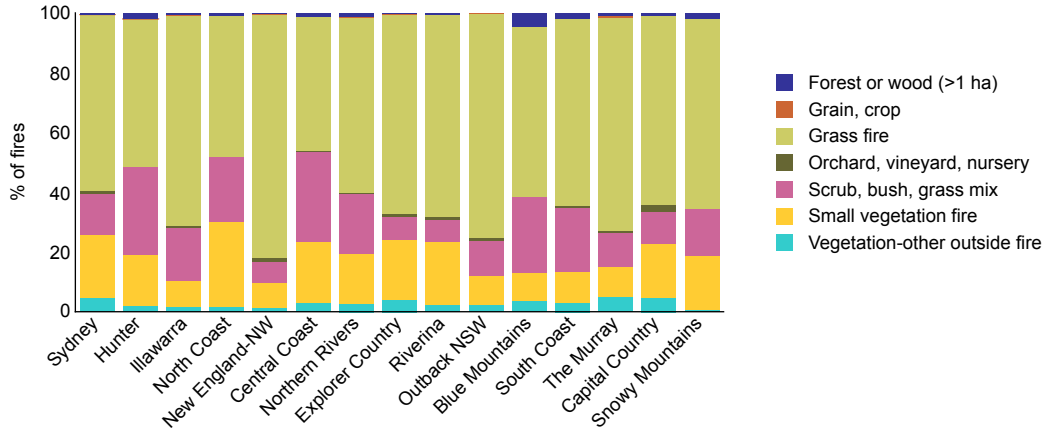
Figure 98: Incident type[a], by cause (percent)



a: The incident type has been summarised to yield seven major categories

Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 99: Incident type[a], by region (percent)



a: The incident type has been summarised to yield seven major categories; and regions are arranged in order of decreased fire frequencies

Source: NSWFB 1997–98 to 2001–02 [computer file]

New South Wales National Parks and Wildlife Service

Background information about the NSW NPWS dataset and its analysis

Important information about the NSW NPWS dataset and the methodology employed to analyse it is outlined below:

- The fire data were sourced from NSW NPWS.
- The database spans from 1995–96 to 2003–04.
- The database does not use AIRS classification codes.
- Cause was defined using the cause variable supplied.

- Incendiary fires included all fires classified as arson, burning off illegally and motor vehicle arson within the cause variable.
- Suspicious fires include all fires where cause = 'arson suspected'.
- Incendiary and suspicious fires are collectively referred to as deliberate fires.
- All natural vegetation fires were the result of lightning.
- Smoking-related fires refer to all fires where cause = 'smoking'. All such fires fall within the 'other' causal category. This differs from most other agencies where they were principally classified as accidental.
- Reserves have been allocated to one of seven regions defined by the NSW NPWS 2007 (see methodology chapter and discussion below). These regions differ from the tourism regions used in the NSWFB and NSWRFS analyses.
- The dataset included information about the area burned.
- Information was available about the tenure, where fires originated and were controlled relative to park boundaries, but no information was available about the fire danger index and weather conditions at the time the fire occurred in approximately one-quarter of cases.

For more detail about these methodologies see the methodology chapter.

Overview

Fires the NSW NPWS attended can be summarised as follows:

- The NSW NPWS records indicate attended at 3,275 fires on or near reserves under their jurisdiction for the seasons encompassing 1995–96 to 2003–04. This represents an average of just over 400 fires per year. The greatest total number of fires occurred in 1997–98 (n=571), although high numbers of fires also occurred in 2000–01, 2001–02, and 2002–03 (Figure 100).
- Fires the NSW NPWS attended both on and near tenures that lie under that organisation's jurisdiction ranged from small vegetation fires to large bushfires. Given the nature of the NSW NPWS's responsibilities is not unreasonable to assume that most fires this agency attended either constituted a bushfire, or had the potential to develop into a bushfire under adverse weather conditions.
- Forty-one percent of all fires were identified as deliberate or deliberate causes were suspected. Such fires comprised almost half of all known causes of fires the NSW NPWS attended.
- Forty-three percent of all fires the NSW NPWS attended occurred in the Sydney and surrounding region, with high numbers of fires also being evident in the Hunter and Mid North Coast and South Coast and Southern Highlands regions.
- Fires the NSW NPWS attended from 1995–96 to 2003–04 burned approximately 3.5 million hectares. Deliberate fires accounted for 21 percent of the total area burned. This principally occurred in 2000–01 and 2001–02. Natural cause was an important factor in large fires spreading from parks onto neighbouring properties, whereas accidental and deliberate causes (commonly legal and illegal burn offs) were one of the key factors in large fires spreading into NSW NPWS tenures.

Cause

Twenty-one percent of all fires were characterised as incendiary, with incendiary activities being suspected in a further 20 percent of cases (Figure 101). Collectively, deliberate causes (incendiary and suspicious combined) accounted for 41 percent of all NSW NPWS fires, 48 percent of instances where the cause of the fire was assigned. One-quarter of all fires resulted from natural causes, with a further 12 percent being accidental in nature.

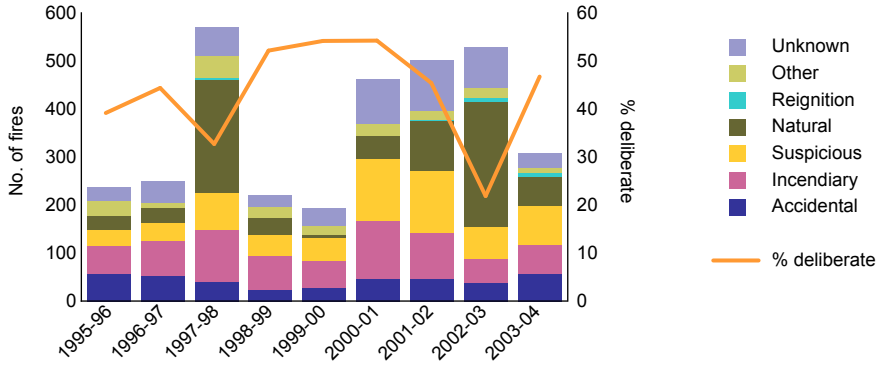
The number and principal causes of fires varied substantially between years. The greatest number of natural fires occurred in 1997–98 and 2002–03 (Figure 100), both seasons associated with El Niño-like weather patterns. Natural fires accounted for 41 and 50 percent in these two seasons, respectively. This compares to rates of three to 21 percent in all other seasons, including 2001–02.

The greatest number of deliberate fires occurred in 2000–01 (n=249) and 2001–02 (n=226; Figure 100). A high number of deliberate fires also occurred in 1997–98 (n=185) and 2003–04 (n=143). Despite the adverse conditions, and the high number of deliberate fires during the previous seasons, the number of deliberate fires in 2002–03 was equivalent to that recorded during less adverse fire seasons like 1998–99 and 1999–2000. The lowest proportion of deliberate fires occurred in the 1997–98 (32%) and 2002–03 (22%) seasons; a reflection of the greater number and hence proportion of natural fires in those season. In years not associated with an El Niño-like weather pattern, deliberate fires constituted 39 to 54 percent of all NSW NPWS-attended fires (Figure 100).

Specific ignition factors

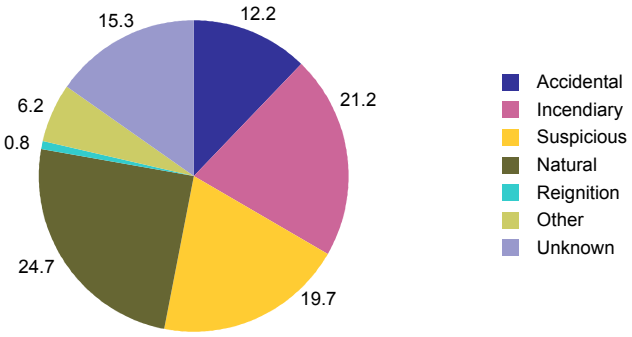
In detail, fires originated from a variety of causes (Figure 102). Deliberate fires incorporated all fires originally classified as arson, suspicious, illegal burn offs, and motor vehicle arson. Arson or suspected arson (excluding motor vehicles) accounted for 36 percent of all NSW NPWS fires from 1995–96 to 2003–04 being the single most dominant factor. Lightning strikes were responsible for all fires classified as natural, and accounted for almost one-quarter of fires. Burning off was involved in 11.9 percent of all fires. Of these almost one-third were illegal. Motor vehicles were implicated in a further 5.3 percent of all fires. Of these one-third (1.5% overall) involved arson or arson was suspected. Fires pertaining to domestic, camping and cooking accounted for 3.1 percent of all fires. Additional factors resulting from industry/farming, public facilities (trains, power lines etc.) comprised a comparatively small proportion of fires.

Figure 100: Seasonal variation in the cause of fires and percentage of deliberate fires



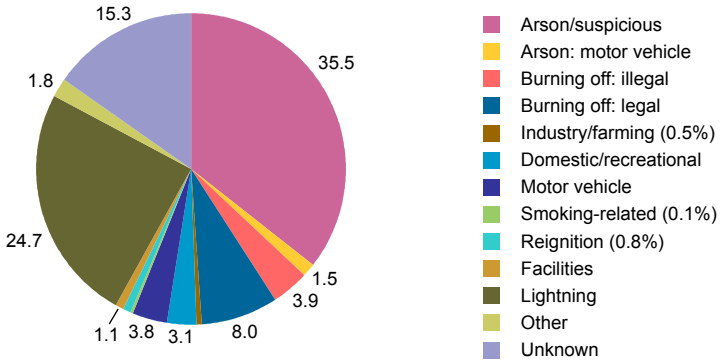
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 101: Cause (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 102: Detailed cause (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Location

Information about the location of fires is discussed in relation to the region and reserves on which fires occurred, the tenure of lands, and the location of the point of origin and final suppression relative to NSW NPWS tenure boundaries.

Region

Region definition: For reasons outlined in the methodology, the allocation of NSW NPWS fires to particular regions differed to that used for the NSWFB and NSWRFS. The system adopted is based on the classification used for national parks outlined by the NSW NPWS (2007b). The seven regions defined therein include Sydney and surrounds, Hunter and Mid North Coast, Northern Rivers, South Coast and Southern Highlands, New England Tablelands, Central NSW, and Outback NSW. In this classification, fires were allocated to a specific region on the basis of the reserve name. The distribution of these regions is illustrated in Figure 103, and a brief description of the regions, including their makeup relative to the regional classification provided with the NSW NPWS data, are outlined below:

- **Sydney and surrounds** is centred on Sydney but incorporated parks extending from the Nattai and Thirlmere Lakes national parks in the south (just north of Wollongong) to the Lake Macquarie State Conservation Area and Wallarah National Park in the north (just south of Newcastle), and to the Gardens of Stone and Kanangra–Boyd national parks in the west (Lithgow region). Thirty percent of fires in the Sydney and surrounding region occurred in areas formerly classified within the NSW NPWS regions of the Central Coast–Hunter (Figure 104). A further 26 percent were from the NPWS Blue Mountains region, 26 percent from the NPWS Sydney South region and 14 percent from the NPWS Sydney North region. Just four percent were from the central Sydney metropolitan region.
- The **Hunter–Mid North Coast** region defines an elbow shape (Figure 103) that extends from just south of Newcastle (Watagans National Park) to just north of Coffs Harbour (Coffs Coast Regional Park), and inland as far as the Towarri National Park (northwest of Scone) in the south and the Nymboi–Binderay National Park in the north. Fifty-three percent of fires in this region were from the NPWS Central Coast–Hunter region, 34 percent in the NPWS Mid North Coast region, and 13 percent from the NPWS North Coast region (Figure 104).
- The **Northern Rivers** region encompasses all reserves on the coast between the Hunter–Mid North Coast region and the Queensland border, and as far inland as the Tooloom and Koreelah national parks in the north. Fifty-one percent of fires in this region were originally classified with the NPWS Northern Rivers region; the other 48 percent were from the NPWS North Coast region (recorded as NOC & NCR codes within the database provided).
- The **New England Tablelands** region incorporates reserves from as far south as Mummel Gulf National Park, to the border in the north, and from Kwiambal and Warrabadah in the west to just east of Dorrigo. Seventy percent of fires in this area were originally from the NPWS Northern Tablelands region, 26 percent from the NPWS North Coast region, and four percent from the NPWS Mid North Coast region (Figure 104).
- The **South Coast and Southern Highlands** region encompassed reserves along the South Coast from Wollongong (Illawarra Escarpment State Conservation Area) to the Victorian border, and as far inland as the Brindabella, Kosciouszko and Woomargama reserves. Thirty-nine percent of fires were from the NPWS Snowy Mountains and NPWS Southwest Slopes regions, 33 percent from the NPWS South Coast, and 28 percent from the NPWS Far South Coast region (Figure 104).
- The **Central West** defines a roughly north–northeast trending region inland of the aforementioned regions, encompassing parks near Narrabri, Coonabarabran, Dubbo, Mudgee, Bathurst, Forbes, and Wagga Wagga. This region extends as far inland as the Cocoparra and Oolambeyan national parks. Thirty-nine percent of fires in this region were from the original NPWS Northern Plains region, 34 percent from the NPWS Central West region, and the remainder from the NPWS Blue Mountains, North Coast, Northern Tablelands and Riverina regions.
- **Outback NSW** incorporates all regions further west, with a further seven percent coming from the NPWS Far West and 28 percent from the NPWS Riverina regions (Figure 104).

- **Total number of fires**: Forty-three percent of all fires the NSW NPWS attended occurred in the Sydney and surrounding region. A further 19 and 17 percent of fires were located in the neighbouring regions of the Hunter–Mid North Coast and the South Coast and Southern Highlands, respectively (Figure 105). Nine percent occurred on the New England Tablelands and eight percent in the Northern Rivers region. Just 4.4 percent of fires were located further inland, in the Central West and Outback NSW regions.

Temporal changes occurred in the regional distribution of fires from 1995–96 to 2003–04. Despite the large spike in fire numbers in the Sydney and surrounding region in 1997–98 (Figure 106), this region consistently accounted for 50 to 56 percent of NSW NPWS-attended fires from 1996–97 to 1999–2000 (Figure 107). The proportion of fires in this region subsequently decreased to below 40 percent from 2000–01 onwards. This was despite increased numbers of fires for both 2000–01 and 2002–03. Increasingly other regions, particularly the Hunter–Mid North Coast, New England Tablelands, and to a lesser extent the Richmond River regions, contributed to higher proportions of NSW NPWS-attended fires during the latter half of the observation period.

From 1995–96 to 1998–99, the NSW NPWS attended an average 42 fires per year in the Hunter–Mid North Coast region, with that region accounting for 12 to 15 percent (Figure 107). However, from 2000–01 to 2002–03 the total number increased to an average of 113 per year, peaking at 140 in the 2001–02 season. Simultaneously, the percentage of NSW NPWS fires in the Hunter–Mid North Coast region increased from approximately 15 percent in 1995–96 to 1998–99 to 22 to 28 percent of fires from 1999–2000 to 2002–03. Both the number and percentage of all fires that occurred in the Hunter–Mid North Coast region, returned to the pre-2000–01 levels during the 2003–04 season.

The number of fires occurring on or near reserves in the New England Tablelands increased from an average of 18 for 1995–96 to 1999–2000 to an average of 51 per year for the 2000–01 to 2003–04 interval. In contrast, the number of fires occurring in the South Coast and South Highlands region was markedly higher during both the 1997–98 and 2002–03 El Niño events than during other seasons (Figure 107), highlighting the potential role that large scale climatic conditions play in the increased incidence of fires in that region. This was particularly noticeable for both the Far South Coast and Snowy Mountains areas, although in 2002–03 higher numbers also occurred on the South West Slopes. Surprisingly the South Coast and Highlands also accounted for a high proportion of all fires in 2003–04.

Cause: The cause of fires on or near NSW NPWS reserves varied markedly between regions. The greatest number of deliberate fires (including arson, suspicious, arson-motor vehicle and illegal burn offs) occurred in the Sydney and surrounding region, followed by the Hunter–Mid North Coast, South Coast and Southern Highlands, and the Northern Rivers regions (Figure 108). Deliberate causes accounted for the highest percentage of fires in the Northern Rivers region (59%), Hunter–Mid North Coast (48%) and Sydney and surrounds (44%; Figure 108).

The relative importance of types of illegal fire activity also varied between regions. Arson involving motor vehicles was a phenomenon principally experienced in the Sydney and surrounding region, although several instances were reported in the Hunter–Mid North Coast and the South Coast and Southern Highlands regions.

The highest number of fires resulting from burning off (illegal and legal combined) occurred in the New England Tablelands, Hunter–Mid North Coast and Northern Rivers regions (Figure 109). Burning off accounted for 37 and 27 percent of all fires in the New England Tablelands and Northern Rivers regions, respectively. Not surprisingly, regions that recorded high instances of burning off also recorded the highest proportion of illegal burns. Fifty-two percent of all burns in the Northern Rivers region and 36 percent of burns in the New England Tablelands regions were illegal. The proportion of burns that were illegal in other areas was typically 20 to 27 percent.

Fires started by lightning strikes were most frequent in the Sydney and surrounding region and the South Coast and Southern Highlands regions (Figure 110), highlighting the fundamental vulnerability of these areas to natural fires. In the absence of significant other causes, lightning was responsible for 67 and 58 percent of all fires in the Outback and Central West, respectively. This compares with values of 25 and 37 percent in the Sydney and surrounds and the South Coast and Southern Highlands, respectively.

Sydney and surrounds region: Marked differences occurred in the cause and number of fires in the Sydney and surrounds region at a sub-region scale. High numbers of natural fires occurred in the Blue Mountains and Central Coast–Hunter, areas that lie on the perimeter of the metropolitan centre, contributing to a high incidence of fires in these areas overall (Figure 111). Deliberate firesetting was an important issue across the entire region, but owing to the preponderance of natural fires, accounted for a lower percentage of all fires in the Blue Mountains and Central Coast–Hunter sub-regions. Between 55 and 65 percent of fires in the Sydney, Sydney North and Sydney South sub-regions were deliberately lit. Within the metropolitan area, the greatest number of deliberate fires occurred in southern Sydney, a finding that is consistent with both the NSWFB and NSWRFS data.

The Sydney and surrounds region experienced the greatest number of fires in 1997–98, followed by 2001–02, and 2000–01 (Figure 112), a reflection of higher frequencies of both natural and deliberate fires during these years. While 2001–02 is sometimes singled out as being a particularly adverse year for deliberate fires, the number of deliberately lit fires in that year was actually lower than in the previous year. Despite the adverse conditions, fewer deliberate fires were recorded in the Sydney region in 2002–03 than in any other year analysed.

Hunter–Mid North Coast region: The Hunter–Mid North Coast also experienced the greatest numbers of fires in 1997–98 and from 2000–01 to 2002–03; unlike the Sydney and surrounds region, the Hunter–Mid North Coast region's greatest number of fires occurred during the latter half of the observation period (Figure 113). This was an area strongly affected by the December–January 2001–02 fires.

Deliberate fires accounted for almost half of all fires in the region. The greatest number of fires occurred in 1997–98, 2000–01 and 2001–02 (Figure 113), coincident with the increases evident for the Sydney and surrounds region. Like that region, a marked decrease in deliberate fire numbers occurred in 2002–03 despite the adversity of the season. With the exception of 1998–99, where 90 percent of fires were deliberate, and 2002–03, where low proportions of deliberate fires were an artefact of high natural fire numbers, the percentage of fires that result from deliberate causes in the Hunter and Mid North Coast region remained comparatively stable throughout the observation period, at approximately 50 percent.

South Coast and Southern Highlands region: The principal cause of fires in the South Coast region varied markedly across the region, a finding that is not surprising in light of the regional differences in climate, vegetation, land-use, population density and demographics. The Snowy Mountain–South West Slopes sub-region recorded the greatest number of fires of any sub-region (Figure 114). A high proportion of these were the result of natural causes. In contrast, the large numbers of fires in the South Coast sub-region largely reflect a high incidence of deliberate firesetting. Roughly half of all fires on the South Coast were deliberate, rates that are equivalent to that observed for the Hunter and Mid North Coast region. The Far South Coast region appears intermediate between the two areas, experiencing a higher incidence of natural fires that than the South Coast, but also a higher number of deliberately lit fires than the Snowy Mountains–South West Slopes. Of the 159 fires that occurred on the Far South Coast, 38 percent resulted from natural causes, with a further 31 percent being the result of deliberate lightings.

High numbers of natural fires during both 1997–98 and 2002–03 El Niño events contributed to higher than average numbers of fires in these two years. Increases principally occurred for the Far South Coast and the Snowy Mountains–South West slopes sub-regions. The higher than expected number of fires in 2003–04 principally reflected a doubling in the number of deliberate fires in that year (Figure 115).

Northern Rivers region: Comparatively few fires occurred in the Northern Rivers region from 1995–96 to 1999–2000. This was followed by a massive increase the number of fires in 2000–01 (Figure 116). Although fire frequencies remained elevated during the later half of the observation period, the number of fires systematically decreased from 2000–01 onwards, almost reaching pre-2000–01 levels by 2003–04. These temporal variations were evident in both the Northern Rivers and North Coast sub-regions. Higher numbers of fires from 2000–01 to 2002–03 principally reflected greater numbers of deliberate fires. The actual numbers of deliberate fires were comparable across the North Coast and Northern Rivers sub-regions, but deliberate causes accounted for 67 percent of all fires in the North Coast sub-region as compared with 50 percent for the Northern Rivers sub-region.

Figure 103: Map of NSW NPWS regions

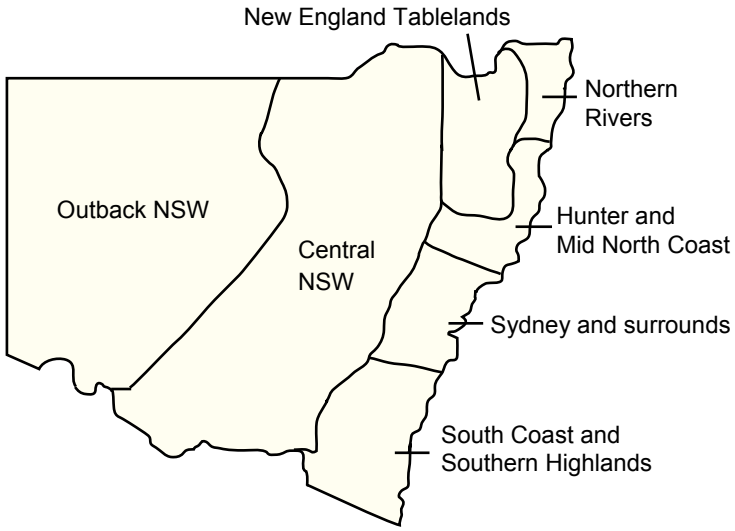
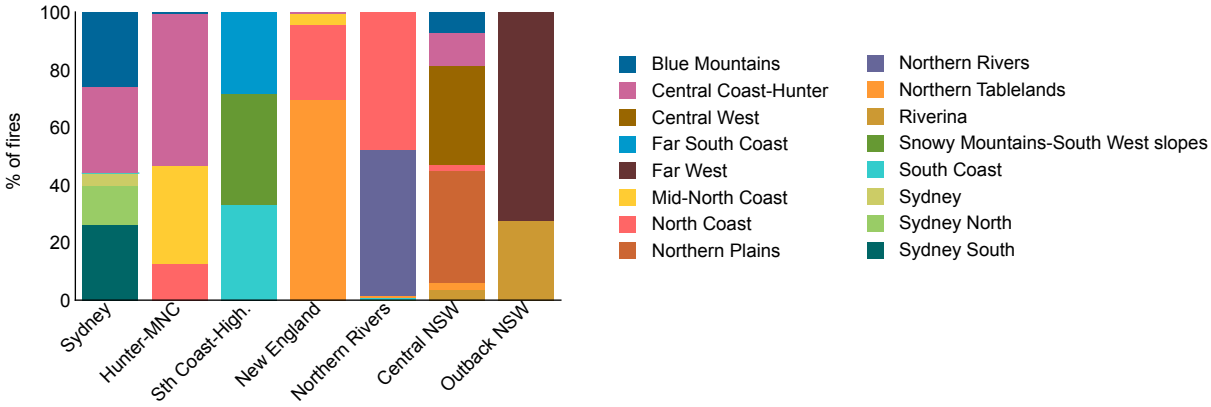


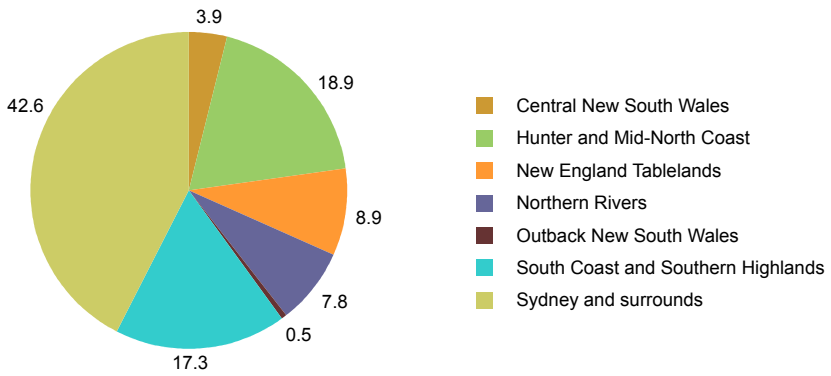
Figure 104: NPWS regions[a], by original sub-region classification (percent)



a: New England = New England Tablelands; Sth Coast-High. = South Coast and Southern Highlands; Hunter-MNC = Hunter and Mid North Coast; Sydney = Sydney and surrounds

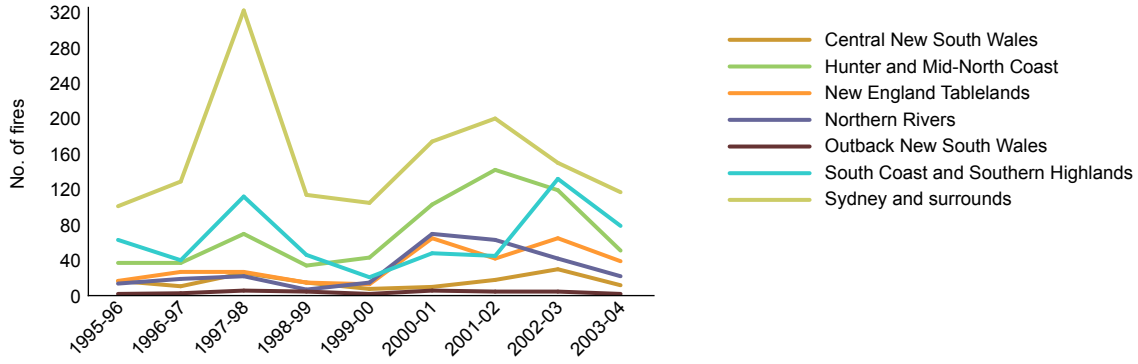
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 105: All fires, by region (percent)



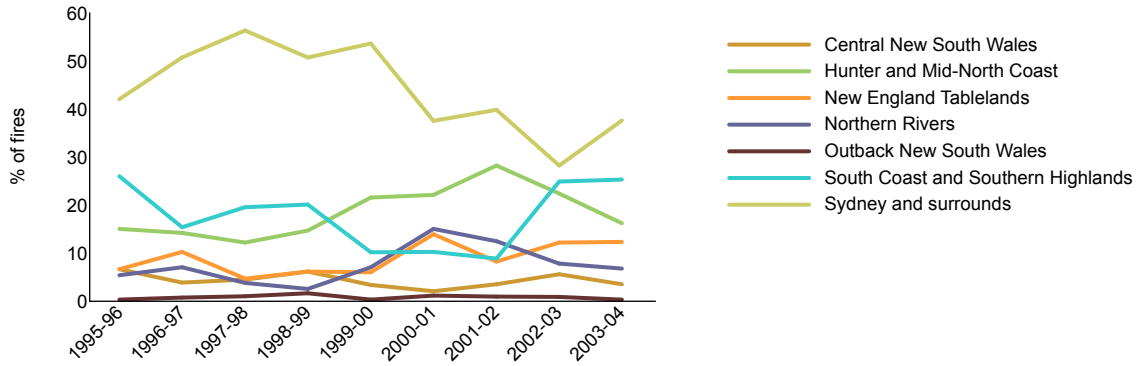
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 106: All fires, by region and season (number)



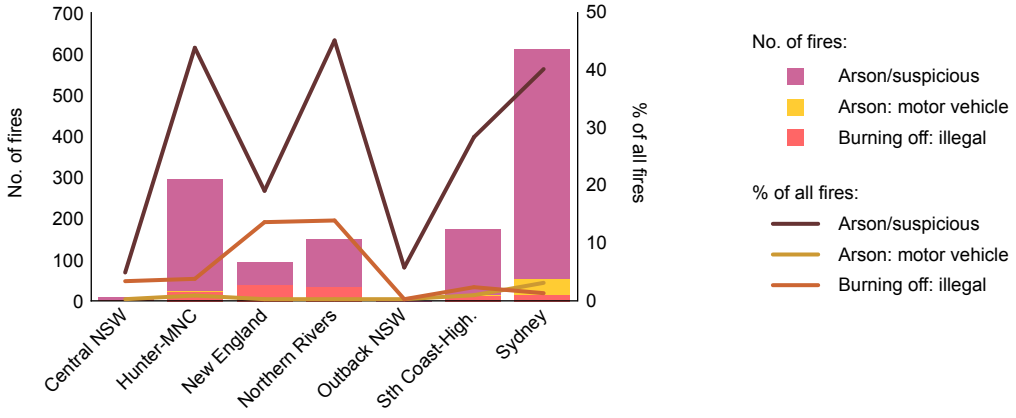
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 107: All fires, by region and season (percent)



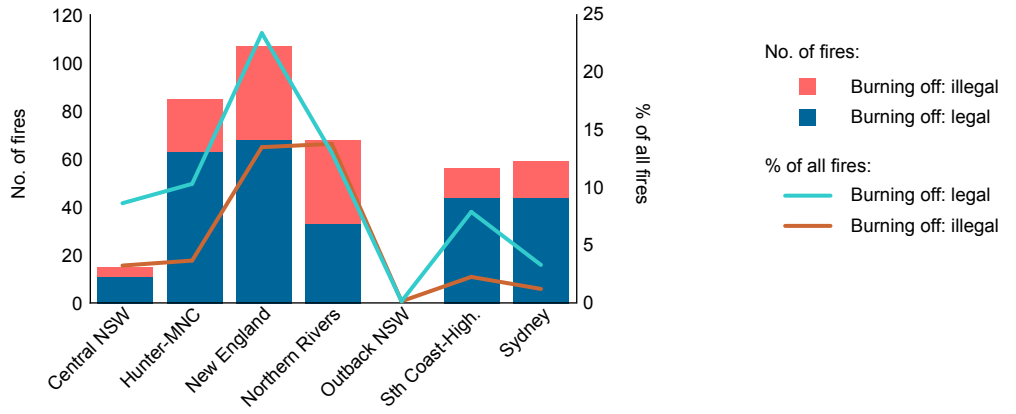
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 108: Deliberate fires, by specific cause and region



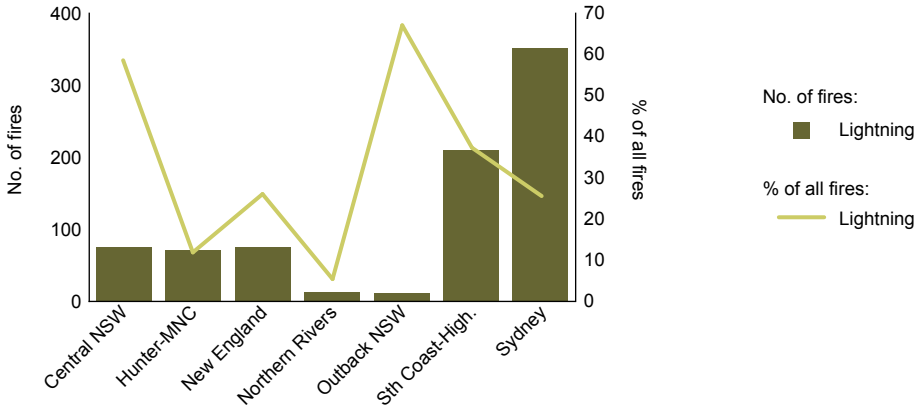
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 109: Burn offs, by region



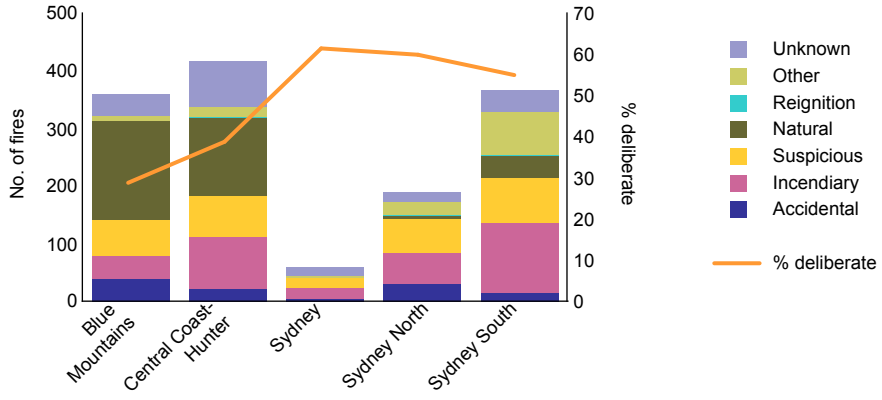
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 110: Natural fires, by region



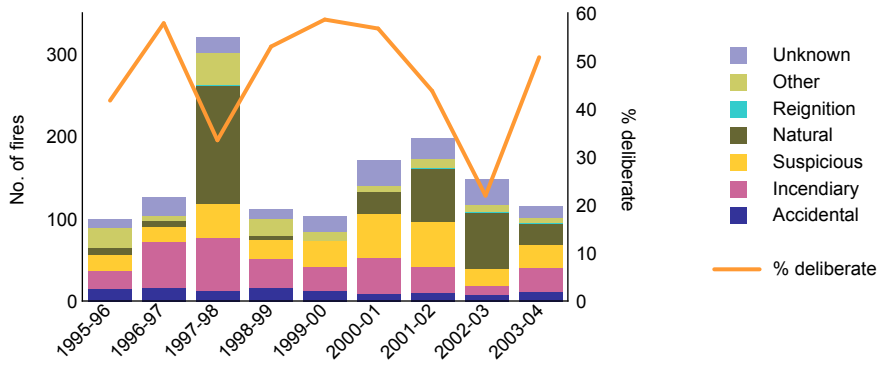
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 111: Sub-regions in the Sydney and surrounds region, by cause



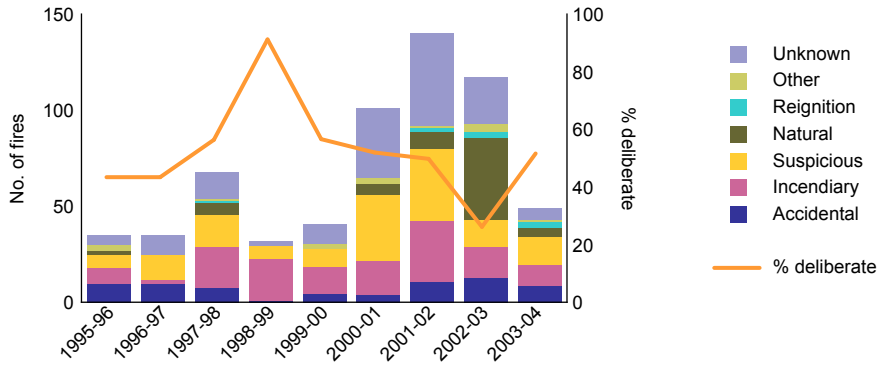
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 112: Fires in the Sydney and surrounds region, by cause for each season



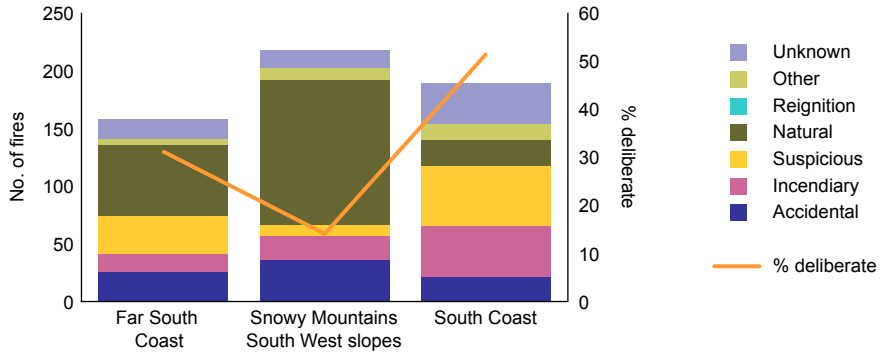
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 113: Cause of fires in the Hunter–Mid North Coast region each season



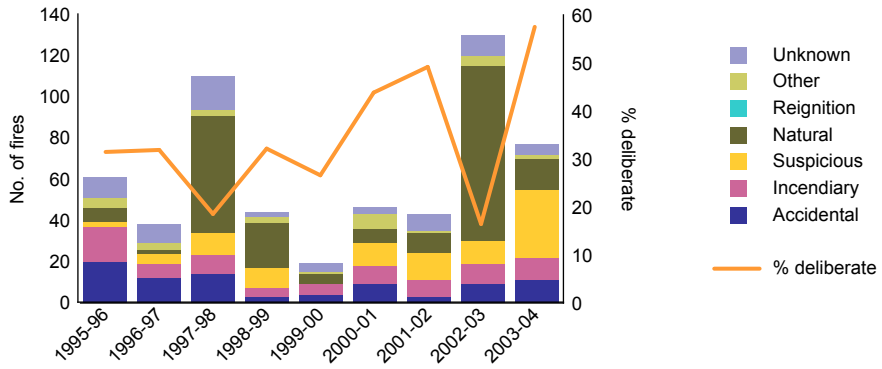
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 114: Sub-regions of the South Coast and Southern Highlands region, by cause



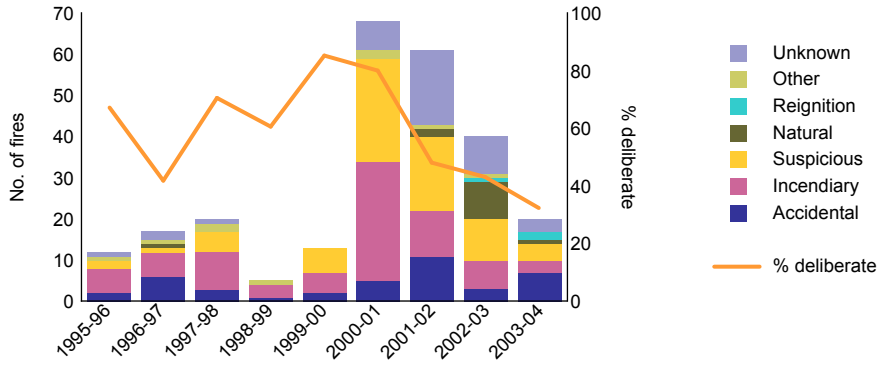
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 115: South Coast and Southern Highlands region fires, by cause each year



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 116: Fires in the Northern Rivers region, by cause each year



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Reserve

The number of fires experienced in eight years varied markedly between reserves. More than 200 fires occurred in or near the Wollemi National Park from 1995–96 to 2003–04 (Figure 117). Another three reserves (Blue Mountains, Kosciouszko and Royal national parks) recorded 100 to 200 fires and five recorded 50 to 99 fires (Ku-ring-gai Chase, Yengo, Morton, Yuraygir and Deua national parks). Of these parks, five occurred in the Sydney and surrounds region, three in the South Coast and Southern Highlands and one in the Northern Rivers regions. Twenty-five to 49 fires were documented for a further 14 reserves over the eight-year interval.

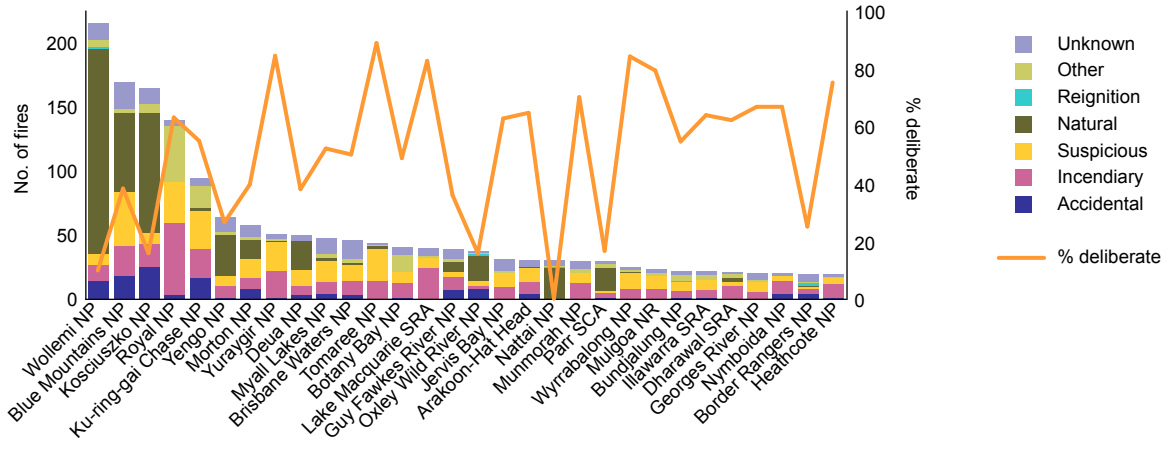
The causes of high fire numbers also varied markedly between reserves (Figure 117). Natural fires were the principal cause of the greater numbers of fires in the Wollemi and Kosciouszko national parks, whereas in the Blue Mountains National Park both natural and deliberate fires featured.

Fires in the Royal National Park predominantly arose from deliberate causes (63% deliberate), with 88 deliberate fires occurring in or near the park in eight years. Other parks to experience in excess of 50 deliberate fires in eight years included the Blue Mountains and Ku-ring-gai Chase national parks. The Yuraygir National Park (Northern Rivers) was the only reserve to record 40 to 49 deliberate fires. Thirty to 39 deliberate fires occurred in the Tomaree National Park and Lake Macquarie State Recreation Area. In these three reserves, deliberate causes accounted for 80 to 90 percent of all fires in those parks.

The proportion of fires resulting from deliberate causes was highly variable across reserves, even for parks with a large number of fires. However, it was common that 50 to 70 percent fires were deliberately lit in reserves documenting 20 or more fires in total.

Of the 48 cases involving motor vehicle arson 17 (35%) occurred in the Royal National Park, with this causes accounting for 39 percent of all deliberate fires in that reserve. A further 10 cases (21%) involving a motor vehicle occurred in the Dharawal State Recreation Area, and this cause was responsible for 77 percent of fires in or near that reserve. This highlights that motor vehicle arson may be a serial offence committed by ‘locals’ within geographically small areas.

Figure 117: Reserve, by cause



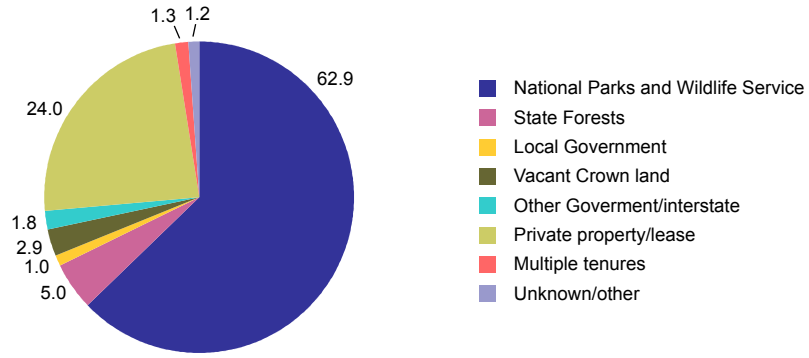
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Tenure

Almost two-thirds of all fires the NSW NPWS attended occurred on lands within their tenure (Figure 118). A further 24 percent were on private property or leasehold land, five percent were in state forests and three percent were on vacant crown land.

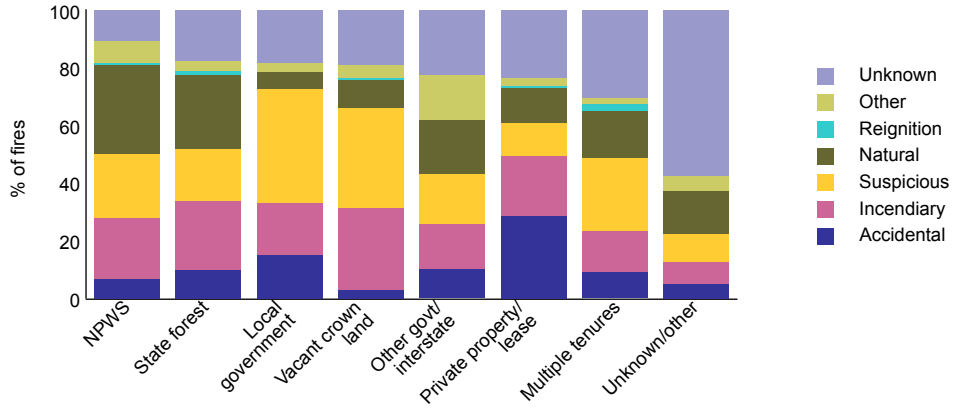
Proportionally more natural fires occurred in NPWS and State Forest tenures than in any other category, whereas deliberate causes accounted for the highest proportions of fires on local government lands and vacant Crown land (approximately 60%). Forty-one to 43 percent of all fires on NPWS and State Forest tenures were deliberately lit (Figure 119).

Figure 118: Tenure (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 119: Tenure, by cause



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Point of origin–suppression (on–off status)

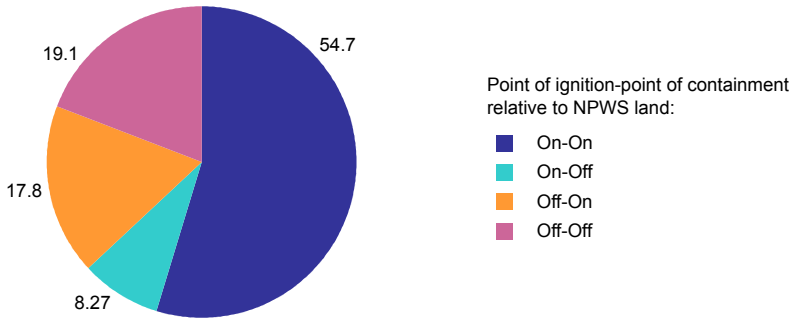
Sixty-three percent of all fires the NSW NPWS attended originated on NPWS reserves (Figure 120). The majority of these were contained on those reserves. In contrast, there was a roughly equal likelihood that fires started off-park were contained off-park as opposed to spreading onto neighbouring NPWS reserves. Moreover, of those fires the NSW NPWS attended, a fire that started off-park and crossed onto park lands was twice as likely as a fire starting on parks lands but crossing onto neighbouring properties.

A higher proportion of fires that originated on NPWS reserves resulted from natural causes when compared to off-park fires (Figure 121). This was particularly evident for fires that subsequently transgressed park boundaries. However, a slightly higher proportion of all fires that started on NSW NPWS lands resulted from deliberate causes, when compared to those originating off-park. To some extent this may be counterbalanced by the higher incidence of fires of unknown causes in off-park categories.

The likelihood of deliberate fires occurring on- or off-park varied depending on the specific cause of the fire. Not surprisingly, most illegal burn offs originated off-park, but between half and two-thirds of all those fires subsequently transgressed park boundaries (Figure 122). Fires resulting from motor vehicle arson typically occurred on-park and were subsequently contained on-park. These figures are dominated by cases of motor vehicle arson in the Royal National Park. Approximately two-thirds of all fires identified as arson or suspicious (not involving a motor vehicle) also occurred on-park. Of these, the majority were contained on-park. Of the one-third of deliberate arson fires that originating off-park, roughly one-third subsequently transgressed parks boundaries.

The inherent tendencies for deliberate fires to originate on- or off-park, and the likelihood that they transgressed boundaries was a function of both the specific causal factors, the size of the park, and ease of containing the blaze, and therefore necessarily varies between regions. The highest proportion of deliberate fires that originated on-park was recorded in the Sydney and surrounds region, and the neighbouring South Coast and Southern Highlands and the Hunter–Mid North Coast regions (Figure 123). Fires that started off-park but subsequently transgressed park boundaries were most evident in those regions where there was a high proportion of legal and illegal burn offs, namely the New England Tablelands and Northern Rivers regions. The overwhelming majority of off-park fires originated on private property or leases. Nevertheless, many fires also started in state forests and to a lesser extent on vacant Crown land.

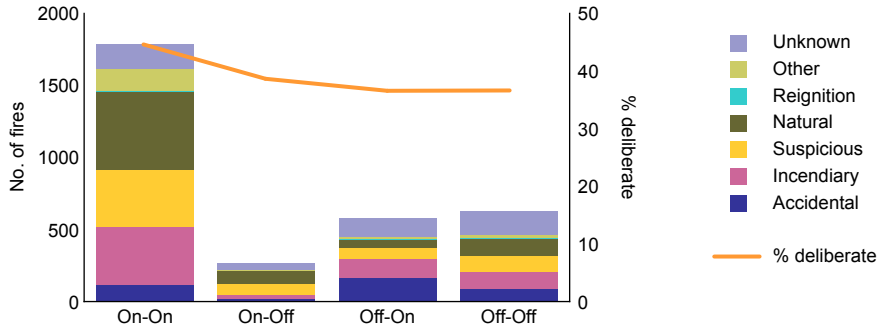
Figure 120: On–off status (percent)[a]



a: on-* and off-*, refers to fires that starting on and off a park reserve respectively; *- on and *- off refers to fires that were contained on- and off-park respectively

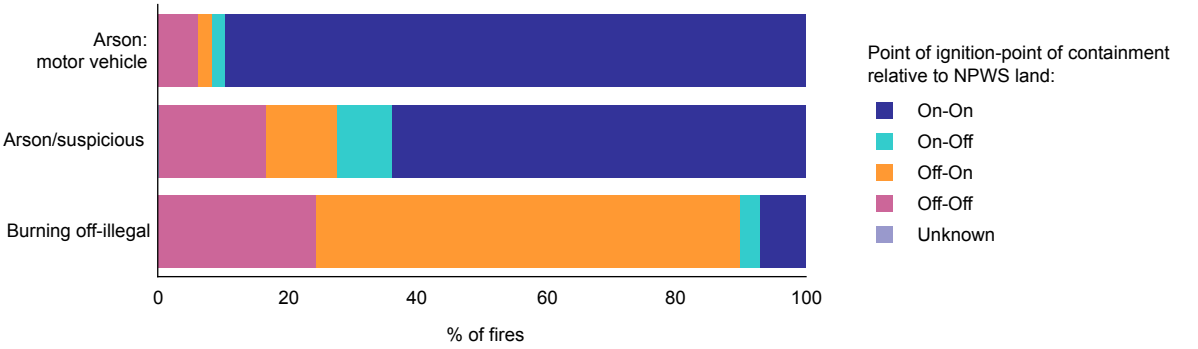
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 121: On–off status, by cause



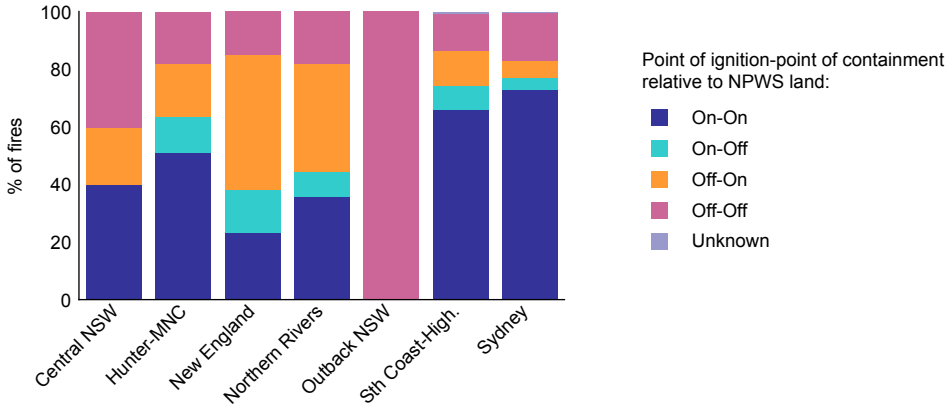
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 122: Specific deliberate fire causes, by on–off (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 123: Deliberate fires in each region, by on–off status (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Timing

The timing of fires is examined by week of the year and the day of the week on which fires occurred, as well as the time that fire crews were in attendance.

Week of the year

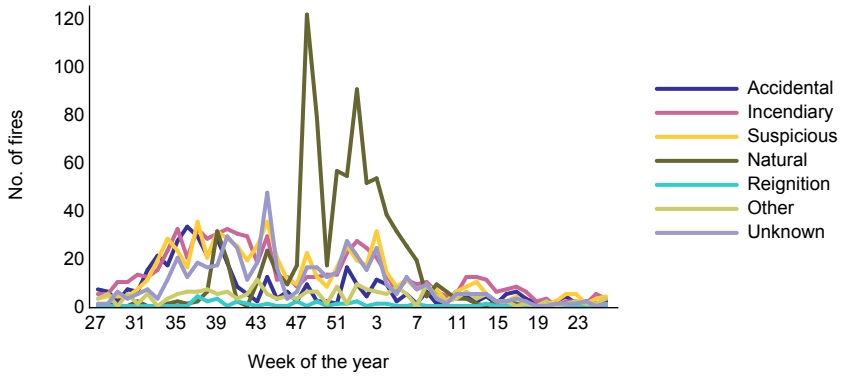
The timing of fires by week of the year was highly cause-specific. Natural fires principally occurred from mid December to the end of February, although earlier occurrences are noted (Figure 124). Accidental fires occurred throughout the year, but the main peak occurred from early August to mid October, reflecting the fact that most legal burn offs in NSW occur within this period (Figure 125). A smaller increase in accidental fires resulting from recreational activities occurred during the Christmas school holidays.

Deliberate fires also occurred throughout the year, but there were two major peaks in activity, mid August to mid November and mid December to early February. This general trend was evident for all fires classified as either arson or suspicious. However, deliberate fires resulting from illegal burn offs principally coincided with the first peak, concomitant with the peak in legal burn offs. Fires resulting from arson involving motor vehicles occurred throughout the year, but with a peak coincident with the last school term (mid September to early November).

Considerable variation was evident in the timing and maximum intensity of fires across fire seasons. Until 2000–01, the number of fires attended in any particularly week was comparatively small (less than 20 to 25; Figure 126). The only notable exception was during 1997–98, an El Niño event, when very high numbers of fires – many natural – occurred during week 48 (early December) and one in the first week of January. The distribution for fires during the 21st century has been somewhat different. In 2000–01, a large spike in activity occurred early September to late October, with a smaller peak in early January (Figure 127). In 2001–02, several smaller peaks occurred in weeks 34 and 41, followed by three large peaks in weeks 44 (early November), 49 (early December) and 52 (late December). In 2002–03, elevated fire numbers occurred from late September to mid January, with increased fire numbers occurring during a number of weeks within that interval. In contrast, the trend in 2003–04 was more similar to that of 2000–01, albeit at reduced numbers. Peaks in that season occurred in September–early October and to a lesser extent in January. These temporal trends defined within the NSW NPWS database are broadly consistent with those described within the NSWFB and NSWRFS data.

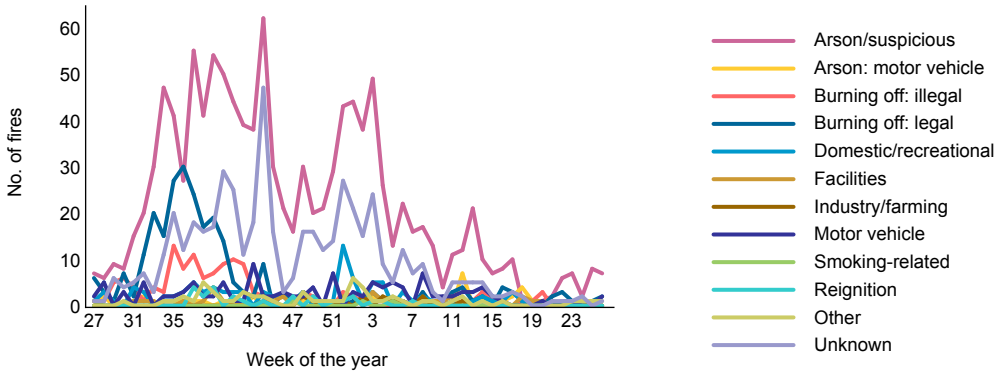
The timing of fires varied markedly between regions, being dependent not only on the inherent climatic conditions, but also the types of practices that lead to fire. Both the Sydney and surrounds region and the Hunter–Mid North Coast region experienced two peaks of activity during September–November and late December–January, coincident with that described above for deliberate fires (Figure 128). In contrast, fires in the New England Tablelands region primarily occurred in September and October, principally because many of those fires resulted from burn offs. Most fires in the Northern Rivers region occurred during August–October, although increased numbers were also evident in January and February. Seasonality in fire occurrences was less well defined for the South Coast and Southern Highlands regions, probably because of the diversity in geographical conditions and the causes of fires within this region.

Figure 124: Week of year, by cause (number)



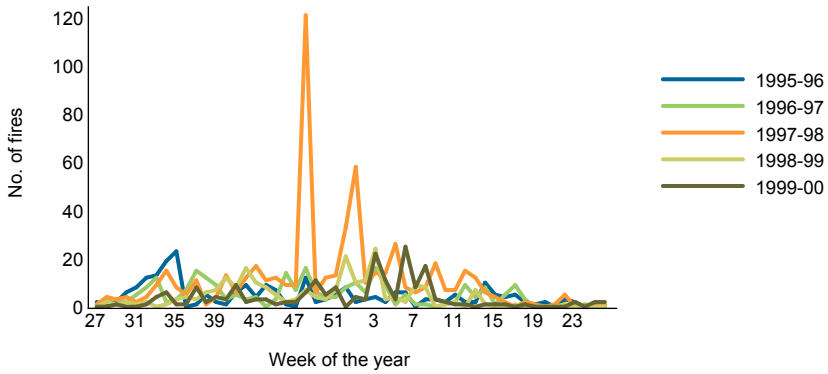
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 125: Specific causes of non-natural fires, by week of the year (number)



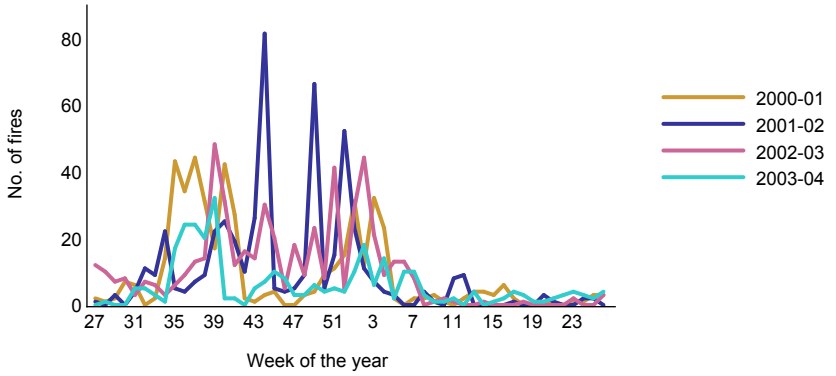
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 126: Week of year, by year, 1995–96 to 1999–2000 (number)



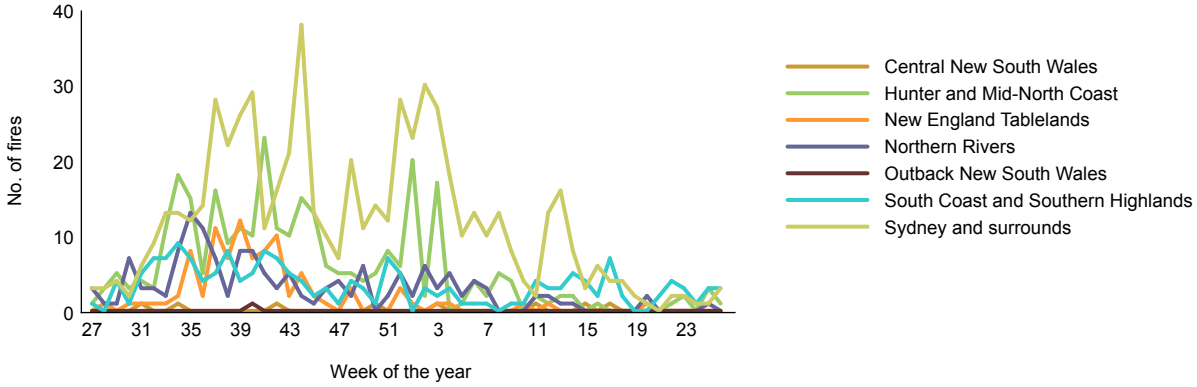
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 127: Week of year, by year, 2000–01 to 2003–04 (number)



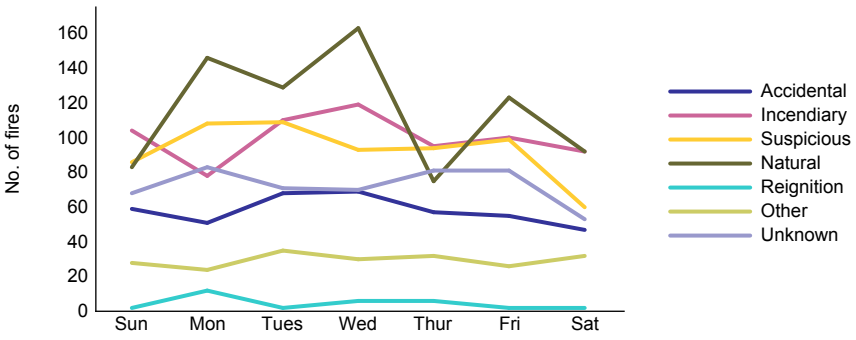
Source: NSW NPWS 2000–01 to 2003–04 [computer file]

Figure 128: Week of the year, by region (number)



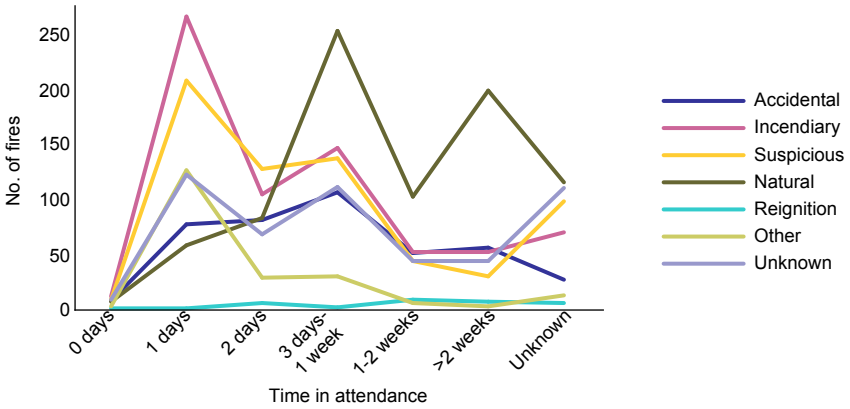
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 129: Day of week, by cause (number)



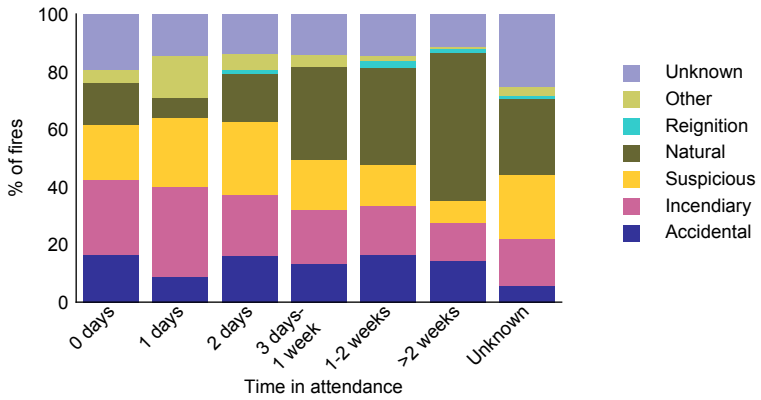
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 130: Number of days attended, by cause (number)



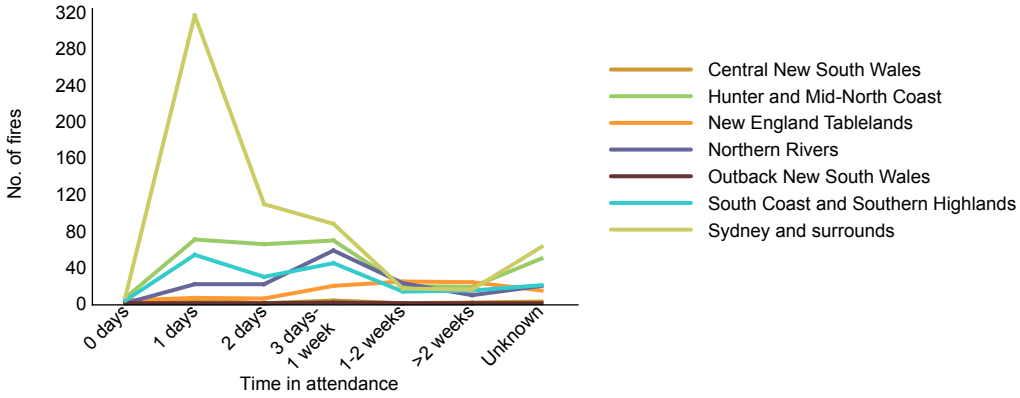
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 131: Number of days attended, by cause (percent)



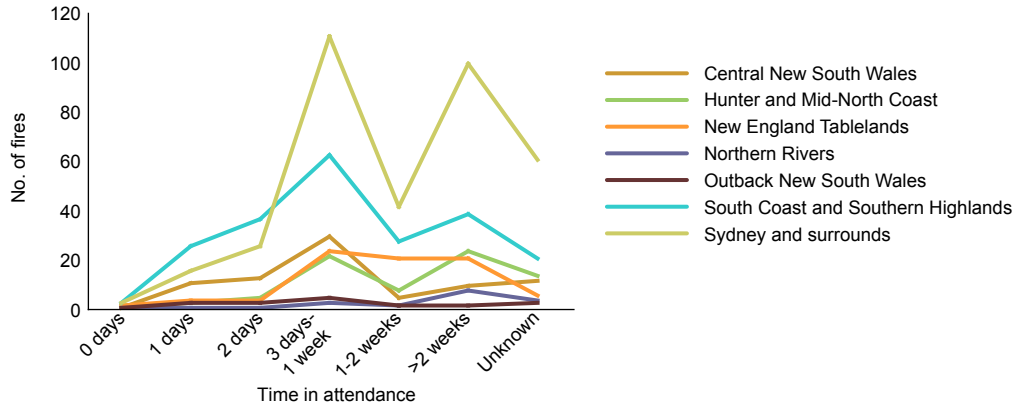
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 132: Number of days attended for deliberate fires, by region (number)



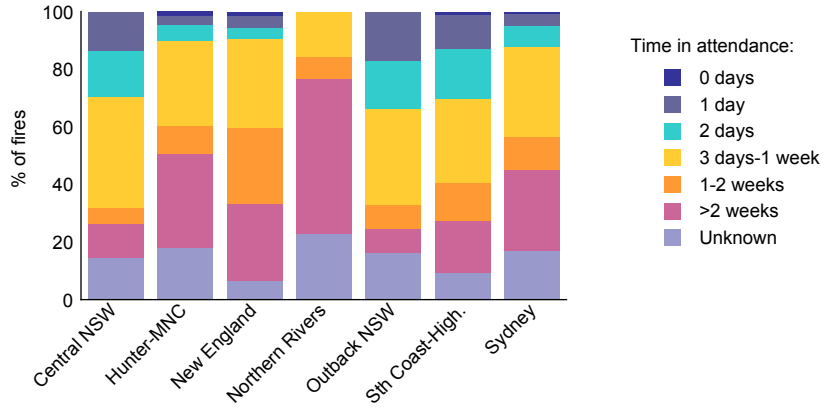
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 133: Number of days attended for natural fires, by region (number)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 134: Time in attendance, by region (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Day of the week

There is no evidence within the NSW NPWS data that fires of a particular cause where inherently more likely to occur on one day or another (Figure 129). This is unlike the trend observed for most urban and rural fire services. Nevertheless, it is possible that such trends may exist in some areas at a local scale.

Length of time attended

The length of time the NSW NPWS was in attendance at individual fires varied markedly, from less than one day through to more than two weeks, ultimately being related to the size of the fire. Overall, the attendance at deliberate fires was generally shorter than for natural fires, with both the number (Figure 130) and proportion of deliberate fires decreasing as the attendance duration increased (Figure 131). Nevertheless, 281 deliberate fires occurred over three days to a week, 94 burned for one to two weeks, and a further 80 deliberate fires burned for in excess of two weeks. Natural fires were typically of longer duration, accounting for higher proportions of fires that required fire crew attendance in excess of three days.

The typical time in attendance at deliberate fires varied markedly between regions, reflecting not only the differences in environment, but also the differences in cause. The vast majority of deliberate fires in the Sydney and surrounds region were less than one day, likely a reflection of the higher incidence of small deliberate fires (Figure 132). In contrast, a higher proportion of deliberate fires in the New England Tablelands region burned over a week or more, as there was a tendency for illegal burns offs to result in larger fires (Figure 132). The balance between small and large deliberate fires varied for other regions.

Natural fires that extended over three days were most frequent in the Sydney and surrounds region (Figure 133). Such fires constituted 28 percent of all fires the NSW NPWS attended in the Sydney and surrounds region (Figure 134). In the Northern Rivers region fires of two weeks or longer were fewer (n=7), but accounted for 50 percent of all fires that occurred in that region.

Area burned

Fires the NSW NPWS attended both on- and off-park burned approximately 3.5 million hectares in NSW in the eight years encompassing 1995–96 to 2003–04. Overall, fires varied in size from less than one hectare up to just over 320,000 ha. The number of fires decreased with increasing fire size, although there was a comparatively high number of fires within the 10 to 500 ha range (Figure 135), particularly compared with the NSWFB and NSWRFS. This general distribution was evident across most causal categories. Nevertheless, deliberate causes tended to account for marginally smaller proportions of all fires as fire size increased (Figure 136). In contrast, natural fires accounted for an increasing proportion of fires as fire size increased. This is particularly evident for fires exceeding 5,000 ha.

The greatest total area burned was burned during 2002–03, followed by 2001–02, 2000–01 and 1997–98 (Figure 137). This is in accord with the temporal variations documented for the NSWRFS. In part this reflects the fact both fire services are likely to attend large fires, and large fires dominated total area burned statistics. Notably, three-quarters of the total area burned in fires the NSWRFS attended fires occurred in national parks.

Natural fires accounted for over half the total area burned in fires the NSW NPWS attended within the observation period, being responsible for approximately 80 percent of the total area burned during 1997–98 and 2002–03. Natural fires also burned large tracts of land during 2001–02, but this only accounted for one-third of the total area burned in that year.

Deliberate fires were responsible for 21 percent of the total area burned by fires the NSW NPWS attended (off- and on-park) from 1995–96 to 2003–04. The most extensive occurred during 2000–01, 2001–02 and 2002–03. In 2000–01, the year preceding the Christmas–New Year fires of 2001–02, deliberate fires accounted for approximately 60 percent (289,788 ha) of the total area burned in that year (Figure 137). Deliberate fires burned a further 220,721 ha in 2001–02 and 153,604 ha in 2002–03. Although deliberate fires were typically smaller than natural fires, 94 deliberate fires exceeded 1,000 ha in area; 34 within the 2000 to 4999 ha range, eight in the 10,000 to 49,999 ha range, with a further four burning between 50,000 and 100,000 ha. Of the latter four, two were in the New England Tablelands region (Guy Fawkes National Park), one was in the Sydney and surrounds region (Wollemi National Park) and another occurred in the South Coast and Southern Highlands region (Morton National Park).

The size distribution of deliberate fires varied somewhat depending on the specific cause of the fire. Fires resulting from motor vehicle arson tended to be smaller (Figure 138). Nevertheless, the potential dangers posed by this practice to the environment are evidenced by the fact that the largest burned between 100 and 215 ha. In contrast, fires resulting from illegal burn offs accounted for a disproportionate amount of larger deliberate fires. Thirty-two illegal burn offs burned 1,000 ha or more; the two largest burned 92,719 ha and 71,899 ha in or near the Guy Fawkes National Park (New England Tablelands region) in the 2000–01 season. Fires attributed specifically to arson or suspicious causes ranged from very small to very

large. Sixty-four fires of this cause burned 1,000 ha or more, 22 burned 2,000 to 4,999 ha, five burned 5,000 to 9,999 and six burned 10,000 to 49,000 ha. The two largest burned 71,164 ha in the Morton National Park (South Coast and Southern Highlands) in 2002–03 and 82,967 ha in the Wollemi National Park in 2001–02 (Sydney and surrounds region). This is among the highest density of large deliberate fires reported in any jurisdiction in Australia.

The percentage of the total area burned in any one region was largely governed by the regional distribution of very large fires. Approximately, three-quarters of the total area burned in NSW NPWS-attended fires of all causes, from 1995–96 to 2003–04, occurred in three regions; the Sydney and surrounds region, the South Coast and Southern Highlands, and the New England Tablelands (Figure 139). Although the Sydney and surrounds region accounted for a high percentage of all small fires, and comparatively fewer moderate sized fires (500 to 200 ha), it also accounted by a substantial portion of the large fires the NSW NPWS attended (Figure 140). Although the overall proportion was lower, a similar distribution occurs for the South Coast and Southern Highlands region.

In contrast, the New England Tablelands region accounted for a very small percentage of fires of less than 50 ha, but a comparatively high proportion of moderate to large fires. Hence, the New England region accounted for a disproportionately high percentage of the area burned, based on the total number of fires. The Northern Rivers region also accounted for higher proportions of larger fires, but the absence of very large fires (greater than 50,000 ha) meant it did not feature significantly in the total area burned across the state. Similarly, the Hunter–Mid North Coast region accounted for 10 to 30 percent of moderate to large fires, but the total area burned in this region was noticeably less than in the Sydney and surrounds region due to the absence of exceptionally large fires (greater than 50,000 ha).

These general regional trends are also reflected in the size distribution of deliberate fires across regions. Notably, the Sydney and surrounds region accounted for a high proportion of both small and large fires, but accounted for only a small proportion of moderate-sized fires (Figure 141). Both New England and the Northern Rivers regions accounted a higher proportion of larger fires, but accounted for a small proportion of small fires.

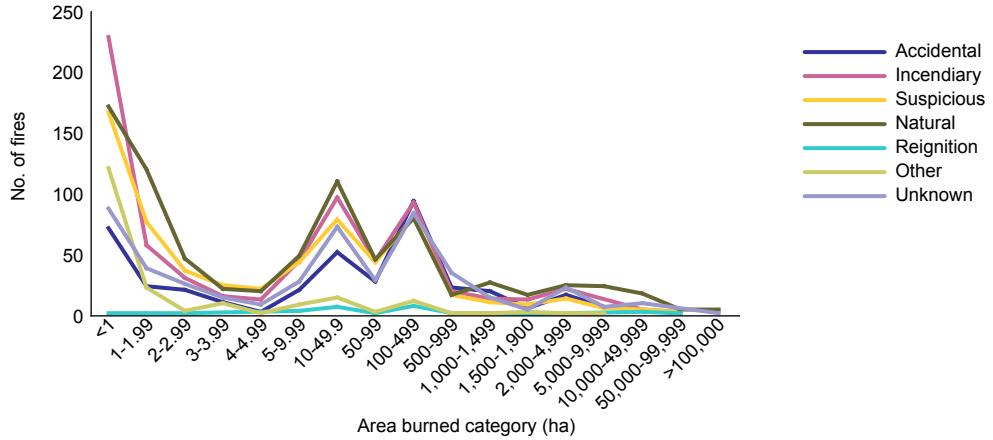
The principal causes of the total area burned are linked to the causes of the largest fires in each region. Natural fires dominate the total area burned in the Sydney and surrounds region, the South Coast and Southern Highlands, Central and Outback NSW.

Deliberate fires accounted for the largest ‘known’ cause of fires in the Hunter and Mid North Coast, New England Tablelands and Northern Rivers regions (Figure 142), burning 95,354 ha, 305,699 ha and 107,213 ha in these region respectively.

The extent to which deliberate fires contribute to the total area burned in each region is largely shaped by the incidence or lack thereof of large natural fires. Although deliberate fires accounted for only 16 percent of the total area burned in the Sydney and surrounds region, they burned 141,722 ha, which represents the second largest area burned by deliberate fires of any one region of the state, behind the New England Tablelands. Similarly, deliberate fires burned 92,104 ha in the South Coast and Southern Highlands, accounting for just nine percent of the total area burned in that region. However, this is comparable to the total area burned in the Hunter and Mid North Coast region during the same interval, a region where deliberate causes were responsible for 30 percent of all land burned.

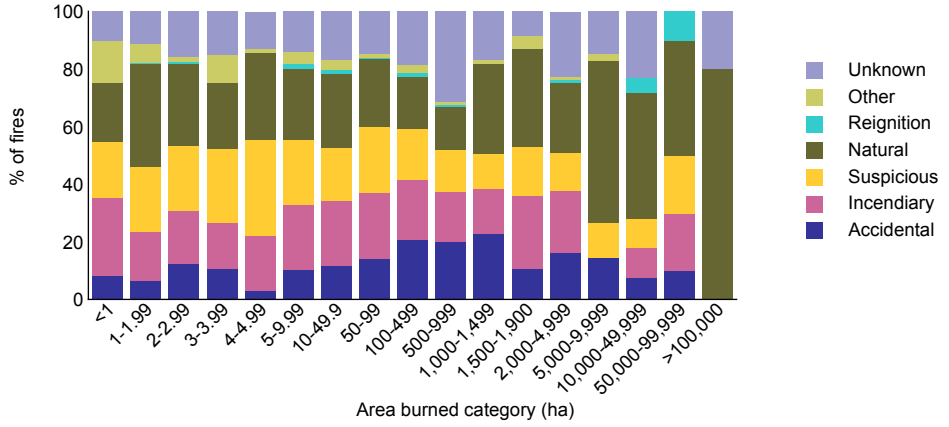
Not surprisingly, fires that started either off-park and spread onto the neighbouring NPWS reserve or started on-park and spread to neighbouring properties accounted for an increasing proportion of all fires as fire size increased; this is because large fires were more likely to transgress property boundaries. Nevertheless, of those fires that did cross boundaries, natural fires were more likely to originate on-park and spread to neighbouring lands (Figure 143), whereas deliberate fires were more likely to start off-park and spread into the park (Figure 144). This has important implications for management of natural reserves in NSW.

Figure 135: Area burned category (ha), by cause (number)



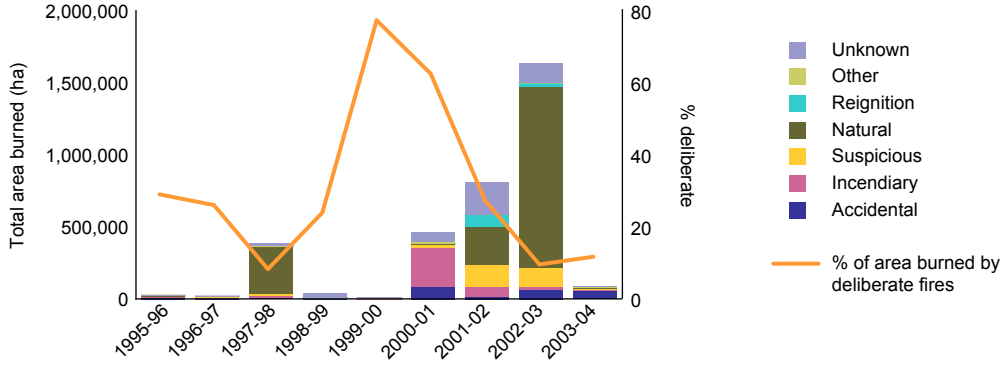
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 136: Area burned category (ha), by cause (percent)



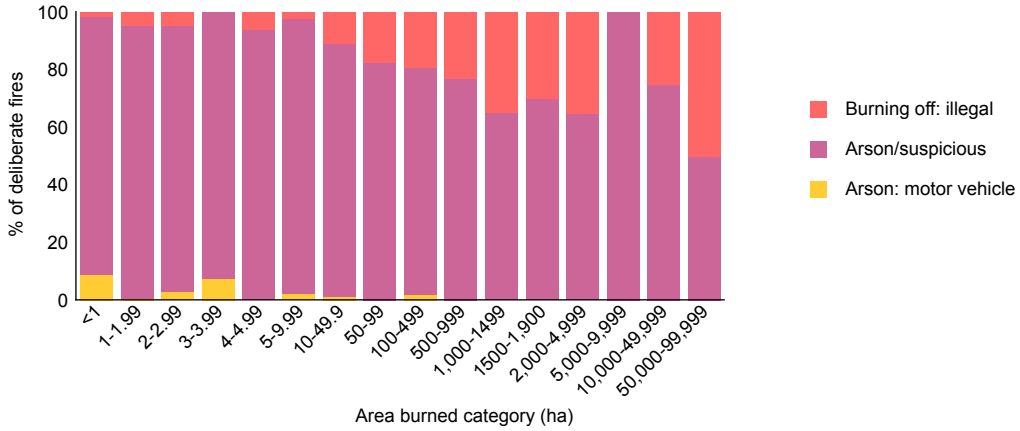
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 137: Total area burned, by cause



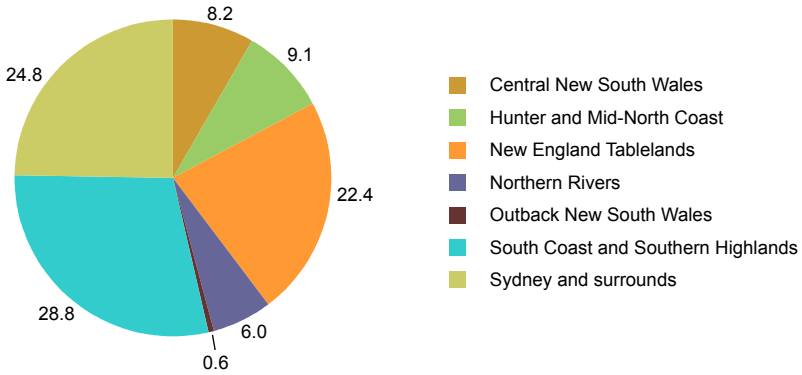
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 138: Area burned category, by specific deliberate causes (percent)



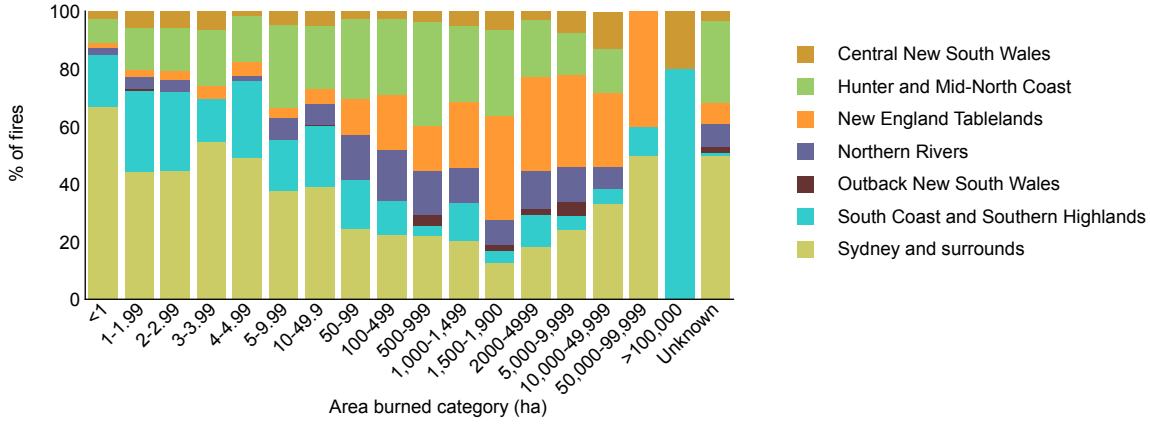
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 139: Total area burned, by region (percent)



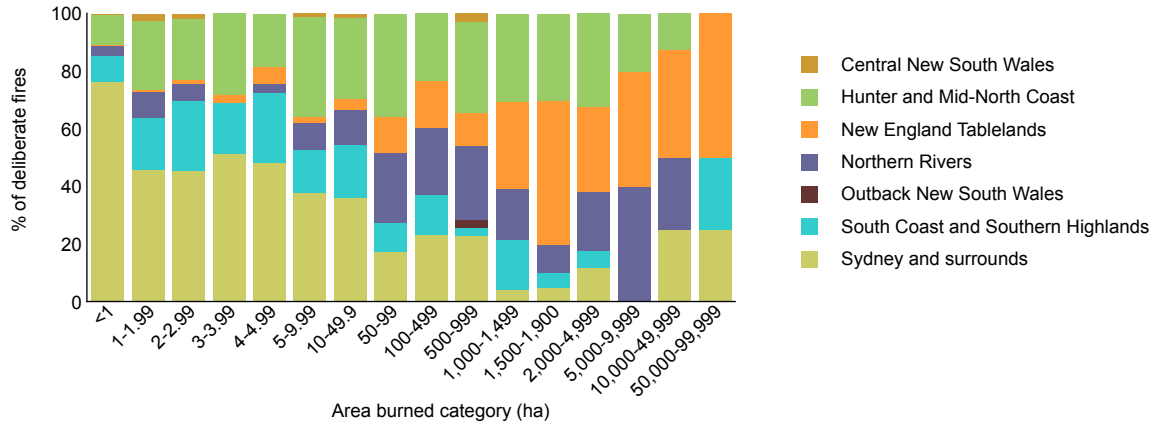
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 140: All vegetation fires, by area burned category and cause (percent)



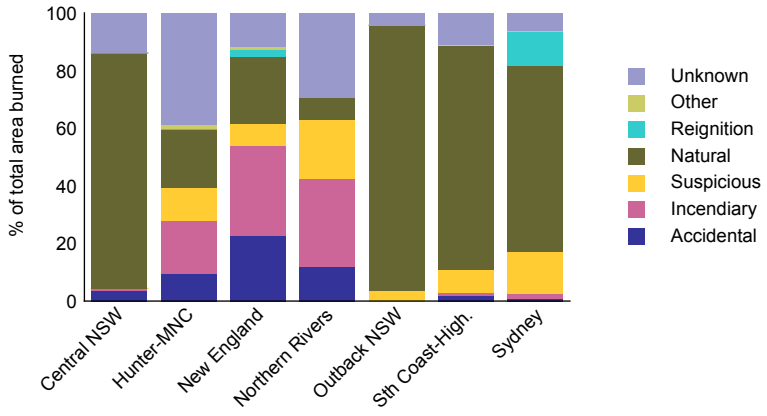
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 141: Deliberate vegetation fires, by area burned category and cause (percent)



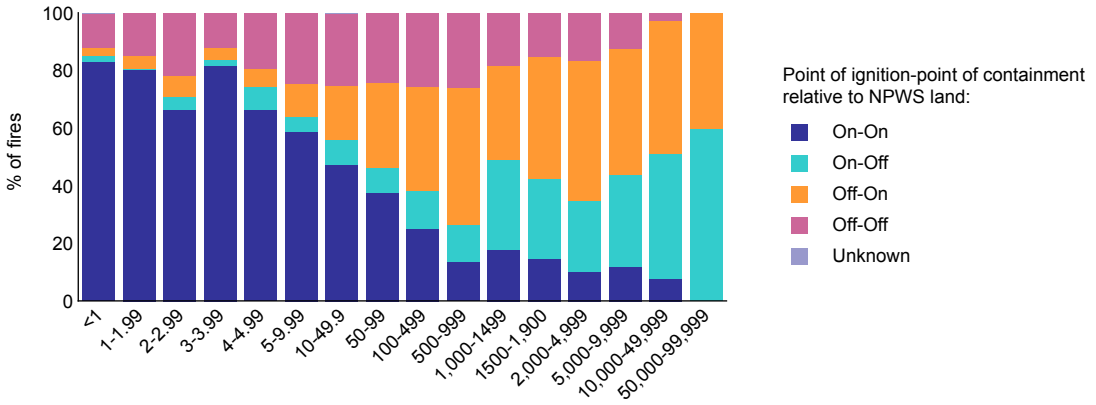
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 142: Total area burned, by cause in each region (percent)



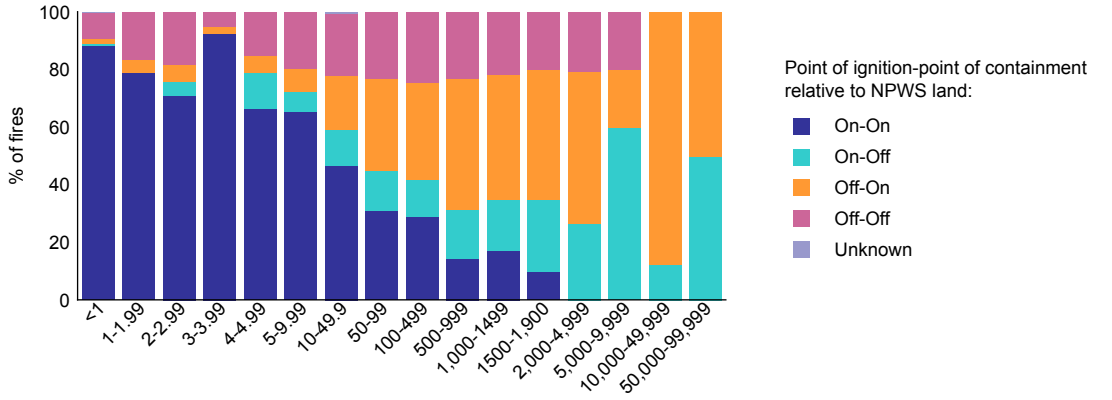
Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 143: Area burned categories for natural fires, by on–off park status (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

Figure 144: Area burned categories for deliberate fires, by on–off park status (percent)



Source: NSW NPWS 1995–96 to 2003–04 [computer file]

New South Wales State Forests

Background about the SFNSW dataset and its analysis

Important information regarding the SFNSW dataset and the methodology employed to analyse it is outlined below.

- Fire data were sourced from SFNSW.
- The database spans from 1997–98 to 1 December 2003.
- The database does not use AIRS classification codes.
- Cause was defined using the cause variable supplied.
- The terms deliberate and incendiary are used to describe all cases were the causes of the fire was listed as incendiarism.
- All natural vegetation fires were the result of lightning.
- Smoking-related fires refer to all fires where cause (provided) = ‘Pipe, cigarette, match’. All such fires were classified within the ‘other’ causal category.
- The regions used in this analysis are broadly based on those provided by SFNSW (see methodology). These regions do not correspond to those used in the analysis of other NSW fire services databases.
- The dataset included information about the area burned.
- Information was available about the tenure of land on which fires occurred.
- No information was available about the specific time that vegetation burned.
- Only limited information was available about the fire conditions on the day fires occurred, and these variables have not been analysed.

For more detail about these methodologies see the methodology chapter.

Overview

Fires the SFNSW attended can be summarised as follows:

- The SFNSW attended 1,785 vegetation fires from 1997–98 to 1 December 2003. Fire numbers varied between a low of 98 during the 1999–2000 season to a high of 504 during 2002–03 (Figure 145).
- These fires occurred both on and near tenures that lie under the SFNSW's jurisdiction and ranged from small vegetation fires through to large bushfires. Given the role and responsibilities of the SFNSW, it is not unreasonable to assume that most fires it attended either constituted a bushfire, or had the potential to develop into a bushfire under adverse conditions.
- Deliberate causes account for 39 percent of all fires.
- Fires were distributed across the state, but areas that recorded the greatest number of fires included the North Coast, Hunter, Northern Rivers and, to a lesser extent, the South Coast and Snowy Mountains areas. The principal causes if fires attended varied markedly between regions. Deliberate fires were an important factor in fires attended in the Hunter and Mid North Coast, South Coast and, to a lesser extent, the Northern Rivers and Explorer Country regions.
- A total of 1,327,009 ha were burned in fires the SFNSW attended from 1997–98 to 2002–03; approximately 22 percent of this was burned by deliberate fires. Deliberate causes were a critical factor in the total area burned in 2001–02.

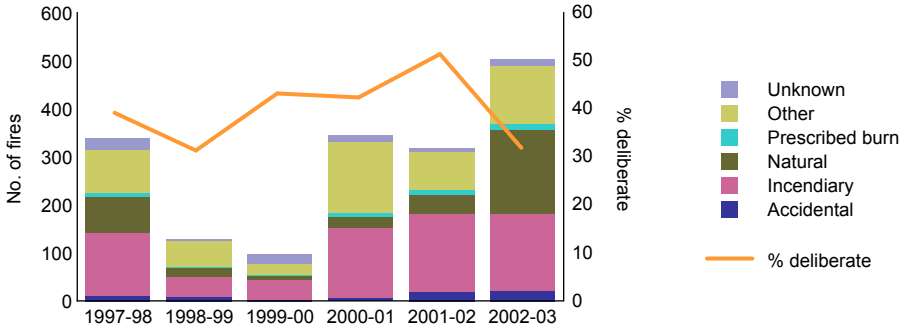
Cause

Deliberate fires accounted for 39 percent of all fires the SFNSW attended, being the single largest causal category (Figure 146). The number of deliberately lit fires varied markedly between seasons. The SFNSW typically observed between 130 and 160 deliberate fires per year, but substantially lower numbers of deliberate fires occurred during both the 1998–99 and 1999–2000 seasons. In any one year deliberate causes accounted for 31 to 51 percent of all fires. The peak occurred during the 2001–02 season (Figure 145).

Natural fires accounted for 20 percent of fires attended (Figure 146). The highest number and proportion of natural fires occurred during 2002–03 (35%) and, to a lesser extent, 1997–98 (22%). In non-El Niño seasons natural fires comprised six to 15 percent of fires.

Fires classified as 'other' constituted 30 percent of fires the SFNSW attended (Figure 146). Almost two-thirds of 'other' fires were burn offs (rural burns). Rural burns were a major factor in higher numbers of fires in 2000–01 (Figure 147), contributing to 31 percent of fires in that region. Smoking-related materials accounted for only 1.3 percent of fires the SFNSW attended, with the highest numbers (n=11) occurring during 2002–03.

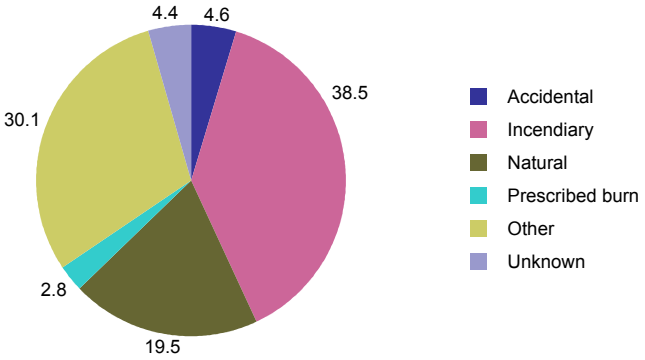
Figure 145: Cause, by year[a]



a: a prescribed burn refers to all burns conducted by a prescribed authority (listed as SF PB, DBFS PB and Burning-other PA), but excludes rural burns, even though some of those burns may have legal and considered a prescribed burn

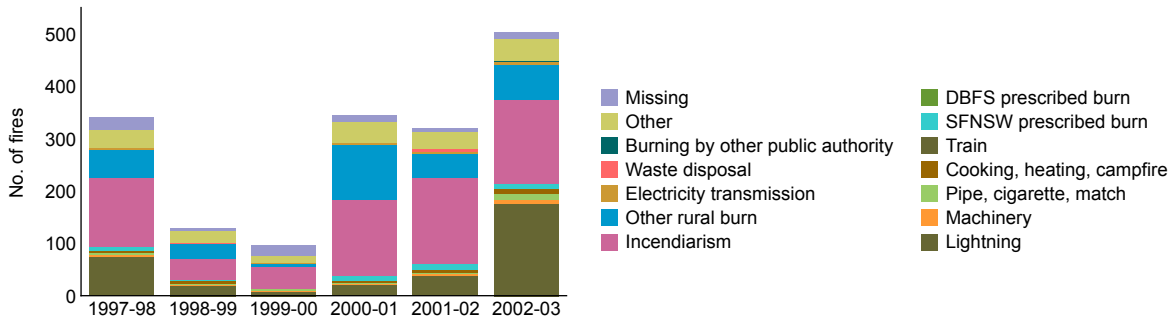
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 146: Cause (percent)



Source: SFNSW 1997–98 to 1/12/2003 [computer file]

Figure 147: Specific cause, by year (number)



Source: SFNSW 1997–98 to 2002–03 [computer file]

Location

The location of SFNSW-attended fires is examined in terms of the region and reserve in which fires occurred and the tenure of those lands.

Region

The definitions of regions used in this analysis are based on but have been modified from those provided by SFNSW, and differ from those used in the analysis of other NSW fire service databases. Important points about the regional distribution of fires the SFNSW attended are summarised below.

North Coast: Almost one-third of all SFNSW-attended fires occurred in the North Coast region (Figure 148). This remained comparatively consistent over the observation period (Figure 149). Approximately 54 percent of fires on the North Coast occurred in the Coffs Harbour district, with a further 29 percent being located near Wauchope.

Fifty-four percent of fires occurring in the North Coast region were the result of deliberate lightings (Figure 150). A higher number of deliberate fires occurred during the latter half of the observation period, with the maximum occurring during 2002–03 (Figure 151). The highest proportion of deliberate fires (77%) occurred during the 2001–02 season. The greatest number and proportions of natural fires occurred on the North Coast in 2002–03 and 1997–98.

Hunter: Nineteen percent of SFNSW-attended fires occurred in the Hunter region (Figure 148). However, the proportion of fires occurring in this region each year steadily declined in the latter half of the observation period (Figure 149). This does not reflect a net decrease in fire incidence; rather the changes in the Hunter region have not kept pace with that occurring statewide. The highest number of fires occurred in 1997–98.

Deliberate fires were again a major cause of fires in the Hunter region (47% of all fires; Figure 150), and from 1999–2000 to 2001–02 deliberate fires accounted for 54 to 62 percent of all fires. The highest incidence of deliberate fires occurred in 2001–02, but high values were also documented for 1997–98 and 2000–01. This is comparable to the trends other fire agencies documented for the Hunter region. Increased numbers and higher proportions of natural fires occurred for both 1997–98 and 2002–03.

Northern Rivers: Sixteen percent of SFNSW-attended fires occurred in the Northern Rivers region, principally within the Casino district. Large discrepancies were evident between the first and second halves of the observation period; average number of fires jumped from 14 fires per year for 1997–98 to 1999–2000 to 69 fires per year for 2000–01 to 2002–03. Between 2000–02 and 2002–03 almost one-quarter of all fires the SFNSW attended occurred in the Northern Rivers region. The greatest number of fires occurred during 2000–01 (Figure 153), accounting for 30 percent of all fires the SFNSW attended in that year (Figure 149).

Factors underlying these temporal changes are complex. A higher number of natural fires occurred in 2002–03 relative to 1997–98 (Figure 153), and higher frequencies of deliberate fires occurred from 2000–01 and 2002–03. Deliberate fire frequencies peaked in 2000–01, but subsequently decreased over the following two years. However, deliberate firesetting cannot be singled out, as the proportion of fires resulting from this cause (30 to 35%) was in fact lower than during the previous three years; deliberate causes were just one of many factors contributing to increased fire numbers in this region. One critical factor to have changed was the increase in fires resulting from rural burns. Overall there was a four-fold increase in the number of rural burns, and in 2000–01 rural burns were responsible for 54 percent of all fires attended in the region. Surprisingly, the percentage of fires resulting from rural burns was not appreciably different to previous years (Figure 153).

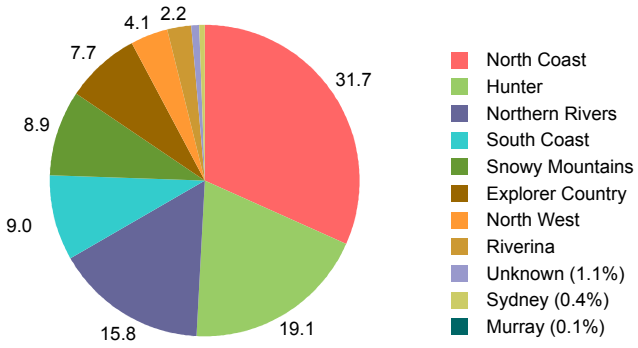
Other regions: The Explorer Country, Snowy Mountains and South Coast regions each accounted for eight to nine percent of fires the SFNSW attended. The SFNSW attended comparatively fewer fires in the North West, Riverina or Sydney and surrounds regions. To a certain extent this reflects the distribution of lands over which the SFNSW has jurisdiction.

Between 50 and 60 percent of fires in the Snowy Mountains and North West regions resulted from natural fires. Higher proportions of fires in the South Coast, Explorer Country and Riverina also resulted from natural causes. The number and proportion of deliberate fires was lower in areas characterised by low total fire numbers.

Comment

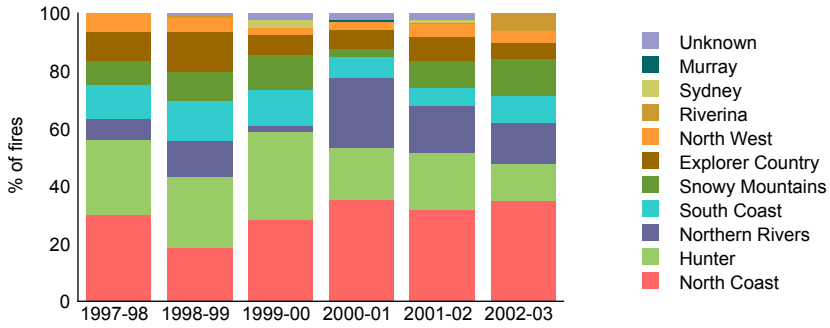
Virtually all regions in NSW were characterised by a higher number of natural fires in 2002–03 and to a lesser extent 1997–98 when compared to the intervening years (Figure 154). In both instances, higher numbers of natural fires were associated with extensive drought conditions, brought about by El Niño or El Niño-like weather patterns in the Pacific. Regions that appeared most affected included the Snowy Mountains, the North and South Coast and the Northern Rivers. Greater numbers of natural fires in 2002–03 compared to 1997–98 may reflect more severe drought conditions, with the 2002–03 droughts having followed comparatively dry seasons in both 2000–01 and 2001–02.

Figure 148: All fires, by region (percent)



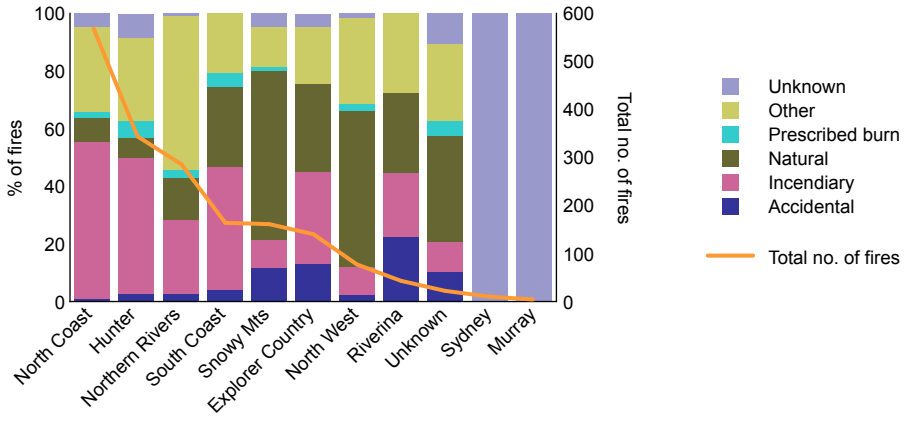
Source: SFNSW 1997–98 to 1/12/2003 [computer file]

Figure 149: Year, by region (percent)



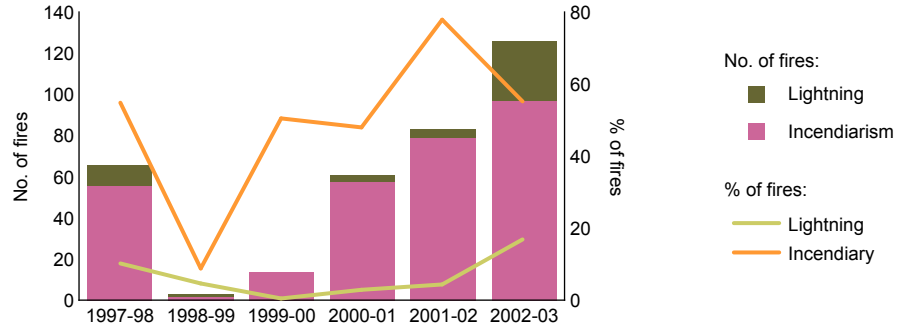
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 150: Cause, by region (percent)



Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 151: Deliberate and natural fires in the North Coast region, by year

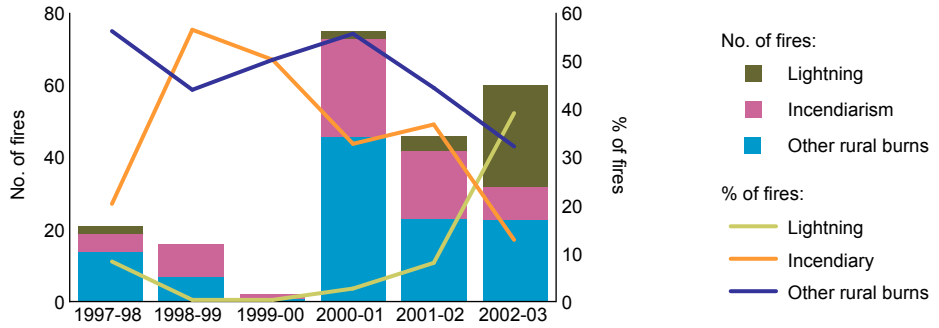


Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 152: Deliberate and natural fires in the Hunter region, by year

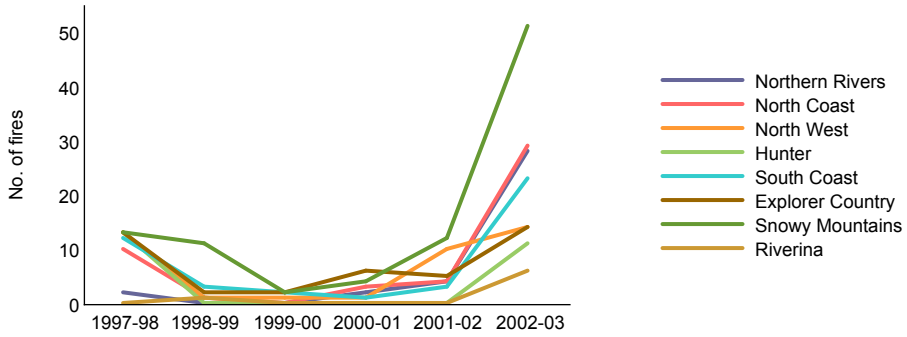
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 153: Deliberate, natural and rural burns in the Northern Rivers region, by year



Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 154: Natural fires, by region and year



Source: SFNSW 1997–98 to 2002–03 [computer file]

Reserves

The 1,785 fires the SFNSW attended occurred on more than 370 reserves. Four reserves, including the Awaba, Olney and Aberdare state forests in the Hunter region and the Bago State Forest in the Snowy Mountains region, experienced between 25 and 50 fires (Figure 155). A further 39 forests recorded between 10 and 24 fires in the six-year period. Of these, 17 were in the North Coast region, nine in the Northern Rivers region, five each in the Hunter and South Coast regions, two in the North West region and one in the Explorer Country region.

Overall, the tendency for a reserve to experience a deliberate fire was positively correlated ($r=.83$; $p<.01$) with the percentage of deliberate fires; if there was a high proportion of deliberate fires within a region, there was a greater probability that a reserve in that region would be the subject of a deliberate firesetting incident. On average, 77 percent of fires were deliberate in reserves that experienced 10 or more deliberately lit fires in six years. On average 66 percent of fires were deliberate in reserves that experienced five to nine deliberate fires in six years.

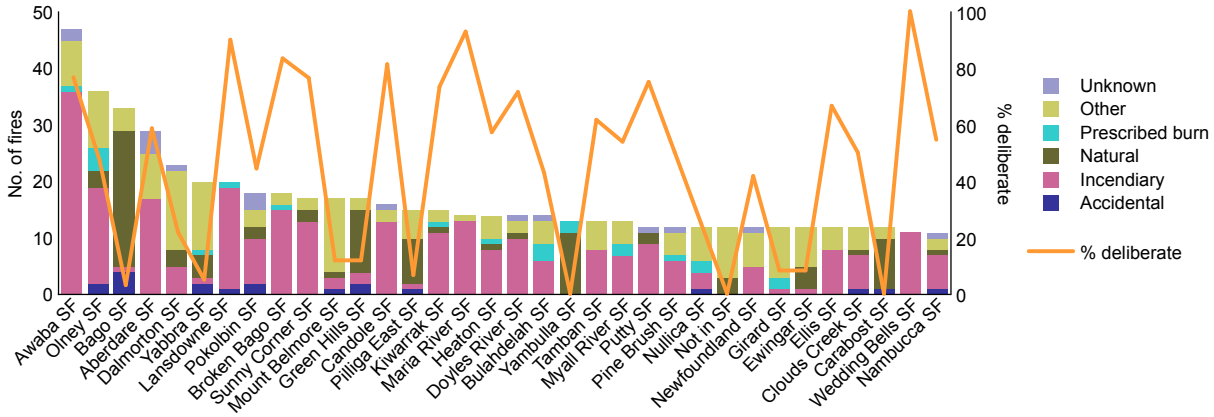
One or more deliberate lightings occurred in 70 and 75 percent of reserves in the North and South Coast regions where a fire was observed. In the Hunter the value was 60 percent. Only 20 to 30 percent of reserve in the Snowy Mountains, Riverina and the North West regions that experienced a fire, also reported a deliberate fire.

However, reserves in the Hunter regions experienced a greater density of deliberate fires. Thirty-six deliberate fires were set in the Awaba State Forest, more than double that of any other reserve in NSW. Seventeen deliberate fires were also recorded in the Olney and Aberdare State Forests. Three of the top four reserves, in terms of the number of deliberate fires, were in the Hunter region (Figure 156).

A high number of deliberate fires also occurred in many North Coast reserves. Seven of the eleven reserves that documented 10 deliberate fires or more occurred in the North Coast region; Lansdowne and Broken Bago recorded 15 to 18 deliberate fires, and another five reserves documented 10 to 14 deliberate fires.

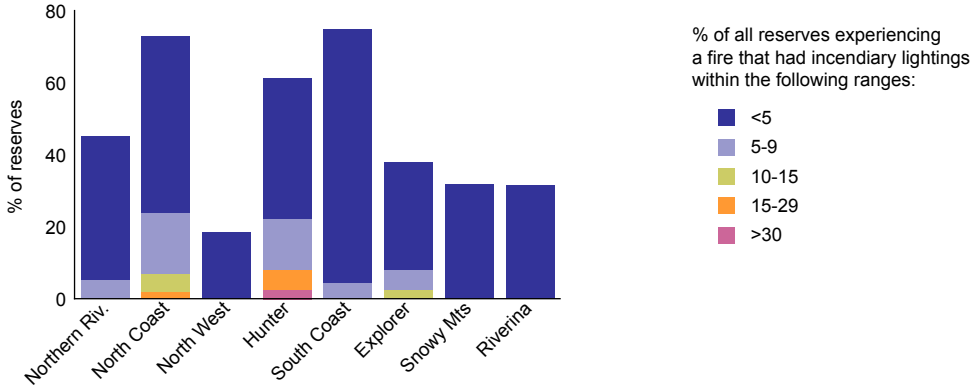
Few reserves in the South Coast or the Northern Rivers experienced a high density of deliberate fires. Fires in these regions tended to be spread across many different reserves.

Figure 155: Reserve, by cause



Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Figure 156: Concentration of deliberate fires in reserves within each region



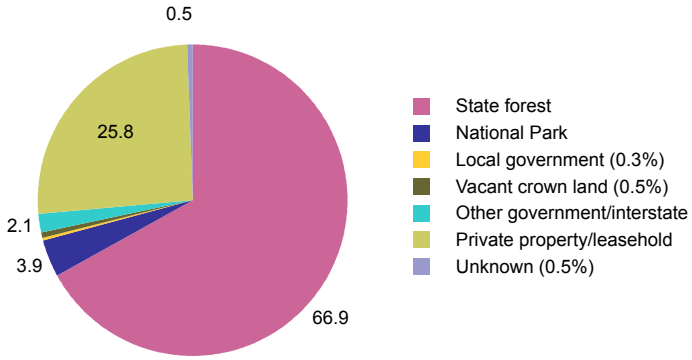
Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Tenure

Two-thirds of the fires the SFNSW attended occurred on state forest tenure, with another quarter occurring on private leasehold land (Figure 157). Only 3.9 percent of fires the SFNSW attended started in national parks.

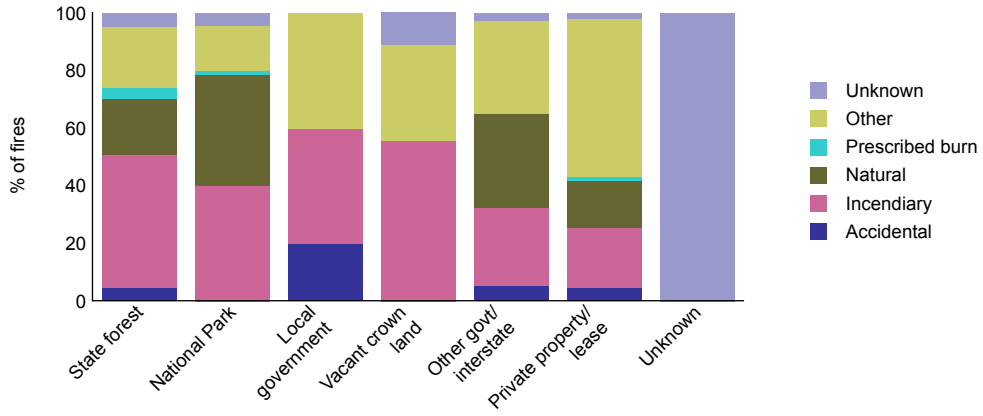
Almost half of the fires that started in state forests resulted from incendiary activities (Figure 158). High proportions of fires in national parks, on local government lands, and vacant Crown land were also deliberate in origin. Natural fires accounted for a higher proportion of fires in national parks, whereas 'other' causes (commonly rural burns) were most significant on private property and leasehold land.

Figure 157: Tenure (cause)



Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Figure 158: Cause, by tenure (percent)



Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Timing

The timing of fires is examined by week of the year, day of the week and time of the day.

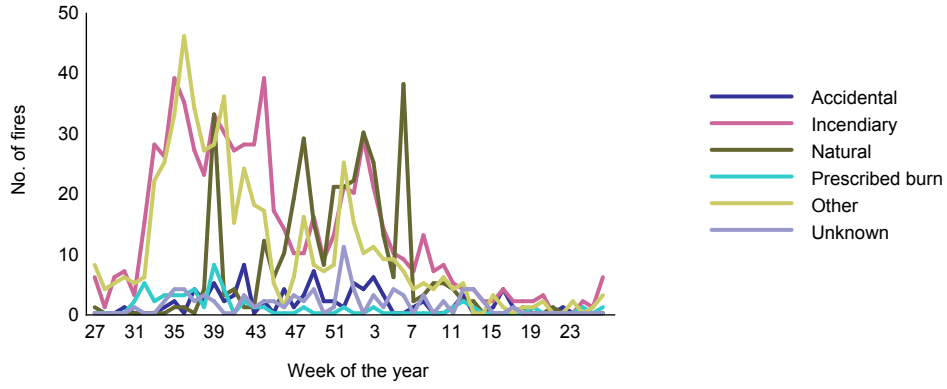
Week of the year

The distribution of fires throughout the year in NSW state forests was highly cause-dependent (Figure 159), with trends being similar to that observed for the NSW NPWS data. Natural fires tended to peak within a one- or two-week period, although both the intensity (number of fires) and timing of natural fires varied substantially across seasons, generating a spiked pattern overall. During 'normal' years (years not associated with an El Niño-like weather pattern) the maximum number of natural fires that occurred within any one week was low. In these seasons, most natural fires occurred between mid to late December and mid to late February. In contrast, large spikes in natural fire activity occurred every three to five weeks

during 2002–03, from the beginning of October to the middle of March (Figure 160). Excluding the early October spike, the numbers of natural fires tended to increase as the summer progressed. Large peaks in natural fires also occurred in 1997–98, but in contrast to 2002–03 the maximum number that occurred in each peak decreased as the summer progressed. Fires started by lightning occurred markedly earlier in 2002–03, and to a lesser extent in 1997–98, as compared with years not associated with an El Niño event.

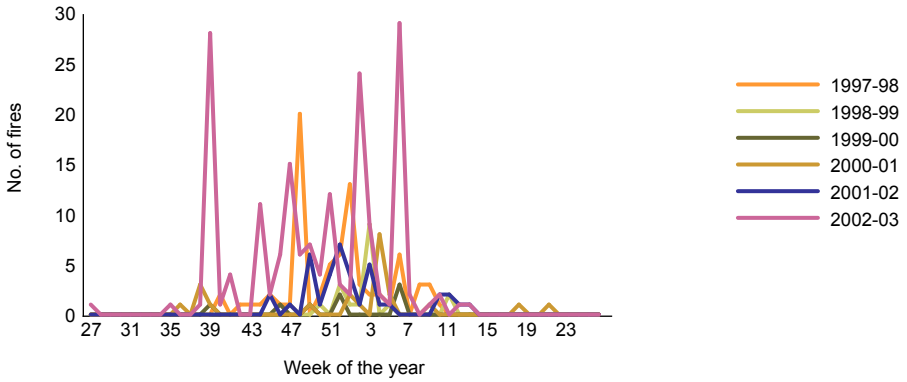
As observed for other NSW fire agencies, deliberate fires the SFNSW attended defined two distinct spikes; one from mid August to mid November, the other in December–January (Figure 159). However, like natural fires, the distribution of deliberate fires varied significantly between years, being subject to yearly variations in weather conditions. Higher rainfall during the winter, spring and to a lesser extent summer of 1999–2000 was associated with low incidences of deliberate fires across that year (Figure 161). In 2000–01, a large spike in deliberate fires occurred in September and October, only being curtailed by high rainfall in November. This was the most intense period of deliberate firesetting observed in SFNSW data over the six-year period. Two peaks were evident during the subsequent 2001–02 season. One was during weeks 42 to 44 (mid October to early December), coinciding with the period during which seven 'bushfire emergencies' were declared around Cessnock, Gosford, Gloucester, Kempsey, Wyong, Greater Taree and Singleton (29 October to 9 November; NSWRFS 2001). The second period occurred from weeks 52 to 2, coincident with the devastating Christmas–New Year fires. During 2002–03, spikes in deliberate fires occurred from mid August (prior to increased natural fire activity) to almost the end of January. Again, somewhat disturbingly, increased numbers of deliberate fires were observed during the third week of January when bushfires devastated much of the Southern Tablelands and the ACT. Nine fires were deliberately lit in NSW state forest in the two weeks after the Kosciouszko–Canberra fires. Six of those occurred in the Taree region and two in the Coffs Harbour region.

Figure 159: Week of the year, by cause (number)



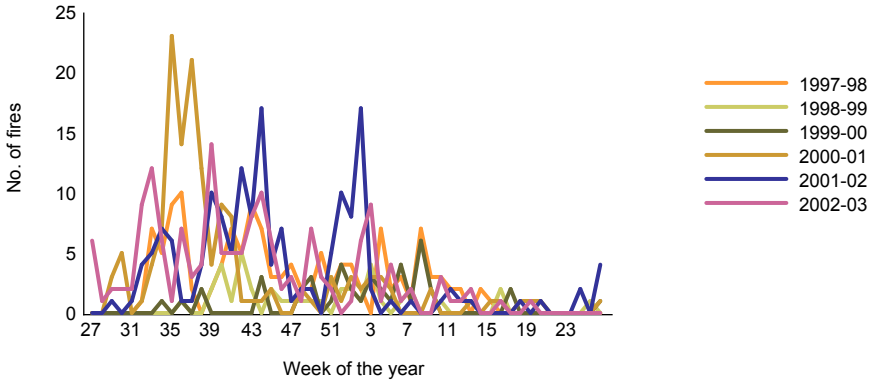
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 160: Natural fires, by week of the year each year (number)



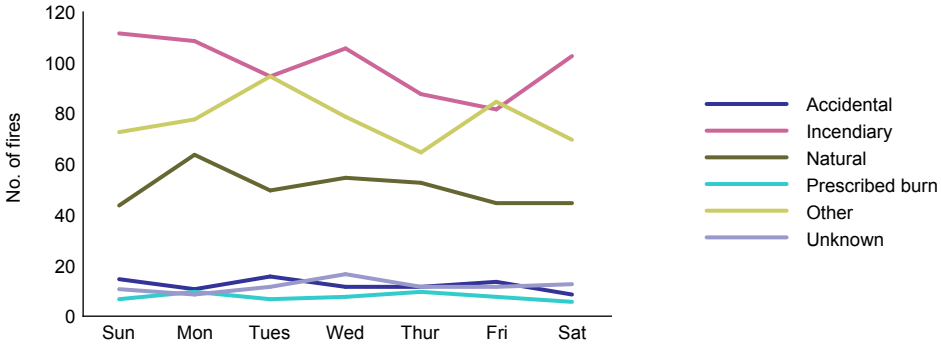
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 161: Deliberate fires, by week of the year each year (number)



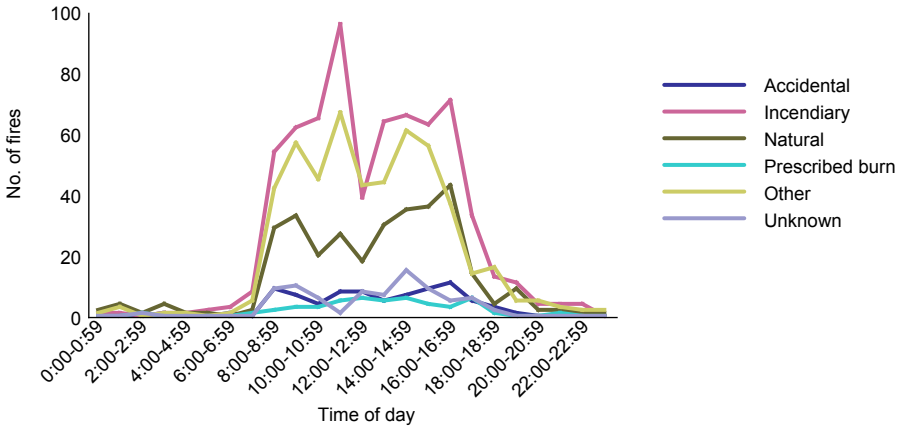
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 162: Day of the week, by cause (number)



Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Figure 163: Time of day, by cause (number)



Source: SFNSW 1997–98 to 1 December 2003 [computer file]

Day of the week

There was no perceptible difference in the number of fire lit on weekends versus weekdays, irrespective of the cause (Figure 162).

Time of the day

The overwhelming majority of fires the SFNSW attended were detected between the hours of 8 am and 6 pm (Figure 163). This was observed irrespective of cause, although some bias toward later times was evident for natural fires. The latter is consistent with observations from other agencies. However, the sharp increase and decrease in fire incidence at 8 am and 6 pm respectively and the consistent decrease in the number of fires reported between 12 and 1 pm (lunch time), implies that the detection times reported for SFNSW-attended fires were affected by the routines of workers as they moved within or through these region and to some extent may not accurately reflect the exact times of ignition. Many fires that started at night may not have been observed and/or reported until the following day.

Area burned

Overall, there was a tendency for the number of fires to decrease with increasing fire size, but the relationship was less systematic in SFNSW data than that observed for many other agencies. In particular, the SFNSW recorded a higher proportion of medium and large fires than other NSW fire agencies (Figure 164), but this is not an uncommon size distribution for a land management agency given the environments in which fires occur.

This general distribution was evident across all causes, but some differences were evident in size distributions based on cause. The proportion of fires stemming from ‘other’ causes tended to increase with increasing fire size, reflecting the fact that many of the larger fires were the result of rural burns. However, this category does also include other fires of unspecified causes. A high proportion of large fires also resulted from lightning strikes. However, not all fires started by lightning strikes were large. Contrary to observations elsewhere, natural fires also accounted for a substantial proportion of small fires the SFNSW attended.

The proportion of fires resulting from deliberate causes tended to decrease with increasing fire size (Figure 165), but incendiary causes were still responsible for a number of very large fires the SFNSW attended. The incidence of large deliberate fires appeared to be restricted to specific seasons. During 1998–99 and 1999–2000, years characterised by milder conditions, fire sizes were comparatively small, with no deliberately lit fires exceeding 1,500 ha (Figure 166). In all other years a high proportion of fires were in the five to 1,500 ha range. Eight deliberately lit fires exceeded 5,000 ha; all occurred during 2001–02 and 2002–03. Specifically:

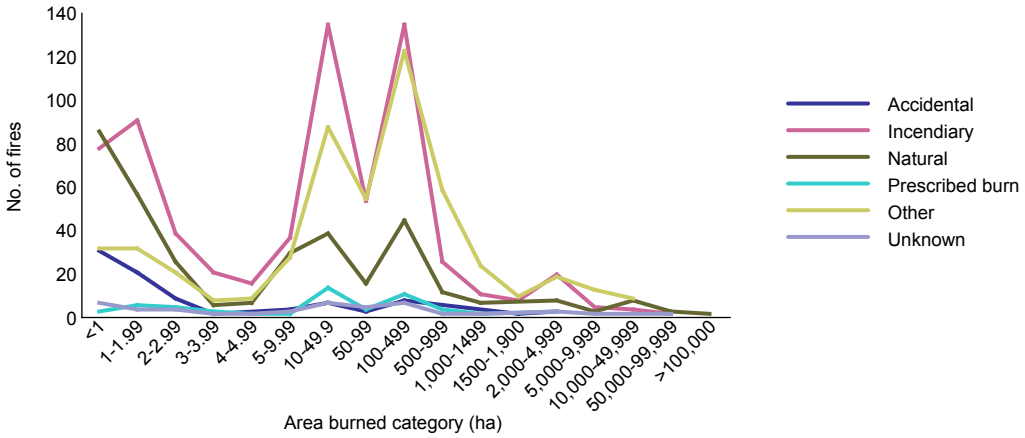
- During **2001–02** four deliberate fires exceeded 5,000 ha. The largest burned 81,133 ha near Newcastle. Three of the five largest deliberately lit fires during this season occurred near Casino (Northern Rivers region), the largest burning 31,800 and 8,694 ha. Another deliberately lit fire during this season burned 20,500 ha near Wauchope. All four deliberately fires greater than 5,000 ha in this season occurred either just before or during the Sydney 2001–02 Christmas fires. The incidence of deliberate firesetting during adverse fire periods is discussed in further detail below.
- In **2002–03**, four deliberate fires exceeded 5,000 ha. Three of these occurred in the Coffs Harbour region, burning 5,140 ha, 5,296 ha and 10,207 ha respectively. Another deliberately lit fire burned 6,500 ha near Newcastle. These four fires occurred within a six-week period comparatively early in the fire season between weeks 37 and 42, prior to the large fires in southern NSW in January.

A total of 1,327,009 ha burned in SFNSW-attended fires from 1997–98 to 2002–03. The largest total area was burned in 2002–03, followed by 2001–02 (Figure 167). However, the predominant cause(s) of the area burned varied markedly between years:

- In both 1997–98 and 2002–03, years where there was a greater incidence of fires started by lightning strikes, **natural fires** accounted for 85 and 47 percent of the total area burned, respectively.
- In 2000–01, fires of **other** causes burned 130,860 ha, accounting for 78 percent of total area burned in that season. Two-thirds of the area burned by other causes was the result of rural burns.
- In 2001–02, **incendiarism** was the largest single contributor to the total area burned, with natural causes accounting for approximately one-fifth of the total area. Other causes burned over 40,000 ha in 2001–02 but this accounted for only 11 percent of the total area burned.
- The total area burned by **deliberate fires** in 2002–03 was lower than that burned in 2001–02, but the area burned by 'other' causes was substantially higher. Fires of other causes burned almost 200,000 ha during 2002–03, of which half related to rural burns. Thirteen rural burns in that year exceeded 5,000 ha. Five of these occurred in the Casino region with an additional five occurring in the Coffs Harbour district. The largest rural burn was 30,524 ha.

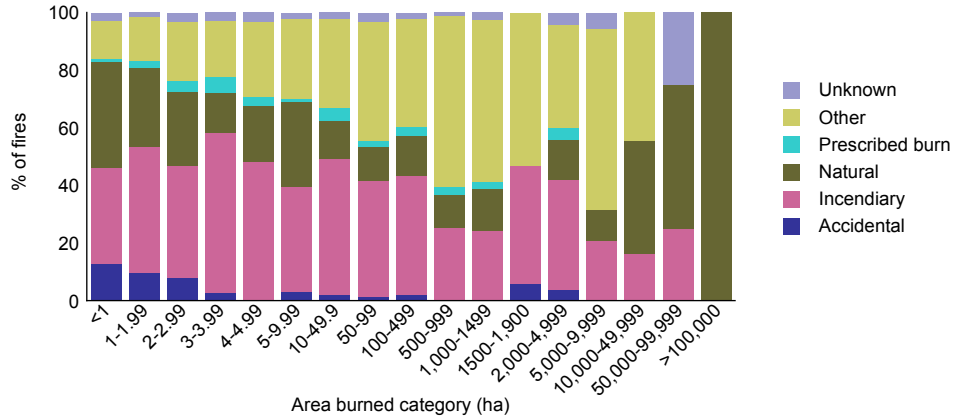
Forty-six percent of the total area burned in fires the SFNSW attended occurred in state forests, 29 percent in national parks, and 21 on private property or leasehold land (Figure 168). Of that burned in state forests, approximately one-third resulted from deliberate causes (Figure 169). Another third each resulted from natural and other causes. Natural fires were the dominant cause of the total area burned by fires the SFNSW attended in national parks. Not surprisingly, the majority of the total area burned on private property and leaseholds resulted from other causes, with rural burns being a major factor. Accidental causes were primarily responsible for lands burned in local government jurisdictions, whereas deliberate causes were responsible for the majority of the total area burned on 'other government lands/ interstate' tenures.

Figure 164: Area burned categories, by cause (number)



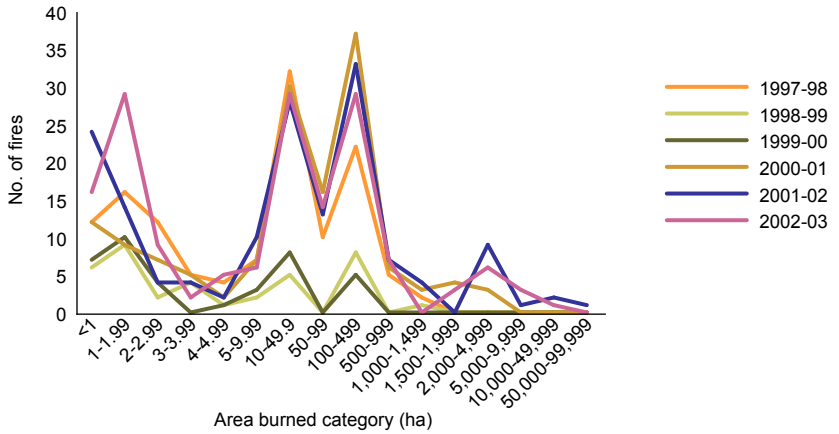
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 165: Area burned categories, by cause (percent)



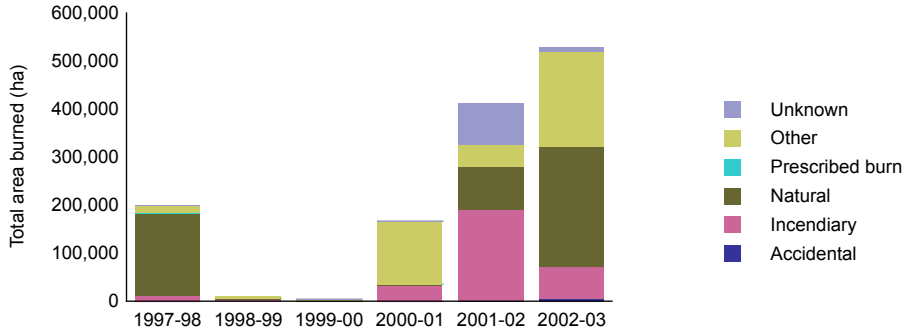
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 166: Area burned categories for deliberate fires, by season (number)



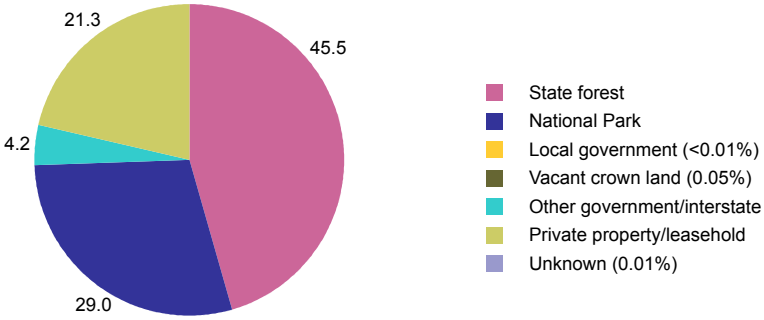
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 167: Total area burned (ha), by cause in each season (number)



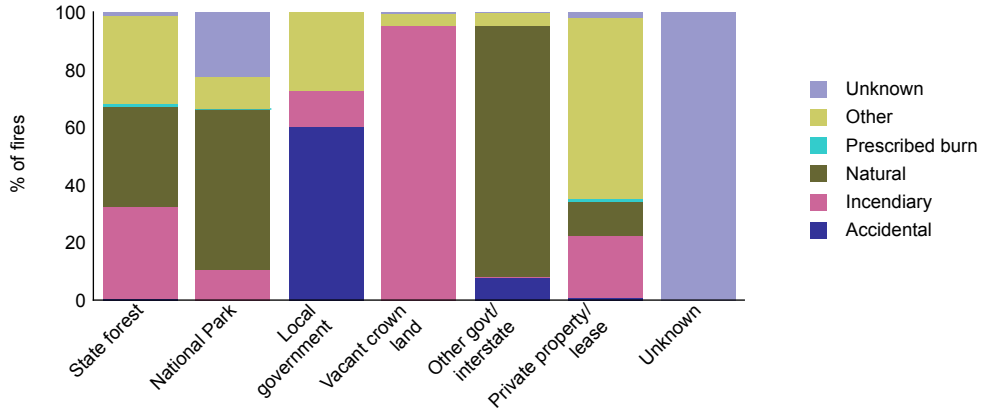
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 168: Total area burned, by tenure (percent)



Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 169: Total area burned, by cause within each tenure category (percent)



Source: SFNSW 1997–98 to 2002–03 [computer file]

Regional distribution of vegetation fires in NSW: combined NSWRFS and NSWFB data

This section analyses the combined NSWRFS and NSWFB data for the total fire numbers and the number of deliberate fires during 2000–01 and 2001–02. These were the only years for which data was available from both agencies.

Total fire numbers

Only one postcode in NSW experienced in excess of 1,000 fires in two years. This occurred in the Campbelltown SLA. Another four postcodes, recorded 500 to 1,000 fires. Of these, two were in metropolitan areas (Blacktown–South West and Liverpool SLAs) and two were in regional areas (Kempsey and Moree Plains SLAs). These postcodes collectively accounted for 12 percent of all fires the NSWRFS and NSWFB attended. Approximately one-fifth of all fires in the state occurred in the 11 postcodes that recorded between 300 and 499 fires, and another 22 percent occurred in the 28 postcodes that recorded 100 to 199 fires in two years.

Of the 44 postcodes that recorded in excess of 200 fires, 16 were located in the Sydney region, with the remainder being spread throughout regional NSW (Table 5). The North Coast and Hunter regions recorded the largest number of postcodes with greater than 200 fires in two years outside the metropolitan area. Fire frequencies of this magnitude were almost exclusively restricted to urban areas; of the 44 postcodes recording in excess of 200 fires all but three had populations exceeding 10,000 people and 32 contained more than 20,000 people.

Population size clearly has a significant impact on the number of fires experienced within a given postcode, and population densities within individual postcodes vary markedly across the state. Individual postcodes have populations ranging from just over 100 to greater than 80,000 people.

The minimum recorded rate of fires per 10,000 people per year decreased with increasing population for individual postcodes, being governed by a single fire event in the two-year interval. Hence, the minimum observed rate decreases within increasing population size. There is no such restriction on the maximum rate of fires per 10,000 people per year. This rate remained comparatively uniform across postcodes with high divergent population densities (Figure 170). Hence, the range of rates observed tends to be greatest in densely population, urban, areas. Overall, NSW postcodes typically recorded between one and 300 fires per 10,000 people per year (Figure 170). However, higher values were recorded in six regional postcodes, within the Brewarrina, Bourke, Great Lakes, Gunnedah and Guyra SLAs. The maximum rates of fires per person tended to be on the high side when compared with some other states. However, these figures may not be representative of the long-term average given that 2000–01 and 2001–02 were both characterised by higher than average numbers of deliberate fires.

Although 36 percent of all NSWFB- and NSWRFS-attended fires occurred in the Sydney region, the majority of Sydney postcodes recorded fewer fires per person per year than postcodes in regional areas (Figure 170). The highest rates observed in the Sydney region were comparable to typical values observed in regional areas. This is not unexpected given the higher population density, more restricted access to vegetation, and commonly small areas covered by urban postcodes. This general difference between the numbers of fires per person per year was noted for regional and metropolitan Victoria. It is noted, however, that several postcodes within the Blue Mountains, Illawarra and Hunter regions with in excess of 8,000 people also recorded lower rates of fires on a per person basis.

Postcodes within individual regions recorded highly diverse rates of fires on a per person basis and there were large overlaps in the rates observed in regional areas. Generally, the average rate tended to remain comparatively constant across postcodes with highly varying population sizes, but there were some exceptions. In regional areas experiencing a low overall incidence of fires, namely the Capital Country,

Snowy Mountains and Murray regions, the rate per person initially decreased, parallel to the minimum curve, before stabilising at populations exceeding roughly 5,000 people. Postcodes within these regions tended to have lower rates of fires per person than postcodes with populations in excess of 5,000 people. Many postcodes in the North Coast region documented higher than average rates of fires per person.

Considerable variation was evident in the number of fires per person per year in the Sydney region. The highest rates were documented in the Outer Western Sydney, Outer South-Western Sydney, Blacktown, and Fairfield–Liverpool SSDs (Figure 171); that is, in those regions that recorded the highest number of fires overall. This was evident for postcodes with highly diverse populations. This indicates that the lower total fire frequencies observed for some postcodes within southwest Sydney are more likely a reflection of lower total populations than any intrinsic heterogeneity in fire distributions.

There were isolated instances where high rates of fires per person occurred for one or several postcodes within a region that was overall characterised by a lower incidence of fires in total and on a per person basis. Examples include four postcodes within the Bankstown SLA, two postcodes each in the Pittwater and Warringah SLAs, and one postcode each in the Randwick and Strathfield SLAs. The rates for postcodes in the Central Western Sydney SSD appear to have been intermediate between the higher values observed in the southwest and lower value reported elsewhere, consistent with the fact that geographically this area lies between areas of higher and lower rates of fire incidence.

Deliberate fires

Only one postcode in NSW experienced in excess of 500 deliberate fires in two years. This occurred in the North Coast region (Kempsey SLA). Another three postcodes, in the Campbelltown, Bourke and Blacktown–South West SLAs recorded 300 to 500 deliberate fires. Two postcodes documented 200 to 299 and another 21 postcodes had 100 to 199 deliberate fires. The 27 postcodes that had 100 or more deliberate fires in two years accounted for 46 percent of deliberate fires recorded in the state in the two-year period. Of these 27 postcodes, eight were located in the Sydney region. The greatest incidence of postcodes recording in excess of 100 deliberate fires in two years in regional NSW occurred in the Hunter (seven postcodes) and Central Coast (four postcodes) regions. Five of these postcodes were in the Lake Macquarie SLA (Table 5).

Typically, there were between 0.1 and 100 deliberate fires per 10,000 people in NSW postcodes, although higher rates were evident locally in the Bourke, Brewarrina, Lake Macquarie and Kempsey SLAs (Figure 172 to Figure 174). No deliberate fires were recorded in almost 150 postcodes, and hence these postcodes do not appear in Figure 173 and 174. This most significantly affected postcodes containing less than 1,000 people. Many other postcodes occur along a line determined by one deliberate fire in two years. This represents the minimum possible rate greater than zero, for a postcode of any population, and highlights the generally low rates of deliberate fires in these locations.

The Outer Western Sydney, Outer South Western Sydney, Liverpool–Fairfield and Blacktown SSDs recorded the highest rates of deliberate fires per person in the Sydney region. Rates in this area were typically in the range of eight to 60 deliberate fires per 10,000 people per year (Figure 174). Most other regions were characterised by rates of one to 10 deliberate fires per person per year. The Central Western Sydney SSD again tended to bridge the range between these two extremes. Occasional postcodes within other areas of the Sydney region also recorded higher rates of deliberate firesetting per person per year. Included within this subset were two postcodes within the Inner Sydney region.

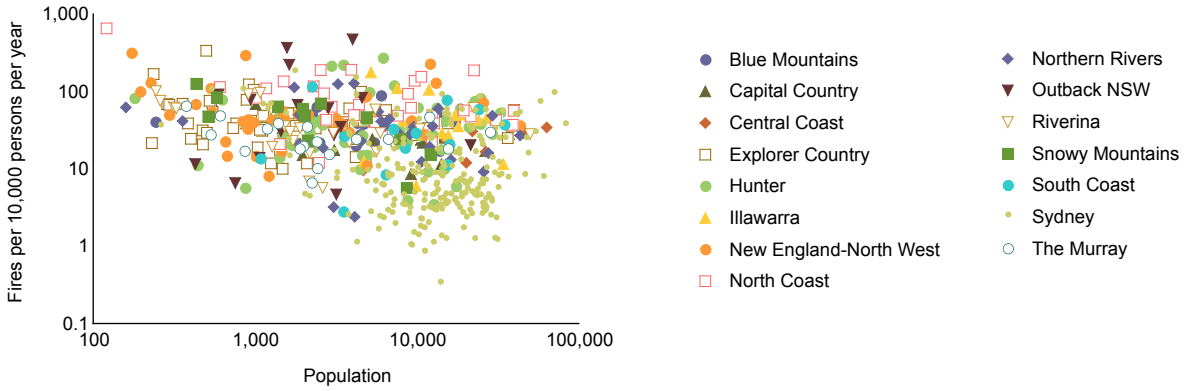
High rates of deliberate fires per person were documented in the Hunter, Central Coast, Illawarra and North Coast (Figure 172); densely populated regions outside of the Sydney region that overall recorded large numbers of fires. The rates of deliberate fires per person in these areas were comparable to those

observed in Central and Outer Western Sydney SSDs (Figure 174). The average rates in other regional areas were typically lower (Figure 173), but some caution is needed when interpreting the data owing to the low levels of causal attribution documented for many regional areas.

Overall, there was greater correspondence between the rates of deliberate fires per person observed in metropolitan and regional areas than that observed for total fire numbers per person overall. To some extent this may have been genuine, reflecting the greater likelihood of other fire causes, including burn offs and natural fires in some regional areas. However, lower levels of causal attributions in many regional areas may also have been a contributing factor.

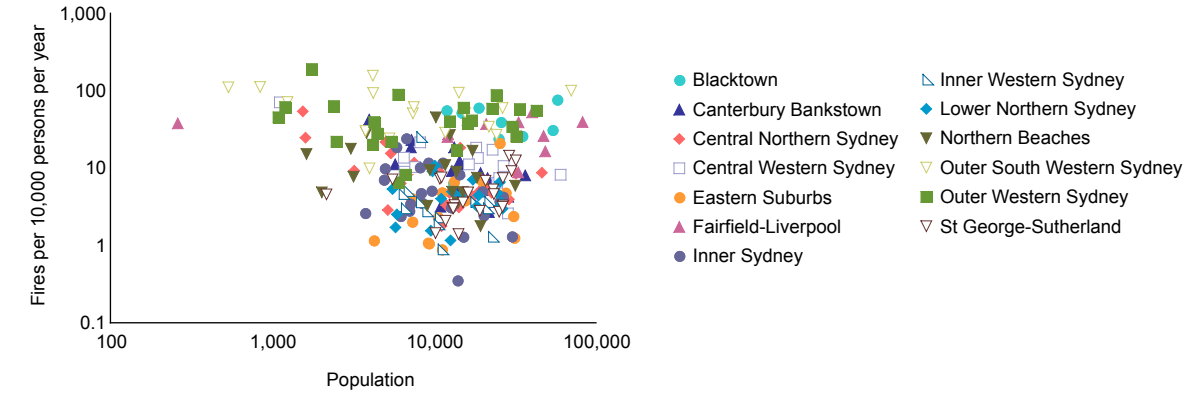
What is clear from this joint analysis is that, overall, the NSWFB and NSWRFS observed high numbers of fires and high numbers of deliberate fires in similar locations. For example, both agencies documented high numbers of fires in the Hunter and Central Coast regions, and North Coast regions. However, it is only on combining the databases that the enormity of the problem is revealed. Although direct comparisons cannot be made, because of the differences in the definitions of regions, it is also evident that both the NSW NPWS and SFNSW attended high numbers of fires in similar areas. This highlights the need for strong cooperation between fire agencies in order to reduce the numbers of fires generally and the number of deliberate fires in particular.

Figure 170: Total fires per 10,000 people per year for individual postcodes within each region (number)



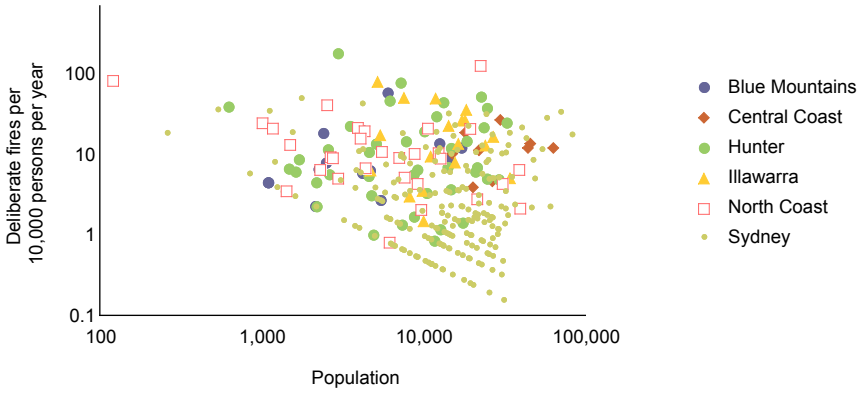
Source: NSWFB 1997–98 to 2001–02 [computer file], NSWRFS 1999–2000 to 2003–04 [computer file]; ABS 2004. Population by post office area, 2001 [computer file]

Figure 171: Fires per 10,000 people per year for individual postcodes within SSDs in the Sydney region (number)



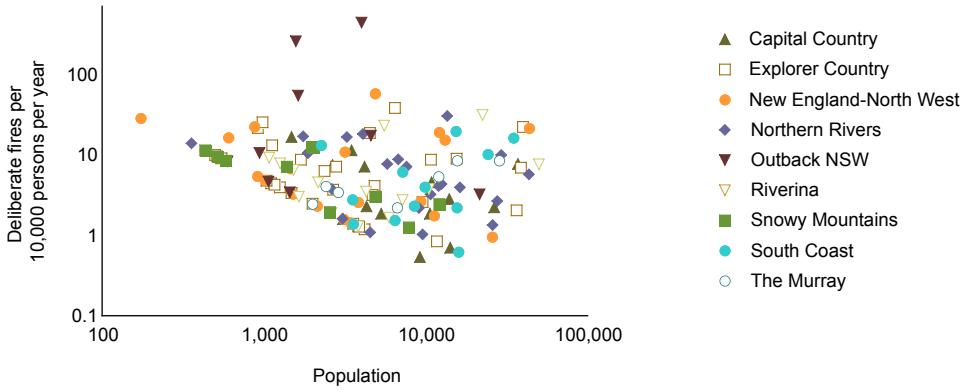
Source: NSWFB 1997–98 to 2001–02 [computer file], NSWRFS 1999–2000 to 2003–04 [computer file]; ABS 2004. Population by post office area, 2001 [computer file]

Figure 172: Deliberate fires per 10,000 people per year for individual postcodes within selected regions (number)



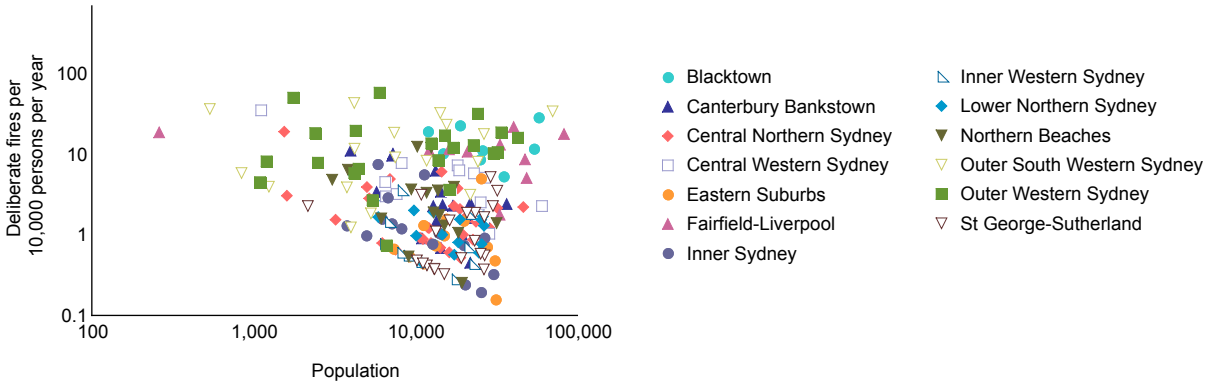
Source: NSWFB 1997–98 to 2001–02 [computer file], NSWRFS 1999–2000 to 2003–04 [computer file]; ABS 2004. Population by post office area, 2001 [computer file]

Figure 173: Deliberate fires per 10,000 people per year for individual postcodes within selected regions (number)



Source: NSWFB 1997–98 to 2001–02 [computer file], NSWRFS 1999–2000 to 2003–04 [computer file]; ABS 2004. Population by post office area, 2001 [computer file]

Figure 174: Deliberate fires per 10,000 people per year for individual postcodes within SSDs in the Sydney region (number)



Source: NSWFB 1997–98 to 2001–02 [computer file], NSWRFS 1999–2000 to 2003–04 [computer file]; ABS 2004. Population by post office area, 2001 [computer file]

Table 5: Number and location (SLA and region) of postcodes where total and deliberate fire numbers exceeded 200 and 100

Region	No. >200 fires	SLA	No. >100 deliberate fires	>100 deliberate fires
Capital Country	1	Queanbeyan		
Central Coast	4	Gosford (2), Wyong (2)	4	Gosford (2), Wyong (2)
Explorer Country	2	Orange, Dubbo	1	Dubbo
Hunter	5	Cessnock (2), Lake Macquarie (2), Singleton	7	Lake Macquarie (5), Cessnock (2)
Illawarra	3	Wollongong (2), Shellharbour	2	Wollongong, Shellharbour
New England North West	4	Moree Plains, Armidale, Tamworth, Inverell	1	Tamworth
North Coast	8	Coffs Harbour (2), Greater Taree, Hastings Pt A, Hastings Pt B, Great Lakes, Port Stephens, Kempsey	1	Kempsey
Northern Rivers	2	Lismore, Grafton		
Outback	1	Bourke	1	Bourke
Riverina	2	Griffith, Wagga Wagga	1	Griffith
South Coast	3	Shoalhaven (C) Pt B (2), Shoalhaven (C) Pt A	1	Shoalhaven (C) Pt B
Sydney	16	Penrith (5), Blacktown (4), Liverpool (3), Campbelltown (3), Fairfield	8	Penrith (3), Liverpool (2), Blacktown (2), Campbelltown

Deliberate fires during adverse fire seasons

This section examines changes in the incidence of deliberate fires during two periods of adverse fire weather in NSW and the extent to which these contributed to total number of fires attended and the total area burned.

Background

Between 1999–2000 and 2003–04 NSW experienced two particularly adverse periods of bushfire activity in which there were large losses of property: October 2001–January 2002 and July 2002–January 2003. Descriptions of these events, derived from NSWRFS (2001, 2003) and Ellis, Kanowski & Whelan (2004), are summarised below.

October 2001 – January 2002: The 2001–02 bushfire season started early when seven bushfire emergencies were declared in the Cessnock, Gosford, Gloucester, Kempsey, Wyong, Greater Taree and Singleton areas between 29 October and 9 November 2001. Another spate of five bushfire emergencies was declared in early December, commencing with the Blue Mountains Rural Fire District. Most of the fires were thought to have been started by lightning strikes from a severe dry thunderstorm. Between 3 and 24 December the Blue Mountains/Lithgow, Hawkesbury, Narromine, Wollondilly/Wingecarribee and Cabonne districts experienced major fires.

By 24 December 2001, as the fires drew closer to Sydney, directly threatening residential property, and because it appeared that many of the fires had been deliberately lit, public and media interest in the fires intensified. By Christmas Day 26 bushfire emergency declarations were made across 48 local government areas. On 16 January 2002, the NSWRFS Commissioner announced that the crisis was over. This was not before 454 fires had burned 744,000 ha and destroyed 109 houses and 6,000 head of livestock in the Greater Sydney region, Hunter, North Coast, and Northern (New England–NW) and Central Tablelands

(Explorer Country). The estimated insurance bill for fire damage between October 2001 and January 2002 was estimated to be $75,000,000 (approximately 3,000 claims); with the estimated cost of operations for NSW fire agencies of approximately $106,000,000. On the positive side an estimated 20,000 properties were saved and there was no loss of life or serious injury to members of the public or emergency personnel.

July 2002 – January 2003: In most states and territories of Australia the 2002–03 bushfire season had the potential to be most severe experienced for 20 and 40 years. In NSW, this potential was manifested with numerous fires occurring over an extended period. Most of the state was into its second consecutive season of drought. This contributed to an abnormally early start to the season, with adverse fire conditions extending over almost five months. Serious fires commenced in the northeast of the state as early as July–September 2002 and were followed by several large and extended firefighting campaigns. These included:

- the alpine regions – Childowla, Brindabella Ranges Complex, Kosciouszko North Complex, Kosciouszko South Complex, Tuross Creek, and Slaughterhouse fire – between December and February
- Shoalhaven – Touga fire – November
- Northern Tablelands and North Coast – September and October
- Hunter and Mid North Coast – October and February
- Blue Mountains – Blackheath Glen, Marked Tree and Airly – October to January
- Bala Range Complex – incorporating Hawkesbury, Cessnock, Singleton and Gosford local government areas – October to December.

Between 1 July 2002 and 28 February 2003 fires burned nearly 1.5 million hectares of land, resulting in the loss of 86 houses (another 28 houses were damaged), as were 33 other major structures, 188 sheds, garages or outbuildings; 102 vehicles, boats or caravans; and about 3,400 head of livestock. Three people lost their lives as a direct consequence of the fires. The cost of insurance claims in NSW during 2002–03 was approximately $40,000,000 with an additional $120,000,000 spent on suppression. This does not include the costs and losses associated with fires that subsequently spread into the ACT, which when combined with fires that had started in the territory, burned 157,000 ha, resulted in the loss of four lives, 580 homes (damage to a further 800 structures), and damage bills of $350,000,000 and suppression costs of $404,000,000.

Although fires in both 2001–02 and 2002–03 resulted in large losses, fundamental differences existed between the two seasons. The dry conditions experienced in 2001–02 were not global-scale climatic perturbations like an El Niño weather pattern. Although natural fires were an important component, the 2001–02 season stands out because of an unprecedented number of fires and area burned by large (greater than 1,000 ha) incendiary and suspicious fires. Based on the available statistics, in 2001–02 deliberate fires accounted for:

- 46 percent (81,000 ha) of the total area burned in SFNSW fires
- 27 percent (90,000 ha) of the total area burned in NSW NPWS fires
- 29 percent (145,000 ha) of the total area burned in NSWRFS fires.

Formulating the total figure burned by deliberate fires is difficult as many large fires may be duplicated across fire agencies' records. Based on the NSWRFS figures, deliberate fires burned a minimum of 145,000 ha.

By contrast, 2002–03 was dominated by an El Niño-like weather pattern, which was exacerbated by drought that had pervaded much of the state during the previous year. Large fires in 2002–03 were

principally natural rather than human in origin. This was experienced both early in the season in northern NSW, and during the middle of summer in the south of the state.

Number of fires

Comparisons across agencies are difficult as the datasets cover different years, but overall, there is strong correspondence between yearly fluctuations documented across all four agencies in NSW (Figure 175 and Figure 176); that is, the number of fires broadly decreased and increased during the same years. Singly and collectively, data from these agencies indicate that although deliberate firesetting became a central focus of media and public attention during the December–January fires of 2001–02, the total number of deliberate fires recorded in that year was not particularly remarkable when compared with other years, for example:

- **1997–98**: Most agencies recorded high numbers of deliberate fires during 1997–98, which was another dry season associated with an El Niño event. The NSW NPWS and SFNSW only documented a 20 to 25 percent increase in deliberate fire numbers from 1997–98 to 2001–02. The NSWFB actually recorded 15 percent fewer fires in 2001–02 than in 1997–98, although this data may have been affected by lower levels of causal attribution.
- **2000–01**: The total numbers of deliberate fires in 2001–02 were not substantially different from that recorded in 2000–01. Notably, the SFNSW and NSWFB only recorded a 12 and six percent increase in deliberate fires relative to the previous year. The NSW NPWS recorded nine percent fewer fires in 2001–02 than in 2000–01. A large increase was evident in the number of fires the NSWRFS attended; although it is unclear if this is an apparent error reflecting the graduated introduction of incident reporting within AIRS across the state.
- **2002–03**: The total number of deliberate fires recorded in 2001–02 was not substantially different from that recorded in 2002–03. Notably, the number of deliberate fires the SFNSW attended remained stable, whereas the NSWRFS attended 10 more fires in 2002–03, and the NSW NPWS attended half as many in 2002–03 compared with 2001–02.

These trends are exemplified when fires the NSWFB attended in the Sydney region are examined on a week-by-week basis. Overall, for the NSWFB, there were strong parallels between the timing of deliberate fires (Figure 177) and the timing of fires generally (Figure 178). This reflects the fact that deliberate fires were an important contributor to fire numbers generally but also that the timing of deliberate fires was not fundamentally different to that observed for other fire causes.

The NSWFB attended 344 vegetation fires in the last week of December 2001–02 (Figure 178) of which 77 were identified as deliberately lit (Figure 177). This may seem extraordinary, but NSWFB records indicate that the number of deliberate fires attended in any one week from mid December to mid January were not unprecedented for that time of year; the maximum number of fires attended in any one week in 2001–02 was comparable to that attended in 2000–01, and less than attended during the peak in 1997–98.

The NSWRFS data for the Sydney region during the same interval are more complex. Notably, in contrast to the NSWFB data, the temporal distribution of deliberate fires (Figure 179) do not directly mirror the trend observed for fires generally (Figure 180). Based on the available results, the proportion of deliberate fires appears to increase as the bushfire season progresses, and the critical period in 2001–02 around Christmas–New Year is approached. When viewed in isolation, it appears that arsonists may have preferentially targeted the adverse fire weather during that period. However, considerable caution is needed before taking this view, as this apparent pattern is paralleled by an increase in the proportion of fires to which a cause was assigned; that is, cause was assigned to a far greater proportion of fires during the Christmas–New Year period than to fires in August–November. The reality may be that the number

and proportion of deliberate fires does not change substantially throughout the entire fire season, it is just that there is a greater emphasis on identifying the causes of fires during the most adverse fire weather conditions.

As for the NSWFB, the actual numbers of deliberate fires the NSWRFS recorded for weeks 52 to 2 of 2001–02 in the Sydney region were lower than those recorded during the same time in 2002–03, and were substantially lower than was documented for September 2000–01; the season was prematurely curtailed by high spring rainfall. Clearly, it is not only the total fire frequency that is important. The time that those fires occurred is also of significance. Hence, it is necessary to specifically examine changes in the number of fires that occurred within the critical window from weeks 48 to 4.

Mid December (week 48) to late January (week 4) corresponds not only with Christmas school holidays, but represents the window in which NSW most commonly experiences its most adverse fire weather, as reflected in the greater numbers of natural fires during this interval. It is during this window that the most devastating of the 2001–02 and 2002–03 fires occurred. It is valuable, therefore, to examine in detail this time period in detail.

In the Sydney region, the NSWFB attended 463 deliberate vegetation fires from weeks 48 to 4 in 2001–02. Although higher than most previous seasons, this was somewhat lower than in 1997–98 (Figure 181). The number of deliberate fires the NSWRFS recorded for weeks 48 to 4 in 2001–02 was higher in 2001–02 than in 2000–01, but was lower than documented during the same period in 2002–03. Combining the NSWFB and NSWRFS data it appears that the percentage of fires of known cause that resulted from incendiary and suspicious activity has decreased since the late 1990s. This is consistent with the trends observed both on a yearly and a week-by-week basis.

In the Illawarra region, the NSWRFS recorded markedly higher numbers of deliberate fires for weeks 48 to 4 in 2001–02 relative to both 2000–01 and 2002–03 (Figure 182). This was also evident for the Hunter (Figure 183) and Central Coast (Figure 184) regions. This is highly divergent from that observed for the NSWFB data. In all three regions the NSWFB recorded a higher incidence of deliberate fires in 2000–01 relative 2001–02. Notably, the NSWFB attended almost twice as many deliberate fires from weeks 48 to 4 in 2000–01 than in 1999–2000 or 2001–02, in the Hunter and Central Coast regions. The reasons for the differences between NSWFB and NSWRFS data are unclear. One possibility is that there may have been incomplete reporting for the NSWRFS for 2000–01. It is important to take into account the differences in scale. An increase of 20 deliberate fires would have had little impact on NSWFB data, but could have had a profound impact on the NSWRFS; not only in terms of the number of fires, but also the greater potential for larger fires to develop in more open country.

Databases from all four fire agencies recorded a high number of deliberate fires in the North Coast region generally; around 80 percent of NSWFB-attended fires where the cause was known, and 50 percent of NSWRFS-attended fires where the cause was known, resulted from deliberate causes in this region (Figure 185). Although the NSWFB recorded higher numbers of fires in weeks 48 to 4 in 2001–02, compared with 2000–01, they were not substantially different to that documented in 1997–98 to 1999–2000. The NSWRFS observed elevated fire numbers during both 2001–02 and 2002–03 relative to 2000–01 and 2003–04. The proportion of deliberate fire, as a percentage of fires of known cause, remained largely unchanged across seasons for both the NSWRFS and the NSWFB.

In summary, the absolute numbers of deliberate fires observed across 2001–02 and within the critical window from weeks 48 to 4 do not appear to be excessively higher in 2001–02 than in other years. There may have been subtle differences in the extent of deliberate firesetting in some regions; but if those differences were real, they were small and had a greater impact in rural and regional settings.

Area burned

Information about the area burned was available for the NSWRFS, NSW NPWS and the SFNSW. All three agencies' data showed (Figure 186):

- the largest areas were burned in 2002–03, followed by 2001–02 and 2001–01
- natural cause was the principal cause of fires in 2002–03
- both natural and deliberate causes were integral to the total area burned in 2001–02.

For both the SFNSW and NSWRFS, the exceptionally large areas burned by deliberate fires in 2001–02 were a unique occurrence. Notably, for these two agencies the area burned by deliberate fires in 2001–02 was six and 15 times greater than that burned by deliberate causes in 2000–01, respectively. For the SFNSW, the area burned by deliberate fires was 3 times greater in 2001–02 than in 2002–03, despite the severity of the latter fire season. Similarly, the NSW NPWS record smaller areas burned by deliberate fires in 2002–03 as compared with 2001–02, but for that agency the area burned in 2001–02 was actually 25 percent less than that burned in 2000–01.

In order to understand the context of the areas burned by deliberate fires in 2001–02, it is necessary to examine the timing and cause of large fires overall. Previously conducted data analysis highlighted the existence of two principal peaks in fire activity in the NSW fire season, which for the purposes of the following analysis will be referred to as:

- early season fires (typically August to October–November; weeks 31 to 47)
- peak season fires (December–January; weeks 48 to 5); termed peak season because this period coincides with the dominant timing for natural fire events in NSW, and the period during which the most destructive fires have occurred.

Three principal factors contribute to early season fires:

- The majority of fires in northern NSW (Northern Rivers and North Coast) regions occurred during late winter and early spring.
- The majority of burn offs (legal and illegal), as reflected in the NSW NPWS and SFNSW data, took place during spring.
- Contributions from incendiary and deliberate fires of unknown intention.

Late season fires appear to reflect two dominant factors, namely:

- Peak numbers of natural fire in central and southern NSW.
- Increased incendiary lighting, particularly in selected urban areas, coincident with a holiday period.

The NSW NPWS observed a substantial increase in both the areas burned by, and the principal causes of, early and peak season fires from 2000–01 to 2003–04 as described below.

- In 2000–01, not a particularly adverse bushfire season, the overwhelming majority of the total area was burned by early season fires (Figure 187). Of the 460,000 ha burned in 2000–01 between weeks 31 and 5, 97 percent was burned during the early season (prior to week 48), and of that almost two-thirds was burned by incendiary or suspicious fires. Approximately 15,000 ha burned in fires from week 48 to week 5. Of this, 48 percent resulted from incendiary and suspicious fires.

- Early season fires also occurred in 2001–02, with 93,000 ha being burned in weeks 31 to 48 (Figure 188). Of this, 56 percent resulted from incendiary and suspicious causes. However, this area was dwarfed by the 682,000 ha that was burned from weeks 48 to 5. Approximately 134,000 ha of that were burned in incendiary and suspicious fires. Nevertheless, this comprised only one-fifth of the total area burned by fires during the same period. The majority resulted from natural fires and reignition. Approximately 30 percent of the area burned in December–January fires were from fires of unknown cause. Two factors that differentiated the 2001–02 season are the large area burned and the significant part that deliberate human actions likely played in peak season fires.
- 2002–03 was markedly different again. Natural fires predominated throughout both the early and peak season periods, with similar total areas being burned in the two intervals (Figure 189). Accidental fires principally occurred before week 41 (late October). Incendiary and suspicious fires burned approximately 148,000 ha during 2002–03, but 98.5 percent of those occurred before week 48 in early December. Deliberate fires appeared to largely post-date accidental fires within the early season. In contrast to the previous season, very little was burned by deliberate fires in December and January.
- 2003–04 was a mild season with the majority of land being burned in early season fires (Figure 190). However, in contrast to previous years, and 2000–01 in particular, the overwhelming majority of fires resulted from accidental rather than deliberate causes.

The implication from the NSW NPWS data is that large areas are burned in early season fires every year, but during particularly adverse seasons far greater areas are burned in peak season fires; in 2001–02 peak season fires principally resulted from natural and deliberate causes, whereas for 2002–03 natural causes were the overwhelming contributor. Superimposed on this trend have been fundamental changes in the principal causes of early season fires; from deliberate causes in 2000–01 and 2001–02, to natural causes in 2002–03, to principally accidental causes in 2003–04. Despite this change in cause, deliberate fires have contributed to greater areas burned during the early season in all years except 2001–02.

The trends observed for the SFNSW and NSWRFS are somewhat different to those observed in the NSW NPWS data. For SFNSW the overwhelming majority of the area was burned during the early season; 2001–02 was the only exception (Figure 191). Like the trends observed for NSW NPWS, greater areas were burned in early season fires in all years except 2001–02.

For the NSWRFS, the greatest total area was burned in early season fires in the mildest years, but during peak season in adverse years (Figure 191). However, like the NSW NPWS and SFNSW, greater areas were burned by deliberate fires in the early season, compared with the peak season in all years except 2001–02 (Figure 192).

Early season fires: Illegal burn offs played an integral role in the large areas burned by deliberate fires during the early season. The NSW NPWS attended the greatest number of illegal burns during the early season of 2000–01 in the Hunter and Mid North Coast, New England Tablelands, and to a lesser extent Northern Rivers and Sydney and surrounds (Figure 193); that is, in regions that generally experienced the greatest number of burn offs. Overall these illegal burns, like burn offs generally, tended to be moderately large (Figures 194). However, for the NSW NPWS the proportion of total area burned in illegal, relative to legal burns, has decreased markedly since 2000–01 (Figure 195), with much of this being due to changes in early season fires.

Illegal burns are also likely to be an important contributor to the number and areas burned by SFNSW-attended fires during the early season, if the general distribution for burn offs is a representative guide. While no definitive information exists, it is evident that most rural burns the SFNSW attended occurred within the period between weeks 31 and 48 (Figure 196). The SFNSW attends the greatest numbers of rural burns in the Northern Rivers (principally Casino), North Coast (Coffs Harbour, Wauchope and Taree) and Hunter (principally Newcastle) regions. It is not unrealistic to assume that most illegal burns will also occur between weeks 31 and 48, in these regions. Rural burns burned large areas in both 2000–01 and 2002–03; comparatively smaller areas were burned as a result of this cause in 2001–02 (Figure 197).

No information is available from the NSWRFS data specifically regarding burn offs, as the form of heat of ignition variable was not supplied. However, fires resulting from inadequate control of an open flame peak between weeks 27 and 42, consistent with the timing documents for burn offs the NSW NPWS and SFNSW attended.

In summary, burning off is a practice that occurs every year, and although variable, a proportion of burn offs every year are likely to be illegal. Given that burn offs are on average larger than deliberate fires of other causes, it is not implausible that deliberate fires may contribute to comparatively large areas burned during the early season in most seasons.

Peak season fires: As noted above, 2001–02 is distinguished by the exceptionally large areas burned by deliberate fires during the peak season. Before proceeding, it is reiterated that the total areas burned are governed by large fire events, and that the overall figures can be shaped by a single large fire event. For example, the largest deliberate fire in 2001–02 burned just over 80,000 ha, accounting for almost 60 percent of the total area burned by deliberate fires. Moreover, it needs to be recognised that this fire was labelled suspicious, and was not definitely identified as having resulted from incendiary causes. On other hand, there were many large (greater than 5,000 ha) incendiary and suspicious fires during the 2001–02 peak season.

There are potentially several different factors that contribute to high numbers of deliberate fires during the peak season of 2001–02; illegal burn offs, systematic/background firesetting, and deliberate firesetting targeting adverse weather conditions. There is no possible way to distinguish between these factors, but some discussion is warranted.

It is evident, from the discussions above, that high numbers of deliberate fires occurred during peak season every year, with the greatest number occurring in those regions characterised by high population densities. Most fires occurred in or near urban areas. These fires were small, and the continuance or even increase in such practices during adverse periods of fire danger was accompanied by increased danger of escape. Therefore, it is possible that a small proportion of fires lit within context of 'normal' background firesetting may have escaped and developed into large-scale bushfires. It is however, evident that a small number of increases occurred in the numbers of deliberate fires attended by the NSWRFS in specific areas. This may imply an increase in arsonists targeting vulnerable sites, however, this must be considered in light of the commonly large variations in unknown attribution, and the likelihood that fires during this critical time would have been more likely to have been classified as deliberate, relative to other years in which the weather conditions were less adverse. The numbers of fires arising from targeted arson are probably small, but then again comparatively few such fires are required to contribute to high losses. Although no definitive links can be drawn, it is emphasised that most large deliberate fires occurred in those regions that generally record high numbers and/or proportion of deliberate fires; namely the Sydney, Hunter, Illawarra, North Coast, Central Coast regions.

It is also difficult to accurately assess the extent of illegal burn offs during the peak season. While a small number of fires have been labelled as illegal burn offs, it is also likely that many such fires would have simply been labelled incendiary, owing to the adversity of the conditions. Indicators of illegal burn offs during adverse peak periods are discussed below.

Of the 11 documented cases of illegal burning off the NSW NPWS attended between weeks 48 and 4 in the years 1995–96 to 2003–04, three were in the Hunter and Mid North Coast region, four were in the Northern Rivers region, three were in the New England Tablelands, and one was in the Sydney and surrounds region. Three such fires occurred during 2001–02, one each in the Sydney and surrounds, Northern Rivers and New England Tablelands regions (Figure 193), which with the exception of the Hunter is largely consistent with the distribution described above. The three fires in 2001–02 fires burned 500, 2,000 and 3,872 ha respectively, falling within the range observed for burn off generally between weeks 31 and 5 of 2001–02 (Figure 194).

All SFNSW districts, except Urunga, Forbes, Eden and Batemans Bay, experienced at least one rural burn in weeks 48 to 4 in the years 1997–98 to 2002–03. Within the same timeframe 20 burns occurred in the Casino region, five in the Newcastle region, three in the Wauchope region and two each in the Taree, Coffs Harbour and Bathurst regions. Given this, it is perhaps not surprising then that four burn offs were observed in the Casino area in weeks 49 to 52 of 2001–02 (Figure 195). These burn offs burned between 450 and 2,000 ha each, being comparable in size to other SFNSW burn off attended between week 31 and 5 (Figure 196). Another fire occurred in the Bathurst region during week 48 of that year but only burned 0.5 ha. An assessment cannot be made based on the available NSWRFS data.

The implication from this analysis is that past temporal trends, whether in relation to deliberate firesetting, or illegal burns, provide the strongest predictor for areas that are likely to experience deliberate fires in the future. Having said this, some notable trends are evident between the 2001–02 and 2002–03 seasons.

Differences between 2001–02 and 2002–03

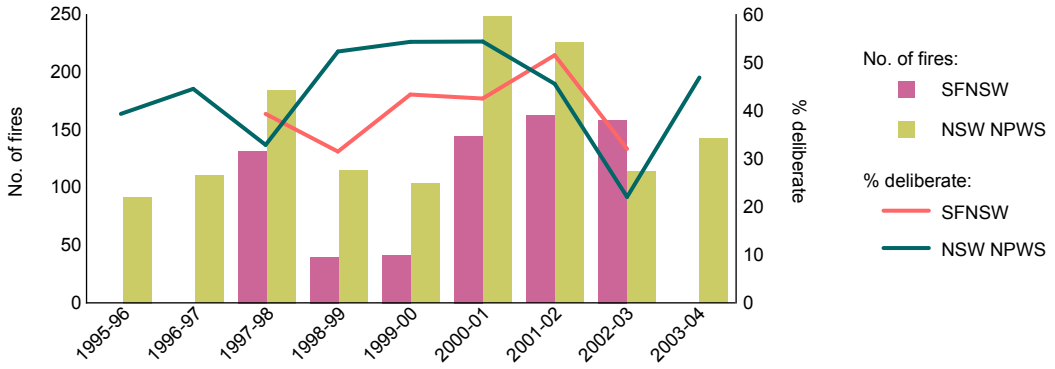
One factor that appears consistent across the NSW NPWS, NSWRFS and SFNSW databases is that fewer large deliberate fires have occurred during the peak season since 2001–02. This is observed both at state and region levels, and is clearly demonstrated in the SFNSW data by the fact that:

- although there were many moderate to large fires in the Newcastle region during December–January 2001–02 (Figure 198), only one such fire occurred in 2002–03 (Figure 199) and it burned less than 50 ha
- no fire in the Wauchope region during the peak season of 2002–03 burned in excess of 10 ha (Figure 198) whereas in the previous season more than 10,000 ha were burned during the same timeframe (Figure 199).

Similar changes are evident within the NSW NPWS and the NSWRFS data. It is unlikely that this simply reflects lower fire danger given the severity of the 2002–03 season. This research cannot evaluate whether this reflects changes in policy, policing, changes in personal behaviour in light of the 2001–02 devastation, or simply that in 2002–03 these areas were characterised by low fuel loads following the 2001–02 fires.

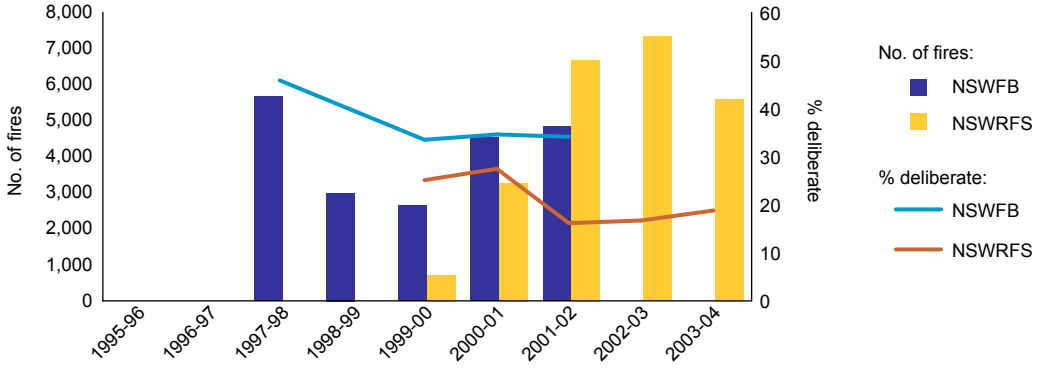
However, there are some aspects that may not have changed as a result of the 2001–02 fires. The numbers of deliberate vegetation fires that fire agencies attended during peak seasons remained high. A small number of illegal burns continued to occur during the peak season of 2002–03, despite the severity of the season. The SFNSW observed large numbers of small fires in the Taree region during the peak season of 2002–03 (Figure 198), when no such population existed in the previous year (Figure 197). A small number of fires continued to occur in the Bathurst region coincident with adverse weather conditions elsewhere in the state in both 2001–02 and 2002–03.

Figure 175: Deliberate fires attended by NSW land management agencies, yearly



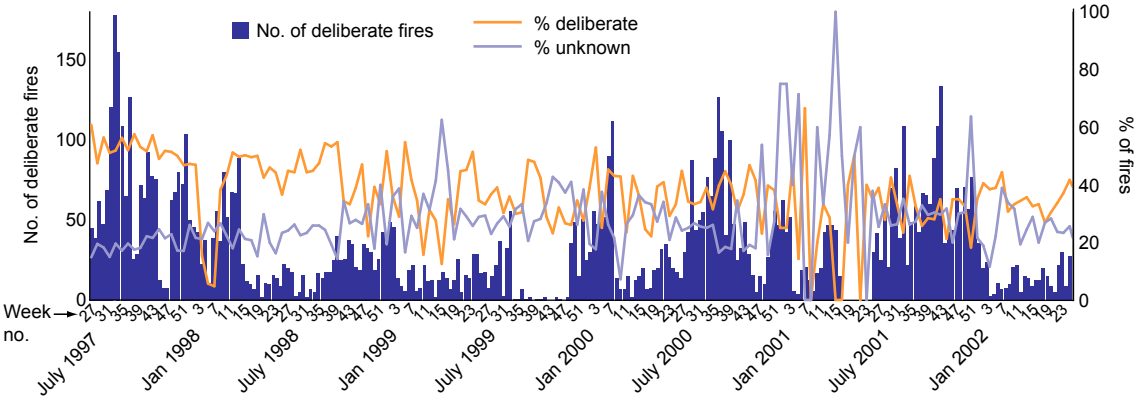
Source: SFNSW 1997–98 to 2002–03, NSW NPWS 1995–96 [computer file]

Figure 176: Deliberate fires attended by rural and urban NSW fire agencies, yearly



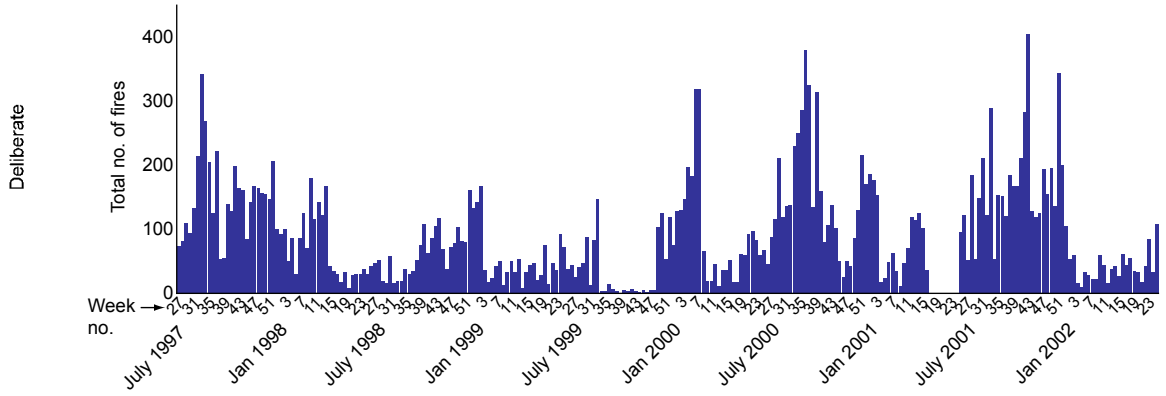
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 177: Number of deliberate fires, and percentage of fires of deliberate and unknown causes, by week, attended by the NSWFB in the Sydney region



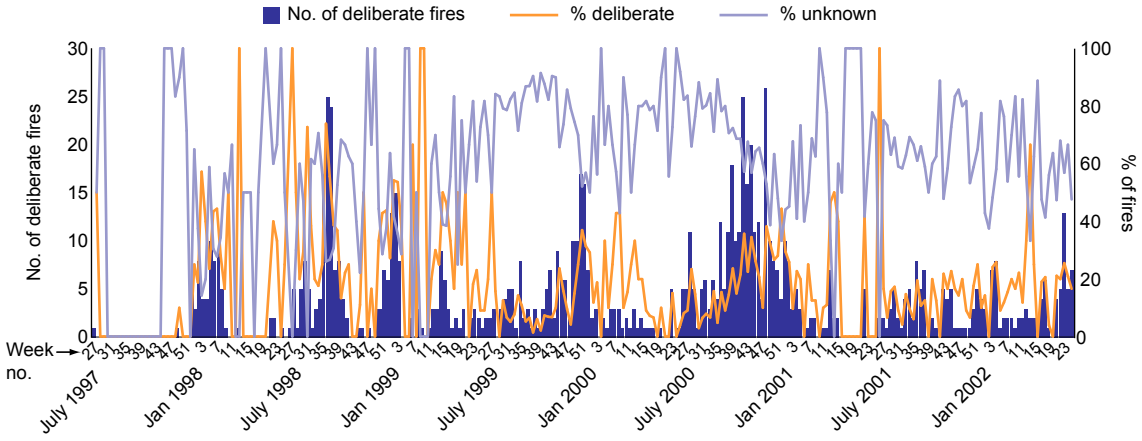
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 178: Fires, by week of the year, for the Sydney region, NSWFB only (number)



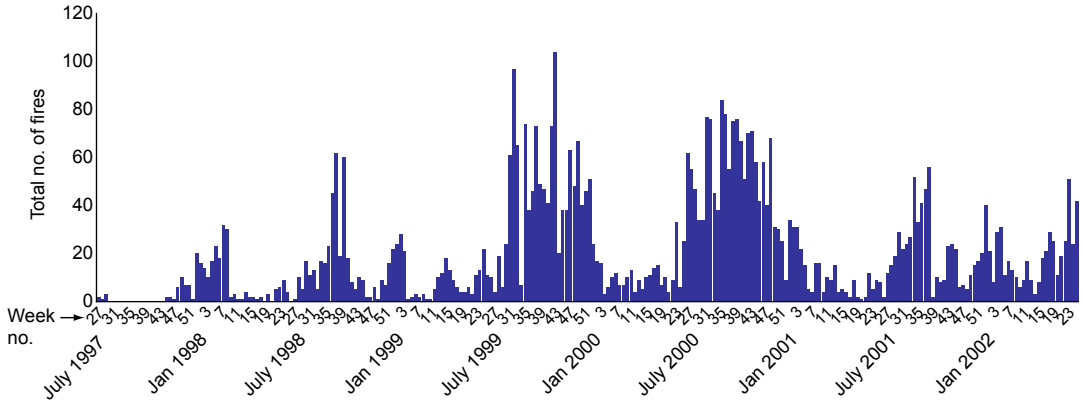
Source: NSWFB 1997–98 to 2001–02 [computer file]

Figure 179: Number of deliberate fires, and percentage of fires of deliberate and unknown causes, by week, attended by the NSWRFS in the Sydney region



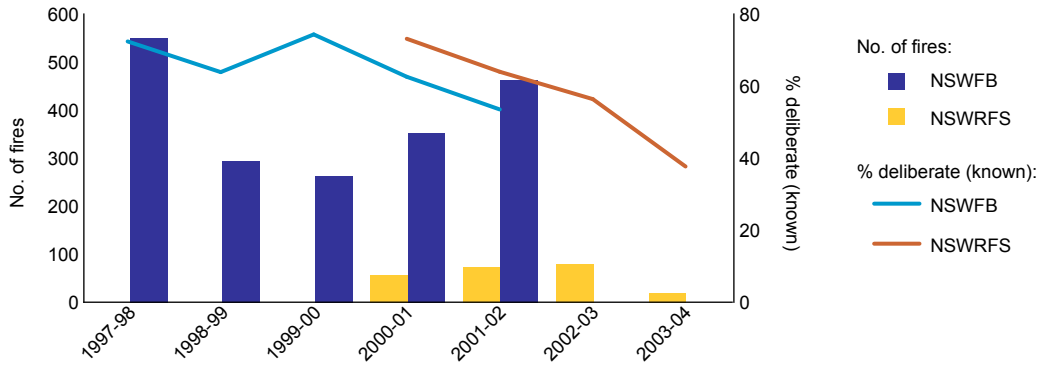
Source: NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 180: Fires, by week of the year, for the Sydney region, NSWRFS only (number)



Source: NSWRFS 1999–2000 to 2003–04 [computer file]

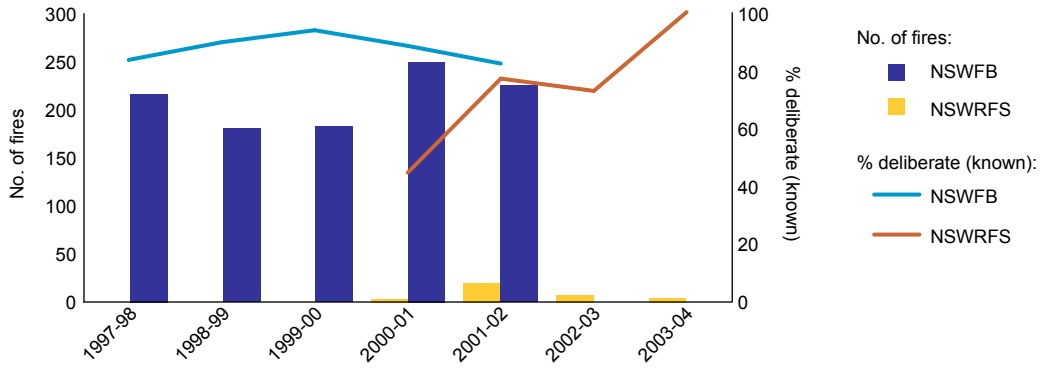
Figure 181: Number and percentage of deliberate (known)[a] fires in the Sydney region each year, NSWRFS and NSWFB



a: percentage of deliberate (known) refers the percentage of all fires of 'known' cause that were attributed to deliberate causes

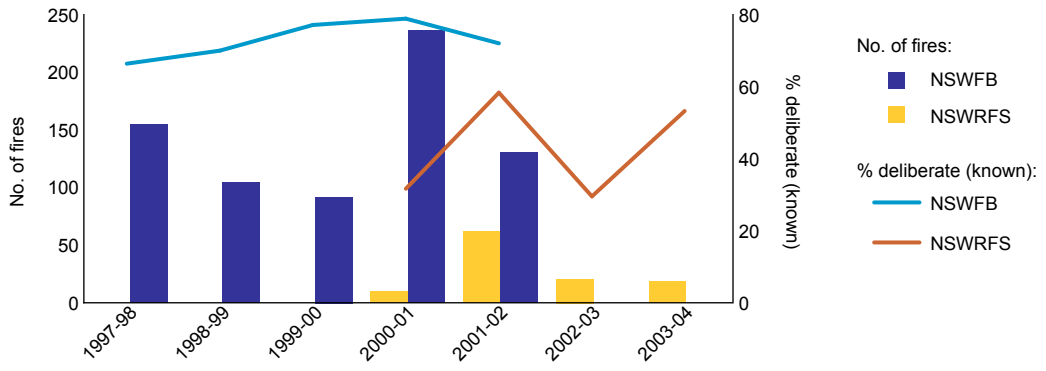
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 182: Deliberate fires in the Illawarra region, NSWRFS and NSWFB



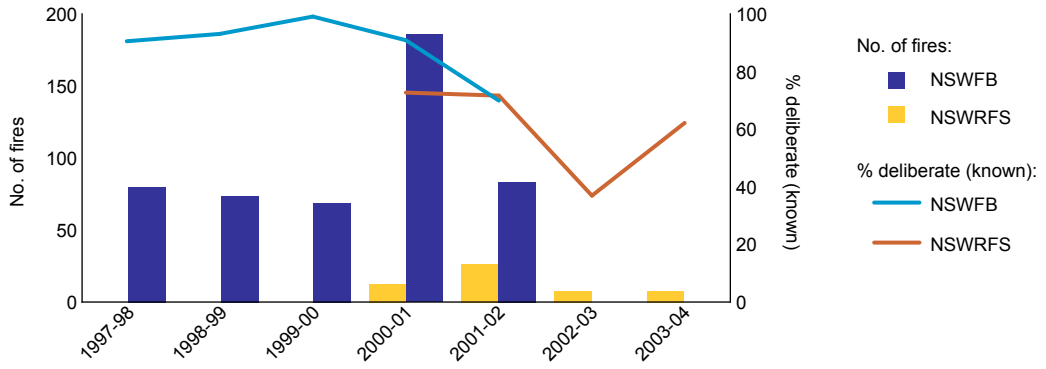
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 183: Deliberate fires in the Hunter region, NSWRFS and NSWFB



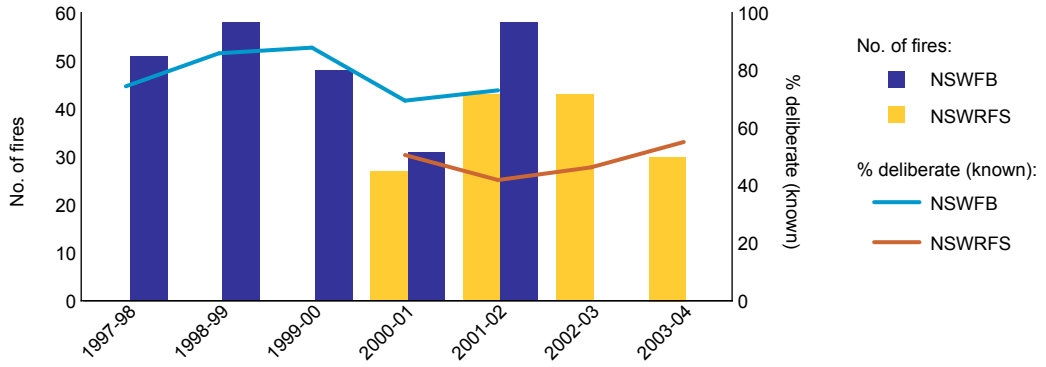
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 184: Deliberate fires in the Central Coast region, NSWRFS and NSWFB



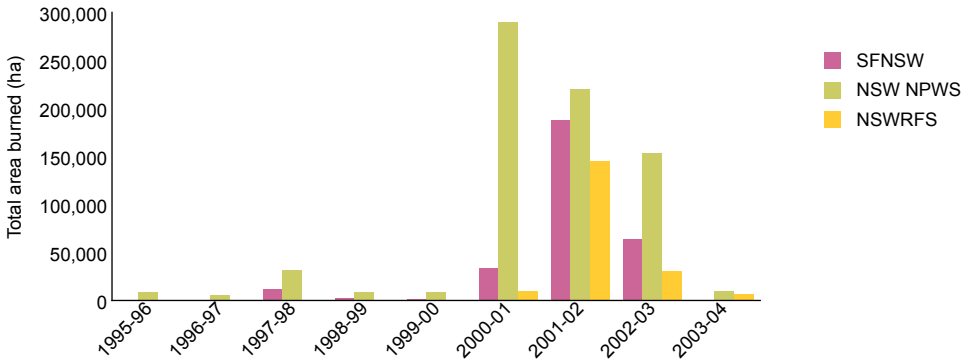
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 185: Deliberate fires in the North Coast region, NSWRFS and NSWFB



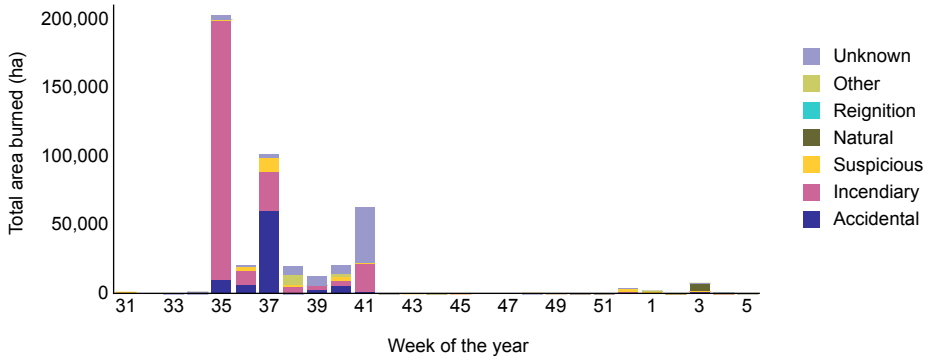
Source: NSWFB 1997–98 to 2001–02, NSWRFS 1999–2000 to 2003–04 [computer file]

Figure 186: Total area burned, annually, in deliberate fires, NSWRFS, SFNSW and NSW NPWS (number)



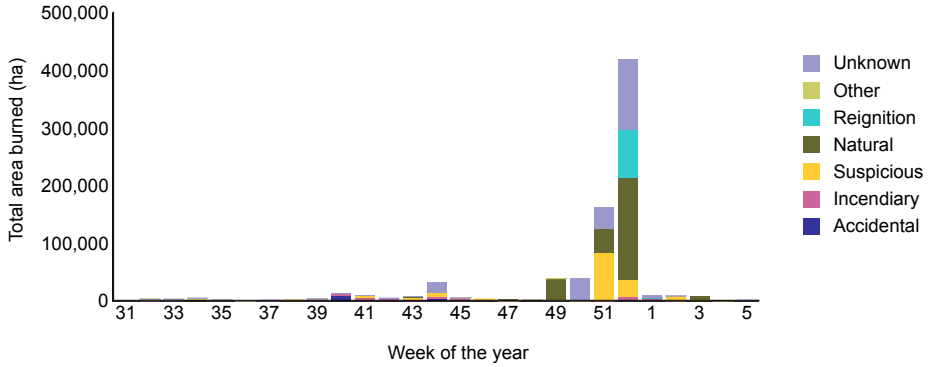
Source: NSWRFS 1999–2000 to 2003–04, SFNSW 1997–98 to 2002–03, NSW NPWS 1995–96 [computer file]

Figure 187: Total area burned, by cause, each week, NSW NPWS, 2000–01 (number)



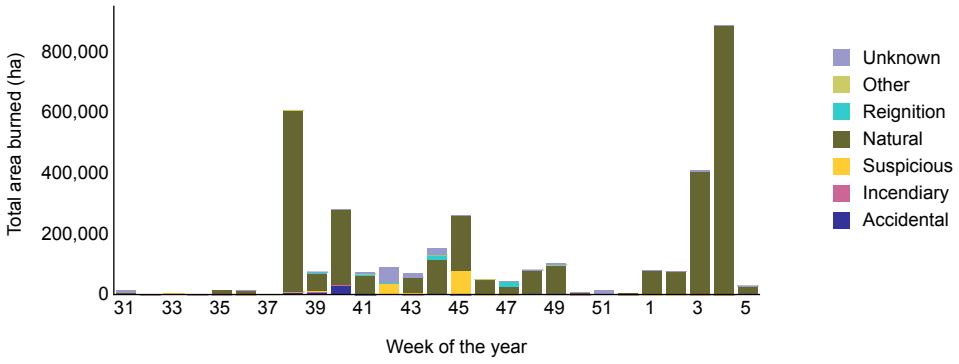
Source: NSW NPWS 1995–96 [computer file]

Figure 188: Total area burned, by cause, each week, NSW NPWS, 2001–02 (number)



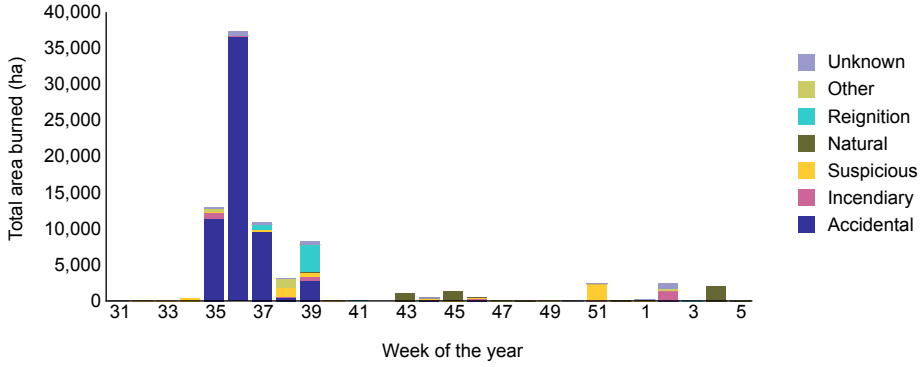
Source: NSW NPWS 1995–96 [computer file]

Figure 189: Total area burned, by cause, each week, NSW NPWS, 2002–03 (number)



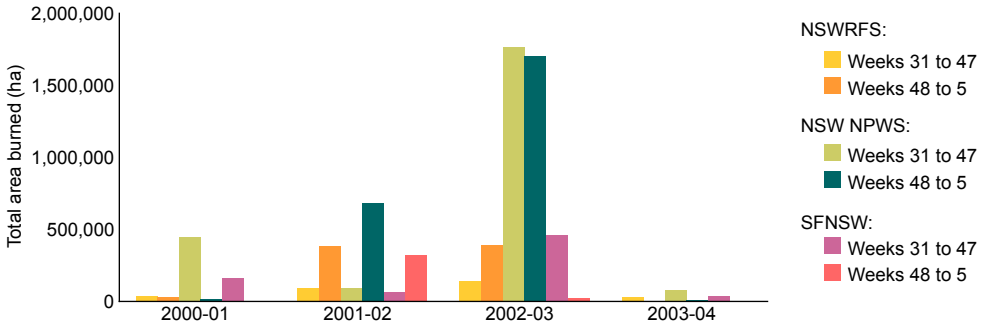
Source: NSW NPWS 1995–96 [computer file]

Figure 190: Total area burned, by cause, each week, NSW NPWS, 2003–04 (number)



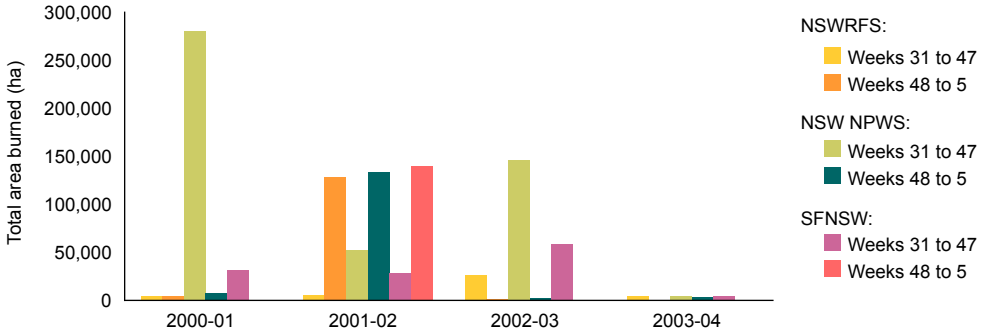
Source: NSW NPWS 1995–96 [computer file]

Figure 191: Total area burned in all early (weeks 31 to 47) and peak season (weeks 48 to 5) fires, individual NSW fire agencies (number)



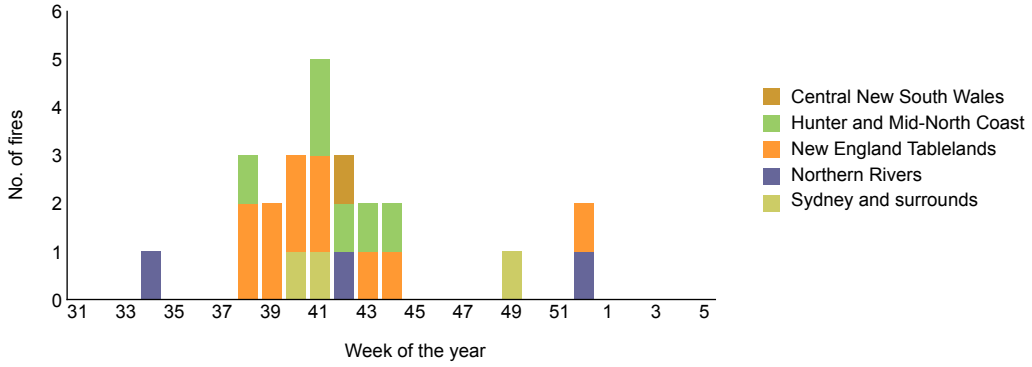
Source: NSWRFS 1999–2000 to 2003–04, SFNSW 1997–98 to 2002–03, NSW NPWS 1995–96 [computer file]

Figure 192: Total area burned in deliberate early (weeks 31 to 47) and peak season (weeks 48 to 5) fires, individual NSW fire agencies (number)



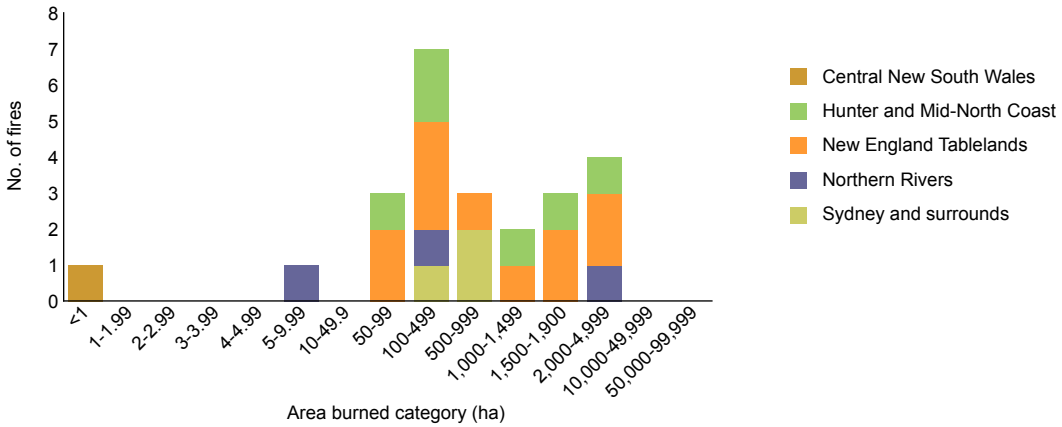
Source: NSWRFS 1999–2000 to 2003–04, SFNSW 1997–98 to 2002–03, NSW NPWS 1995–96 [computer file]

Figure 193: Illegal burn offs, by week of the year, by region, NSW NPWS 2001–02 (number)



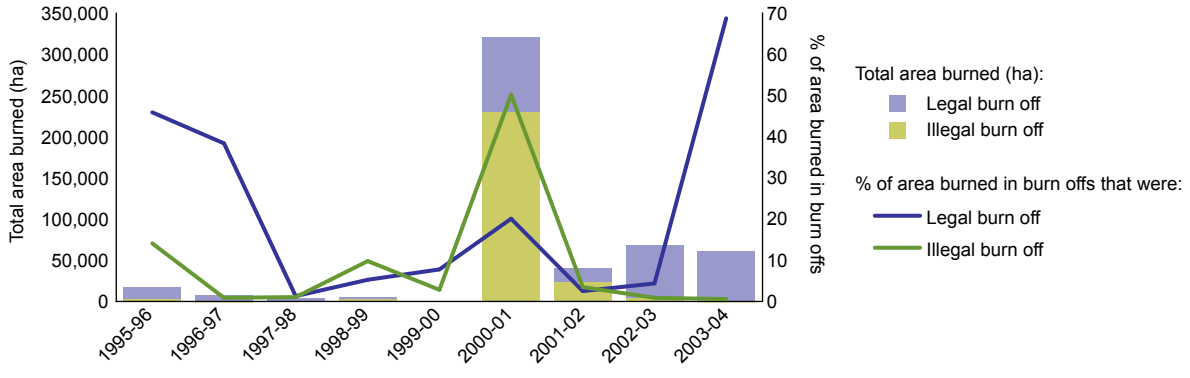
Source: NSW NPWS 1995–96 [computer file]

Figure 194: Illegal burn offs between weeks 31 and 5, by area burned (ha), by region, NSW NPWS 2001–02 (number)



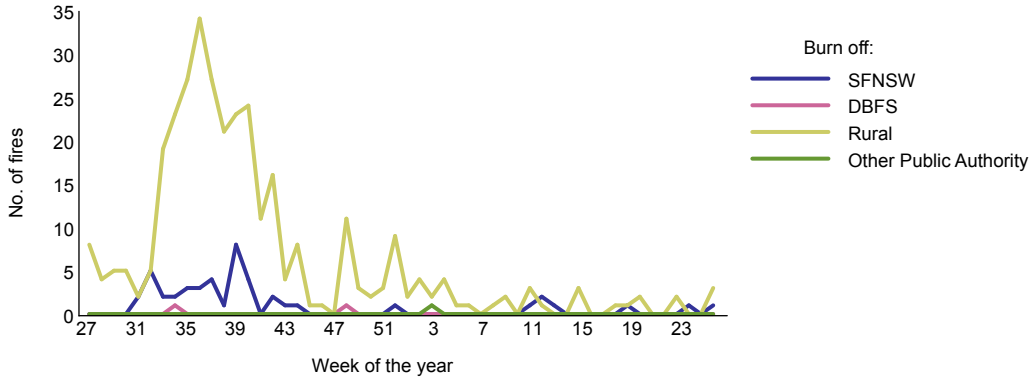
Source: NSW NPWS 1995–96 [computer file]

Figure 195: Area burned annually by legal and illegal burns, NSW NPWS



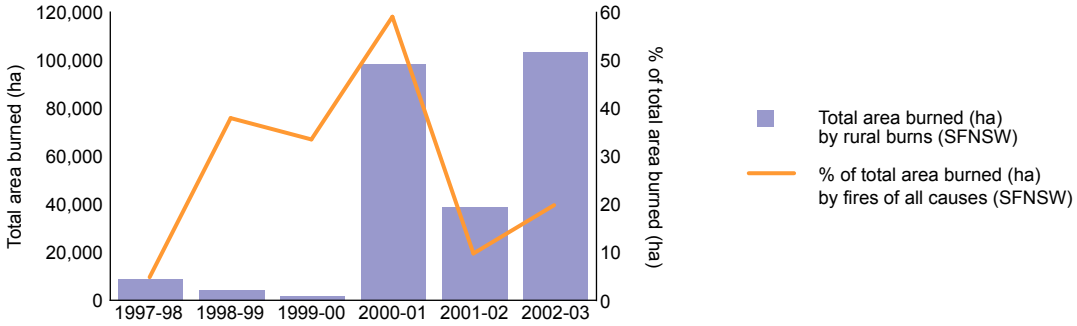
Source: NSW NPWS 1995–96 [computer file]

Figure 196: Rural and other burns, by week of the year for all SFNSW fires (number)



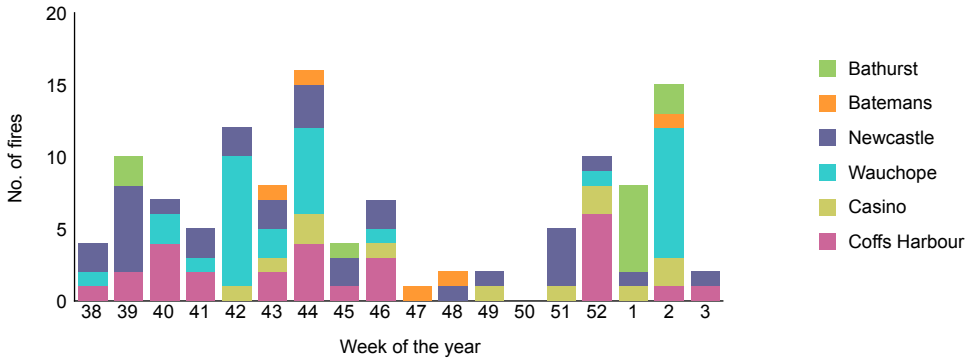
Source: SFNSW 1997–98 to 2002–03 [computer file]

Figure 197: Area burned annually by rural burns, SFNSW



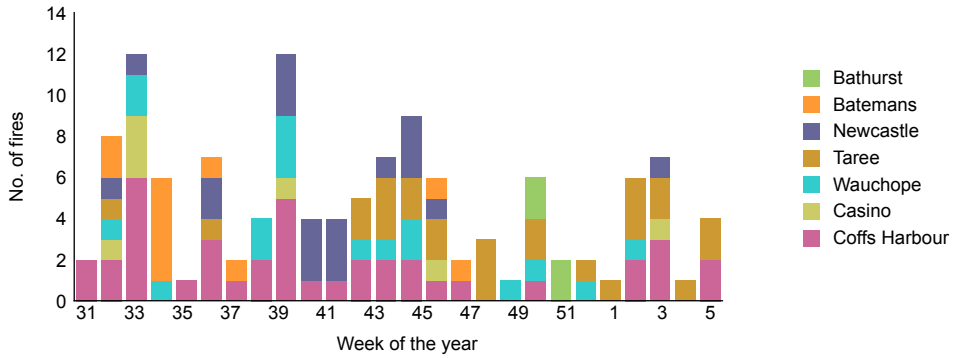
Source: SFNSW 2002–03 [computer file]

Figure 198: Deliberate fires, by week of the year, by region, SFNSW 2001–02 (number)



Source: SFNSW 2001–02 [computer file]

Figure 199: Deliberate fires, by week of the year, by region, SFNSW 2002–03 (number)



Source: SFNSW 2002–03 [computer file]

Summary

Number of fires: Information about the number of fires all NSW fire agencies attended during the observation period are summarised below:

- Fire services attended approximately 16,500 vegetation fires across NSW every year (based on data provided). This is slightly lower than that reported to the Australian Productivity Commission, where the number of landscape (vegetation) fires varied between 17,000 and 22,000 for the years 2000–01 to 2004–05 (APC 2006).
- Differences in the years analysed, incomplete data during implementation of the AIRS database, and industrial actions are several factors that may have contributed to differences between the average numbers documented herein and that reported to the Australian Productivity Commission (APC 2006).
- According to Australian Productivity Commission data, between 39 and 46 percent of all fires attended in NSW every year were landscape (vegetation) fires.
- The NSWFB (urban) attends approximately two-thirds of all vegetation fires in NSW, the NSWRFS 29 percent, and the NSW NPWS and SFNSW approximately two percent each. The figures for NPWS and SFNSW represent a maximum, as fires in these jurisdictions are commonly duplicated across agencies.

The type and location of incidents attended varied markedly between agencies. Salient points can be summarised as:

- **NSWRFS**: No specific information was available about the types of incidents attended but it is noted that 70 percent of all fires attended occurred on private land, 21 percent on local, federal and other public lands, and four percent each in state and national parks. Of those incidents attended, approximately 88 percent were grassfires, 1.9 percent in heathland and 1.7. in native eucalypt forest. The proportion of fires that constituted a bushfire or had the potential to develop into a bushfire is unknown; eight percent is a minimum but actual figures may be considerably higher.
- **NSWFB**: attended a large number of small fires. The number or proportion of fires that either constituted a bushfire or had the potential to develop into a bushfire under adverse conditions is unknown; 60 percent of fires were grass fires, 17 percent were scrub, bush and grass mixtures, and 18 percent were small vegetation fires. These three incident types constituted the bulk of vegetation fires in all regions. The cause of fires was remarkably similar across different incident types although it is noted that the proportion of deliberate fires was lower for grain and crop fires and higher for orchard, vineyard and nursery fires.

- **NSW NPWS**: fires most probably either constituted a bushfire or had the potential to develop into a bushfire under adverse conditions and/or in the absence of timely suppression activities. Sixty-three percent of fires occurred on NSW NPWS tenure, 24 percent on private property/lease, and five percent in state forests. Eighty-seven percent of all fires originating on NSW NPWS lands were contained on those lands, almost half the fires originating outside NSW NPWS tenure, subsequently spread onto NSW NPWS's lands.
- **SFNSW**: fires most probably either constituted a bushfire or had the potential to develop into a bushfire under adverse conditions and/or in the absence of timely suppression activities. Sixty-seven percent were in state forests, 26 percent on private property/leasehold and four percent in national parks.

Cause of fires in NSW is summarised in Table 6 and in the following text.

Deliberate fires comprised 19 to 41 percent of all fires individual agencies attended. The large range principally reflects differences in the levels of causal attribution, which are variable across the state, but lowest overall for the NSWRFS. Deliberate fires comprised 38 to 56 percent of known causes of vegetation fires for individual agencies. On average (agency weighted basis) deliberate fires accounted for at least 32 percent of all fires attended, representing 51 percent of known causes of vegetation fires in NSW (Table 6).

Natural fires accounted for one-fifth to one-quarter of all fires land management agencies attended, approximately one-tenth of fires the NSWRFS attended, and less than one percent of all fires urban brigades attended (Table 6).

Non-deliberate child fires accounted for 0.4 to 16 percent of all fires (Table 6), being greatest for urban brigades; in rural areas 6 to 12 years were most implicated (59% of 6 to 12 year olds, 33% of 13 to 16 year olds) whereas in urban areas a greater proportion of identified children were older (20% of 6 to 12 year olds, 37% of 13 to 16 year olds, 42% of unknown age). NSWFB indicates non-deliberate child fires accounted for higher proportions of all fires over time, and that most fires were started with an open flame (principally matches and, to a lesser extent, lighters).

Smoking-related fires comprised between 0.1 and six percent of all fires individual agencies attended, being considerably greater in urban areas compared with regional areas (Table 6).

In addition:

- **NSWRFS**: principal causes of accidental fires were inadequate control of an open flame, reignition, vehicle fires, high wind, and other ignition factors.
- **NSW NPWS**: 12 percent of fires were burn offs and almost one-third of burn offs were illegal; the proportion of illegal burns attended has decreased since 2000–01, when almost half were illegal. Motor vehicles were implicated in five percent of fires; of these one-third (1.5% overall) involved arson.
- **SFNSW**: 18 percent of fires were rural burns; the proportion of illegal burns is unknown.

Table 6: Fire cause

Agency	% Incendiary	% Suspicious	% Deliberate (known)	% Natural	% Non-deliberate child fires	% Smoking-related fires	% Rural burns
NSWRFS	2.6	15.9	19 (38)	9	0.4	0.7	unknown
NSWFB	14.6	22.6	37 (56)	1	16	6	
NSW NPWS	21.2	19.7	41 (48)	25		0.1	12
SFNSW	38.5		39 (40)	20		1.3	18

Location: Vegetation fires are heterogeneously distributed across the state. Thirty-six percent of all fires the NSWRFS and NSWFB attended occurred in the Sydney region, with large numbers of fires also occurring in the Hunter, North Coast (11%), New England–North West, Illawarra, Northern Rivers and Explorer Country regions:

- Overall, the greatest numbers of fires occurred in regions of greatest population density; hence most fires occurred along the eastern seaboard, commonly within close proximity to the metropolitan area.
- Fires were heterogeneously distributed within individual regions; in the Sydney region higher numbers of fires occurred in the Outer South Western, Fairfield–Liverpool, Blacktown and Canterbury–Bankstown SSDs; comparatively fewer fires occurred in the Inner Sydney, Eastern Suburbs, Lower Northern and Inner Western SSDs.
- Integrating causal data for the NSWRFS and NSWFB was complicated by the substantially lower rates of causal attributions in the NSWRFS data.
- Deliberate causes accounted for a high proportion of all fires in densely populated urban areas that experienced a high number of fires. Hence, high proportions of deliberate fires are observed in the Sydney, Illawarra, Hunter, Blue Mountains, Central Coast, North Coast and South Coast region. Similarly higher rates were evident in southwest Sydney when compared to other locations within the Sydney region.
- Individual locations with high rates of deliberate firesetting commonly accounted for a disproportionate number of all fires within a region, and a disproportionate number of deliberate fires within a given region or state. For example, 10 postcodes accounted for half of all deliberate fires the NSWFB attended in the Sydney region, and one-fifth of all deliberate fires it attended across the state.
- Regions where there were high rates of deliberate firesetting in urban areas also commonly experienced high rates of deliberate firesetting in rural, forestry and conservation areas, although there was some variation in detail. Both NSW NPWS and SFNSW observed high numbers of fires and a high proportion of deliberate fires in reserves under their jurisdiction where deliberate firesetting was a problem.
- Deliberate firesetting was also an important factor in fires in the Outback and Riverina regions although in these two instances intensive and localised cases of deliberate firesetting strongly affected the trends observed for the region as a whole.
- Natural causes accounted for a high proportion of fires land management agencies attended in the Explorer Country, Capital Country, Murray and Snowy Mountains regions.
- Land management agencies attended the greatest number of burn offs in the New England, Northern Rivers and Hunter and Mid North Coast regions. These regions also tended to experience the greatest number of illegal burn offs.
- Substantial differences can exist between the principal causes of fires in urban and in rural (including land management tenures) areas within the same region. Differences in specific causes of deliberate fires (for example, illegal burns versus malicious incendiarism) can also arise.
- Overall, there was strong correlation between the number of **non-deliberate child fires** and the total number of fires within a given area, and for a given year; specifically, non-deliberate child fires accounted for the highest proportion of fires in the Sydney and New England–North West regions (20%).
- Most **smoking-related fires** occurred in the Sydney (57%), Illawarra (11%) and Hunter (9.5%) regions; percentages of smoking-related fires were highest in the Illawarra (9.3%), Sydney (8.1%), and the Murray (8.6%) regions.

- Individual postcodes commonly experienced between one and 100 fires of any cause, and between 0.1 and 100 deliberate fires per 10,000 people per year. The maximum recorded rates were comparatively uniform across populations ranging from 100 to 100,000 people. Higher rates were evident in southwest Sydney compared to other areas in the region.

Timing: Important aspects of the timing of vegetation fires in New South Wales are summarised in terms of the time of the year, day of the week and the time of day at which they occurred.

Week of the year: NSW experienced the highest numbers of vegetation fires from mid-July to the end of March, but there were two dominant populations: early season fires (mid August to mid November – late winter and spring) and peak season fires (mid-December–January – summer). The proportion of early season to late season fires varied between agencies, regions, and seasons, reflecting differences in principal causes of fire, the types of environment in which fires occurred, and differing climatic/weather conditions. Most natural fires occurred in the peak season, irrespective of the fire agency concerned. However, large numbers of natural fires occurred earlier in 2002–03, and to a lesser extent 1997–98 (SFNSW); that is, in years associated with El Niño-like weather patterns. Some differences were evident in the timing of fires across agencies, namely:

- **NSWRFS**: A high proportion of all NSWRFS fires occurred during the early season. Greater numbers of accidental fires occurred during the early season compared with the peak season, reflecting the high contributions from burn offs within this category. The numbers of deliberate fires were comparable between early and peak seasons, but deliberate fires comprised a higher proportion of all fires during the peak season; the cause of a high proportion of fires during the early season was unknown. However, some differences may exist in the types of deliberate fires lit during peak and early seasons.
- **NSWFB**: The NSWFB attended a greater proportion of peak season fires than did other fires agencies. The timing of accidental and deliberate fires was comparable. The Sydney, Hunter, Illawarra and Central Coast regions all experienced peaks in fire numbers during both the peak and early seasons. High numbers of peak season fires occurred in all these regions, being most pronounced for 2001–02. Most fires in northern NSW occurred during the early season, but higher than normal numbers of fires occurred during the peak season in 2001–02. In contrast, the Murray, Riverina and to the less extent the Explorer Country regions experienced greater numbers of fires in the peak season.

NSW NPWS: The balance of early and peak season fires varied markedly between years, depending on the number and timing of natural fires. Overall most deliberate fires occurred during the early season, overlapping with but also post-dating the timing of burn offs. Large numbers of peak season fires primarily occurred in the Sydney and surrounds region and the Hunter–Mid North Coast region

- **SFNSW**: Most deliberate fires occurred during the early season, coincident with the timing of rural burns; large numbers of deliberate fires during the peak season were principally restricted to 2001–02.

Day of the week: Variations in fires by day of the week are described below:

- **NSWRFS**: Thirty percent of fires occurred on Saturday and Sunday relative to the average weekday; the incidence of weekend cause-specific fires were incendiary, 50 to 55 percent more likely; suspicious, 23 to 30 percent more likely; accidental, 33 to 37 percent more likely. High proportions of weekend fires occurred in the Sydney (39 to 49% higher), Blue Mountains (45 to 65% higher), Illawarra, North Coast, and Outback commonly 30% to 50% higher) regions.
- **NSWFB**: NSWFB-attended fires were 30 percent more likely to occur on Saturday and 28 percent more likely on Sunday than on the average weekday but were cause specific (incendiary, 40% higher; suspicious, 29 to 32% higher; and accidental 29 to 34% higher on weekend days) and varied between regions.

- **NSW NPWS** and **SFNSW**: No weekend bias was observed.

Time of the day: Information about the detection times of fires for the NSWRFS, NSWFB and SFNSW are summarised below:

- **NSWRFS**: The incidence of deliberate and natural fires peaked between 3 and 5 pm; accidental, other and reignition peaked between 1 and 2 pm; 32 percent of suspicious fires occurred between 6 pm and 6 am compared with 18 percent for accidental fires; 13 percent of suspicious fires occurred between 10 pm and 6 am compared with five percent of accidental fires. A high proportion of night-time fires occurred in the Riverina and Outback regions.
- **NSWFB**: Peak numbers of fires occurred between 3 pm and 7 pm. Although the peak for non-deliberate fires was slightly earlier than for deliberate fires, it is noted that the peak for accidental fires is slightly later than in many other jurisdictions. Peak numbers of fires also occurred earlier on weekends. A higher proportion of deliberate fires occurred at night compared with other fire causes; 33 percent of deliberate fires occurred between 7 pm and 5 am, compared with 26 percent of accidental fires. Greater numbers of deliberate fires occurred on Friday night–Saturday morning and Saturday night–Sunday morning. However, the dominant timing of fires varied both between and within regions.
- **SFNSW**: No substantial differences were evident between the times fires occurred, but detection times appear to have been shaped by the time during which staff were on duty.
- **Non-deliberate child fires**: The distribution of non-deliberate child fires by week of the year parallels that observed for fires generally within each region. Overall, non-deliberate child fires were 36 to 42 percent more likely to occur on weekend days. Numbers peaked between 3 and 6 pm on weekdays, but somewhat earlier on weekends. One-quarter of all child fires occurred between 7 pm and 5 am, with the proportion of night-time fires increasing with age of the child.

Area burned: Most fires were small, with the number of fires decreasing with increasing fire size. A higher proportion of SFNSW-attended fires were of a moderate to large size, compared to other NSW fire agencies.

Overall, deliberate fires accounted for a decreasing proportion of fires, as fire size increased, although this relationship breaks down for large fire sizes. Natural fires and to some extent rural burns/burn offs accounted for higher proportion of all moderate and large fires.

The size distributions for individual regions were related to the principle cause of fires in those regions. For example, a high proportion of the moderate to large fires the NSW NPWS attended occurred in the New England region owing to the greater numbers of burn offs, whereas the Sydney region accounted for a high proportion of small fires (owing to the high density of small deliberate fires) and a high proportion of larger fires (many of which were natural in origin).

For the NSW NPWS, natural fire causes were a significant contributor to large fires that started on, and subsequently escaped from, NSW NPWS' tenure, whereas many large deliberate fires originated outside of and subsequently spread onto NSW NPWS tenure.

All three regional agencies recorded the greatest total areas burned in 2002–03 followed by 2001–02 and 2000–01; natural ignition was the principal cause of the large areas burned in 2002–03, whereas large fires in 2001–02 resulted from both natural and deliberate causes. Most large deliberate fires in 2001–02 were identified as suspicious, as opposed to positively being identified as incendiary.

Large areas were burned in NSW every year during the early season; illegal and legal burns were major contributors to the total area burned during this time. NSW NPWS records indicated that greater areas of land were burned by illegal causes (principally illegal burns) in 2000–01 than during 2001–02. The ratio of area burned by illegal burns, relative to burned in legal burns has systematically decreased since that

time. SFNSW still recorded large areas burned in rural burns during 2002–03, although there was no indication if these fires were legal or illegal.

The most devastating fire seasons, namely 2001–02 and 2002–03, were both characterised by large fires during the peak season (mid December and January); deliberate (suspicious) causes, along with fires of natural origin were an important contributor to the large areas burned during 2001–03; large areas were not burned by deliberate fires during 2002–03, despite the severity of the season.

In relation to fires during adverse fire seasons, it is noted that:

- the 2001–02 season was not particularly remarkable in terms of the overall number of deliberately lit fires, either on a state-wide scale or within the particular regions most adversely affected by the 2001–02 fires
- small increases in the numbers of deliberate fires during the 2001–02 and 2002–03 seasons may imply some deliberate firesetting specifically targeting adverse fire weather, but absolute numbers of such fires are likely to be low
- regions most affected by the 2001–02 fires, including the Hunter, Central Coast, North Coast, Illawarra and to some degree Sydney, all reported high levels of deliberate firesetting generally; in most instances, this problem existed before 2001–02, being evident as early as 1997–98 in some areas
- all three regional agencies recorded a decrease in large deliberate fires during December–January since the 2001–02 fires.

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