Australian Capital Territory

Contents

The first part of this Chapter provides **contextual information** on the Australian Capital Territory, 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 the Australian Capital Territory. The second part represents an **analysis of data** provided by the ACT Parks Conservation and Lands.

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

Introduction

The Australian Capital Territory consists of a small (2,400 square kilometres) landlocked enclave located in the Southern Tablelands of New South Wales.

Geography

The western margin of the territory is bounded by the Brindabella Ranges (Figure 1), the northern extension of the Snowy Mountains and the highest expression of the Great Dividing Range. The mountain slopes commonly rise to 1,200 m, but in the south and west steep ridges and mountains peaks reach above 1,800 m. Most of the mountainous terrain in the southern and western parts of the territory is heavily forested and in the south, the comparatively untouched forests are preserved within the Namadgi National Park and the Tidbinbilla Nature Reserve. Beyond these areas lie the high country and the Snowy Mountains.

In the northeast the territory consists of low undulating hills and floodplains of the Murrumbidgee and Molonglo Rivers. Most of this area lies below 600 m in elevation. Within this area lies the city of Canberra, the capital of Australia and the only major urban development in the territory. Lying between the mountain and urban areas is a strip of land dominated by agriculture and forestry, scattered semi-rural residential areas, and small settlements (Williamsdale, Naas, Uriarra, Tharwa and Hall).

Canberra is a comparatively young city, with much of the urban area having been built in the last 30 to 50 years. It is commonly referred to as the bush capital, being surrounded by bushland or grassy plains on all sides, but with tracts of open land separating distinct parts of the city and neighbouring suburbs.

Figure 1: Map of the Australian Capital Territory

Map courtesy of Mapping Services, ACT Planning and Land Authority, January 2008

Climate

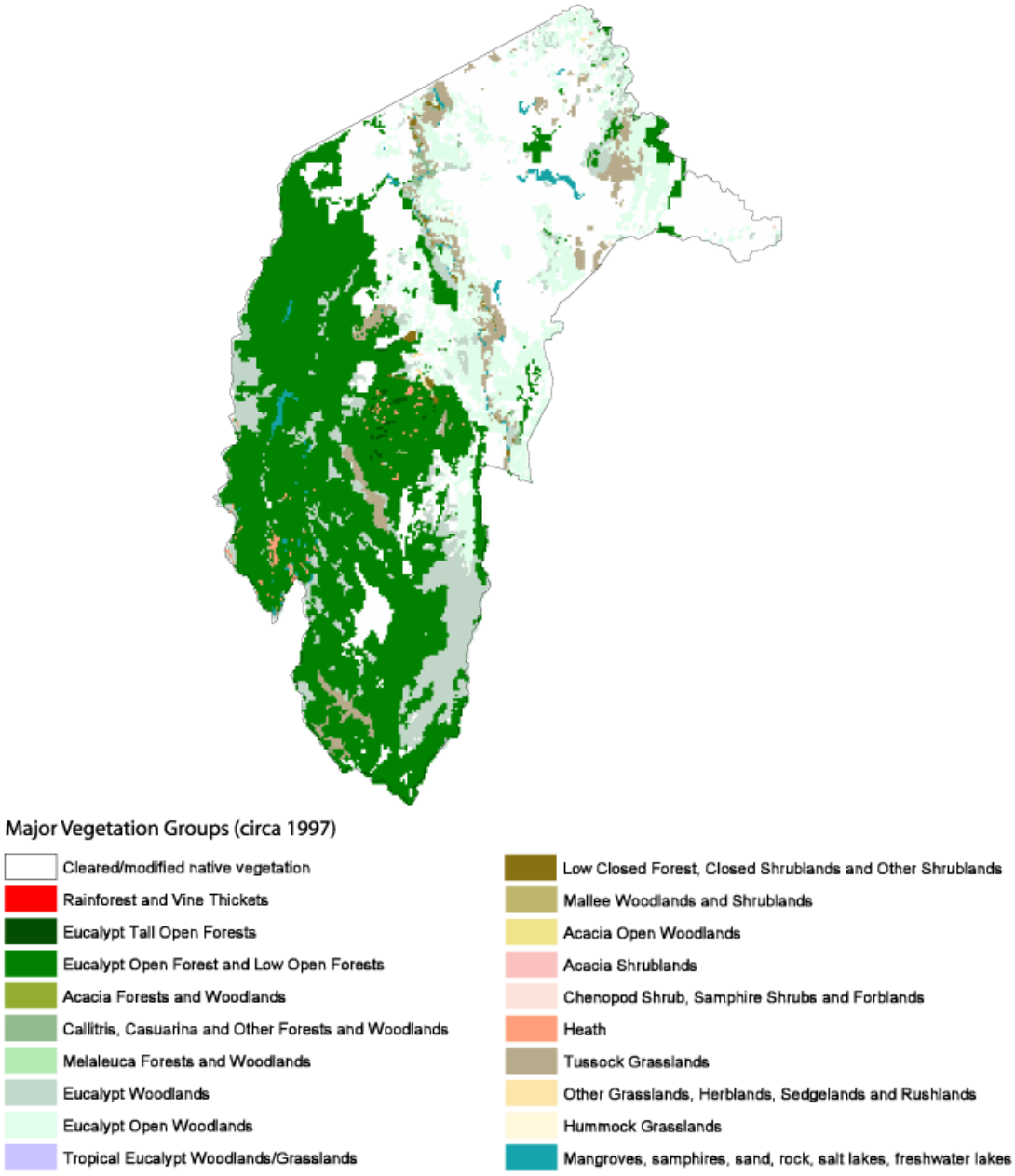
The territory experiences four distinct seasons. Owing to its distance from the coast, there are few moderating influences from coastal breezes, and the largely continental climate incorporates hot dry summers through to cold winters characterised by heavy fog and frequent frosts. The higher mountains of the west experience snow, and may remain snow-covered for at least part of the winter. Average annual rainfall in Canberra City is 633 mm, but greater than 800 mm is experienced in the western and southern mountainous regions (Australian Bureau of Meteorology 2007). Rainfall in the territory is uniformly distributed throughout the year, with winter precipitation principally related to the west to east movement of cold fronts across southern Australia. The low rainfall experienced in the territory and the Southern Tablelands, as compared to other parts of the Great Dividing Range, reflects rain shadow effects generated by the Snowy Mountains to the southwest. Summer rainfall is commonly derived from thunderstorms that can occur from October and March.

Native vegetation

Consistent with its location, major vegetation types in the territory are typical of those observed in bioregions of the Australian Alps and South East Highlands. Most of the west and south of the territory is dominated by eucalypt open forest and low open forest, eucalypt woodlands, with valleys of tussock

grasslands, pockets of heath and eucalypt tall open forest (Figure 2). The little that remains of the original vegetation in the northeast is dominated by eucalypt open woodlands, with lesser amounts of tussock grassland, eucalypt open forest and low open forest, and eucalypt open woodlands (Department of Environment and Heritage 2001b).

Figure 2: Major vegetation groups (c. 1997)

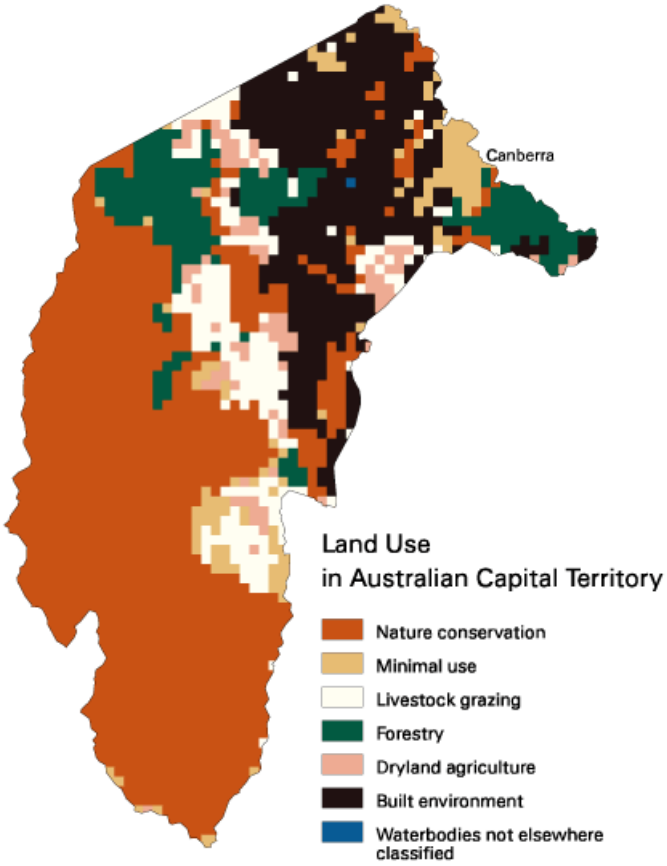


Source: Department of Environment and Heritage 2001b

Land use

As at 1996–97, 53 percent of the territory was used in nature conservation. This principally occurs in the southwest at Namadgi National Park and Tidbinbilla Nature Reserve, although smaller reserves are scattered across the territory, including through the urban centre itself (Figure 3). In 1996–97, forestry occurred on 10 percent of territory lands, with forestry reserves bounding both the Namadgi National Park and urban centres. However, much of this resource was lost during the 2003 bushfires. Dryland agriculture and livestock grazing, principally in the north and east, accounted for a further four and eight percent of the total area respectively.

Figure 3: Land use in the Australian Capital Territory (c. 1996–97)



Source: Department of Environment and Heritage 2001a

Population

As at June 2006, the territory's resident population was estimated to be 328,800 accounting for 1.6 percent of Australia's total population (ABS 2006b); the majority resides in the city of Canberra.

With a median age of 34.5 years (at June 2005), the territory's population is younger than the national average (median age of 36.6 years). The lowest median age occurs in the Gungahlin–Hall statistical subdivision (median age of 31.1 years), followed by Tuggeranong (33.1) and North Canberra (33.3) statistical subdivisions. As at June 2005, 19.2 percent of the territory's population was under 15 years of age. However, nearly one-quarter of people in the Gungahlin–Hall statistical subdivision (23.9%) and Tuggeranong statistical subdivision (23.6%) fell within this age bracket.

Overall, the territory has a lower proportion of people aged 60 years or older, but a higher proportions of people aged 16 to 58 years and young adults (18 to 33 years) than other jurisdictions. This reflects the high number of people within these age groups who move to Canberra for the purposes of tertiary education and/or employment (ABS 2005).

Bushfire regimes

Bushfire regimes in the territory are equivalent to those observed in most of the Snowy Mountains and South West Slopes. The bushfire season in the territory typically spans October to March being associated with the hot, dry summer conditions. However, deviations from this interval are facilitated by the sometimes erratic rainfall distribution.

Bushfire history

A detailed history of bushfires in the territory is available at the ACT Emergency Services Authority website at www.esb.act.gov.au. The most devastating bushfires and bushfire seasons are documented in Table 1, with a number of these discussed in more detail below (ACTESA 2006b).

1939: 3 to 14 January – November 1938 to mid January 1939 were the driest months on record since 1918. Fires broke out beyond Uriarra Station during heat-wave conditions, and by 14 January had reached the territory along three main tongues – one near Mount Franklin, one at Two Sticks Road (near Mount Coree) and the third near Horseshoe Bend along the northern boundary of the territory. Strong winds of up to 70 km per hour on the 14th fanned the flames and started numerous spot fires up to 24 km ahead. By Saturday afternoon the fire front was 72 km long and had crossed the Murrumbidgee River in several places, before being halted. Approximately 60,000 ha of timbered and grazing land were burned out (including 1100 ha of pine plantation, which at that time was worth £300,000. No lives were lost and stock losses were small. The main losses were property and approximately 64 km of fencing, particularly in the Tidbinbilla and Uriarra area.

1952: January to March – from 17 to 24 January six fires at Bobbys Plain, on the Brindabella–Tumut Road, burned 800 ha; all six were believed to have been deliberately lit. Another three fires (two ignited on the 25th; one ignited on the 23rd) burning in the Yarralumla (Campbell Fire), Red Hill (Jennings Fire) and Woden (Tanner Fire) areas combined, and over 12 days, racing across Mugga Hill and towards Tuggeranong, and subsequently across scrub country and into New South Wales. At least two of the three fires were attributed to power lines. These fires claimed two lives, burned two cottages, 40 sheds and out-buildings, machinery, haystacks, 357 acres of pines, thousands of hectares of fodder, five railway bridges, several hundred miles of fencing, and resulted in the deaths of approximately 7,000 sheep and other livestock. Subsequently, fires started by lightning strikes in the northwest of the territory, in pine forests near Mount Stromlo, and in the Hall District on 5 February, collectively burned thousands of hectares of grassland and some pine plantations. Lightning on 5 February was also considered responsible for fires near Baldy Mountain, California and Bag Range. These fires were not detected until 7 February and over several weeks burned 14,500 acres.

1979: 13 February 1979 – a bushfire broke out under extreme weather conditions near Hall. Fanned by 70 km per hour winds, the fire quickly spread, and by 5 pm the township of Sutton was evacuated, as the fire reached nearby hilltops. A subsequent wind changed caused the fire to break out towards the northeast, but it was contained the next day. The fire burned 16,500 ha in total, of which 4,025 ha was located in the territory. Two cottages, three sheds, machinery and stored fodder, about 5,000 sheep, six horses and fencing worth $200,000 were destroyed. A dropout fuse from a high-tension power line caused the fire. Other outbreaks on the same day occurred at Mount Painter, Tuggeranong, near Kambah Pool, and at Stirling.

1983: 9 to 30 January – A large fire broke out in inaccessible terrain in near Mount Kelly, in the southwest of the territory. A total of 36,000 ha burned, including 300 ha of pine plantations, but there was no loss of life or property. Large costs arose from attempts to suppress the fire as it burned over several weeks.

2003: 18 January – the territory, like much of Australia, experienced severe drought during 2002–03. On 8 January, lightning strikes started numerous fires to the west of Canberra, in both New South Wales (McIntyre Hut, Broken Cart and Mount Morgan) and the territory (Bendora, Stockyard Spur and Gingera). The fires burned for about a week in inaccessible terrain under high but not extreme fire conditions. Despite suppression operations the fires continued to grow. During extreme weather conditions on 17 January the fires broke containment lines. On the afternoon of 18 January, fires quickly spread, enveloping outlying rural settlements, farmland and forest before reaching the westernmost suburbs of Canberra. The behaviour of the fire was extraordinary. The speed of the fire meant fires penetrated deep into suburbs, with many houses lost through ember attack. The ferocity of the fires was compounded by a fire weather-generated tornado, which not only fanned the fire, spread embers, but also by itself caused extensive damage. The speed and ferocity of the attack surprised residents, fire agencies and fire experts alike, and fire authorities could do little to stop the blaze. The fires affected 70 km of the urban edge of Canberra, burned a total of 157,170 ha, of which 109,400 ha was in nature reserves, 16,770 ha in plantation forests, and 31,000 ha was in rural lands. The fires burned over 90 percent of the land managed by Environment ACT and 65 percent of the land managed by ACT Parks Conservation and Lands (ACTPCL). The fires resulted in four deaths, many injuries, loss of 488 dwellings, and nearly 100 other structures, and the deaths of 4,000 livestock. The insured cost has been estimated at $350 million.

Table 1: Fire history of the Australian Capital Territory

Date	No. of deaths	Area of fire (ha)	Losses	Location(s)
1951 December – 1952 February	2	10,000	2 houses, 40 farm buildings, several Observatory buildings, 450 ha of pine, 6 bridges, several hundred km of fences, 3 vehicles	Molonglo valley, Mount Stromlo, Red Hill, Woden Valley, Tuggeranong, Mugga Hill
1956 December – 1957 January		3,125	Primarily pasture and bushland	Ginninderra, Hall, Majura, Black Mountain, Tharwa
1979 February		16,500 (ACT, NSW)	2 houses, 3 sheds, machinery, fodder, 5000 sheep, 6 horses, $200,000 in fencing, fire tanker	Hall, Sutton, Mount Painter, Kambah Pool, Stirling
1982 September, 1983 March		36,000	300 ha of pine	Jervis Bay (Sept. 1982), Mount Ainslie, Bullen Range, Gudgenby area
1985 March	1	28,000 (10,000 in ACT)	Total damage of several million dollars, 7000 livestock	Mugga Lane, Red Hill, Mount Majura, Tharwa, Symonstown, Googong – Queanbeyan area of NSW (site of fatality)
2001 December		>1,600	500 ha of pine forest valued at several million dollars	Coppins Crossing, Yarralumla, Red Hill, Stromlo, Bruce Ridge, Oaks Estate, Wanniassa hills
2003 January	4	>157,000	450 injuries, 488 houses, 100 other structures, Mount Stromlo Observatory, 4,000 stock, 16,770 ha of pine plantations, 4 bridges, 300 vehicles, total damage >$350m	Namadgi National Park; Uriarra, Pierces Creek and Stromlo settlements; Cotter, Corin, Tidbinbilla, Mount Stromlo, Duffy, Holder, Chapman, Kambah, Curtin, Lyons, Murrumbidgee Valley, Coppins Crossing

Source: Ellis, Kanowski & Whelan 2004

Fire services

The two principal agencies that provide fire services in the territory are the ACT Fire Brigade and the ACT Rural Fire Service.

The **ACT Fire Brigade** forms one arm of the ACT Emergency Services Agency. It attends all types of structural, transportation and bush and grass fires, as well as other emergencies such as industrial and road accidents, hazardous chemical spills, and storm damage operations. Fire services principally cover the urban area. As at 2005–06, the ACT Fire Brigade comprised 316 full-time professional fire fighters and 28 community fire units with approximately 650 volunteers (ACTESA 2006a). Further information about the ACT Fire Brigade can be found at www.firebrigade.act.gov.au.

The **ACT Rural Fire Service** (ACTRFS) is responsible for suppressing bush and grass fires within rural and remote areas of the territory. As at 2005–06 there were 11 permanent staff, eight Rural Fire Brigades with approximately 370 volunteers and one brigade staffed by the ACT Parks Conservation and Lands (ACTPCL), part of Environment ACT, with approximately 120 departmental firefighters (ACTESA 2006a). The ACTRFS falls under the umbrella of the ACT Emergency Services Agency; it undertakes operational planning with the ACT Fire Brigade, attends fires outside of the city area and provides operational support for other agencies. Further information can be found at www.rfs.act.gov.au.

As the territory's data analysis was restricted to a dataset provided by ACTPCL, there is incomplete coverage for rural areas, and no analysis was undertaken for fires in the territory's urban areas.

ACT Parks Conservation and Lands analysis

Background about the ACTPCL dataset and its analysis

The ACTPCL database principally incorporates vegetation fires that occurred on or threatened reserves, conservation areas and other parklands in the territory from 1975–76 to 2002–03, but also includes 54 rural vegetation fires, 22 urban vegetation fires, 26 vegetation fires that occurred in New South Wales and one instance listed simply as ACT. Although this dataset includes some information about fires attended by the ACTRFS, it does not provide complete coverage for all vegetation fires attended by that agency in non-urban regions of the territory. Nor does it include fires on federal lands at Jervis Bay, a distinct enclave of land within New South Wales that formed part of the territory before self-government was declared in 1988. The analysis draws on historical records of vegetation fires (frequency and total area burned) documented on the Firebreak website to highlight differences between the ACTPCL data and vegetation fires in non-residential areas. Firebreak is a newsletter published online by the ACT Volunteer Brigades Association (ACTVBA), hosted on the ACT Emergency Services Authority website (ACTESA 2006b). Additional points about the analysis and dataset include:

- The database does not use the Australasian Fire Authorities Council AIRS codes.
- Fire cause was based on the 'ignition factor' variable provided; this is not equivalent to the AIRS ignition factor variable.
- The database does not generally include urban vegetation fires (hedge fires, fires on the local oval, etc.), other than if those fires were genuinely within or threatened nature reserves and vegetated parklands.
- The ACTPCL database provided included nine causal categories; accidental, lightning, barbecue, arson, prescribed burn, prescribed burn–reignition, reignition, other and unknown.
- Vegetation fires identified as arson were labelled incendiary in the seven-fold classification scheme adopted in this analysis. These are referred to as deliberate fires throughout much of the text; that is arson = incendiary = deliberate.

- Vegetation fires attributed to prescribed burns and reignition were incorporated into a single category. It is unclear to what 'prescribed burns' documented in this database represent a controlled situation as opposed to an escape of a controlled burn.
- Unlike other jurisdictions, the spatial distribution of vegetation fires is charted in terms of districts (Figure 1) as opposed to regions; the district information is as provided, with only subtle modifications having subsequently been made (see methodology).
- A 'remoteness' classification incorporating five categories – urban, urban fringe, rural, remote and unknown – was defined on the location of the reserve relative to the major population centre of Canberra (see methodology).
- Information was included about the location (reserve, district), timing (date), and area burned by vegetation fires.
- No information was given about fire restrictions or fire danger index.

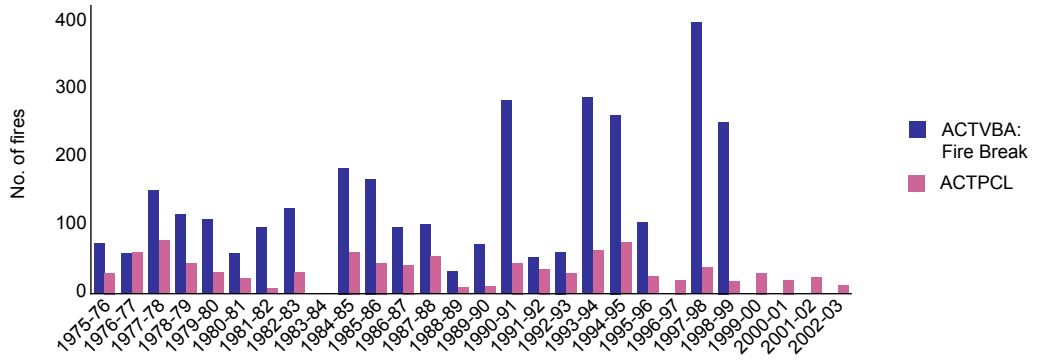
For more detail about these methodologies see the methodology chapter.

Overview

Overall characteristics of fires included within the ACTPCL database can be summarised as:

- The ACTPCL database comprised 988 vegetation fires from 1975–76 to 2002–03, with an average of 35.3 fires per year (sd=20). The number of vegetation fires peaked at >70 in 1977–78 and 1994–95 and at >60 in 1976–77, 1984–85, and 1993–94. The lowest number of vegetation fires (less than 10) occurred in 1981–82 and 1983–84, years bracketing 1982–83, in which drought pervaded much of the Monaro region. Despite the widespread devastation of the January 2003 fires, and possibly because of that devastation, vegetation fire numbers reported for 2002–03 were also exceptionally low. Despite this variation, the number of vegetation fires each year oscillated about a comparatively stable mean, although comparatively low numbers of vegetation fires have been recorded since the mid 1990s. This is in marked contrast to trends the ACTVBA (Firebreak) recorded over the same interval, where elevated numbers of fires have been evident since the early 1990s. In 1997–98, Firebreak documented 400 fires (Figure 4).
- Sixty-nine percent of vegetation fires recorded by ACTPCL were deliberate; representing 70 percent of assigned causes.
- Almost 80 percent of all fires occurred in or near urban and semi-urban areas; these areas were characterised by higher rates (number and proportion) of deliberate fires than rural and remote districts.
- A total of 377,000 ha was burned, mostly during 2002–03; only 11 percent of this was burned in deliberate fires.

Figure 4: Fires per year, by ACTPCL and ACT Emergency Services Authority (Firebreak) (number)[a]



a: data were unavailable in Firebreak for vegetation fires during 1996–97 and for 1999–2000 onwards

Source: ACTPCL 1975–76 to 2002–03 [computer file] and Firebreak, ACTESA 2006b

Cause

Almost 70 percent of vegetation fires documented in the ACTPCL database between 1975–76 and 2002–03 were incendiary (Figure 5). A further 19 percent of vegetation fires were prescribed burns or reignition of previous vegetation fires. Lightning strikes were responsible for eight percent of vegetation fires attended, with just over two percent being accidental in origin.

Some notable changes are evident in the cause of vegetation fires through time. During the later half of the 1970s and early 1980s deliberate (incendiary) causes accounted for approximately 60 percent of the ACTPCL fires in any given year (Figure 6). However, for most of the 1980s and 1990s the rates were over 80 percent. The proportion of deliberate vegetation fires recorded in the ACTPCL database was generally lower during the late 1990s and this century, although in 2001–02 the rate was again over 80 percent. In 2002–03, only 31 percent (n=4) of ACTPCL fires were identified as deliberately lit.

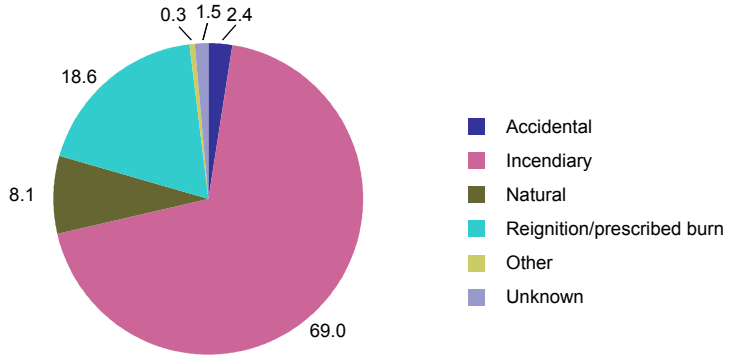
The actual number of deliberate vegetation fires documented in the ACTPCL database was highly variable between years, with the highest number occurring in 1993–94 and 1994–95 (approximately 60 fires per year). A higher than average number of deliberate vegetation fires also occurred during the 1970s and mid 1980s. A low number of deliberate vegetation fires (less than 20) were documented for 1995–96 onwards. The large fluctuation in total number of fires and frequency of deliberate fires from year to year tends to obscure long-term changes in the role of deliberate firesetting, with higher rates being evident since the mid 1980s. The average proportion of deliberate fires (determined from the slope of the line in Figure 7) from 1975–76 to 1984–85 was 49 percent, as compared with an average of 88 percent deliberate lightings for 1985–86 to 2002–03. Note that, a higher percentage of deliberate causes does not necessarily translate as a greater number of deliberate vegetation fires, at least in ACTPCL data. However, this may not have been the case in other jurisdictions.

The ACTVBA (Firebreak) documented higher numbers of fires during the 1990s. If similar rates of deliberate fires are equivalent to those documented by ACTPCL, then it is possible that almost 350 fires in 1997–98 attended by that agency may have may have been deliberately lit. The differences in numbers of fires recorded by the ACTVBA and ACTPCL, may relate to changes in where people chose to light fires (or jurisdictional changes) rather than a real decrease in actual numbers of deliberate fires. Clearly, greater investigation into the actual incidence and cause of territory vegetation fires is needed to ascertain if this is the case.

Between 35 and 40 percent of vegetation fires (12 to 32 fires per year) from 1975–76 to 1978–79 were identified as prescribed burns. However, during subsequent years, prescribed burns accounted for less than 10 or 15 percent of documented vegetation fires. The notable exception was from 1997–98 to 1999–2000 where this cause accounted for between one-quarter and two-thirds of the documented fires in a given year.

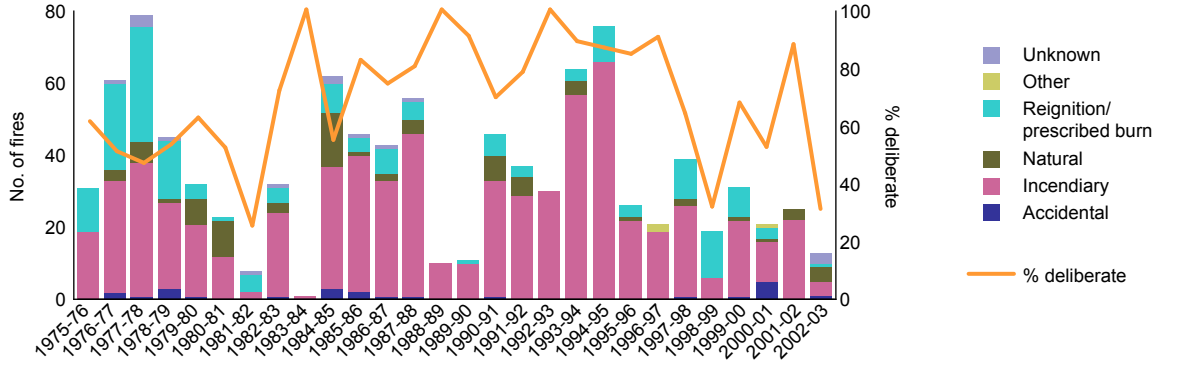
The number of natural vegetation fires caused by lightning strikes was also highly variable across bushfire seasons, ranging between 0 and 15 fires per year (Figure 8). Unlike for many jurisdictions, there was no clear relationship between increased number of natural fires and years in which there were El Niño events. However, interpretation may be clouded by the fact that multiple fires arising from the same thunderstorm system may be documented as a single fire event. This is certainly the case for 2002–03.

Figure 5: Cause of fires (percent)



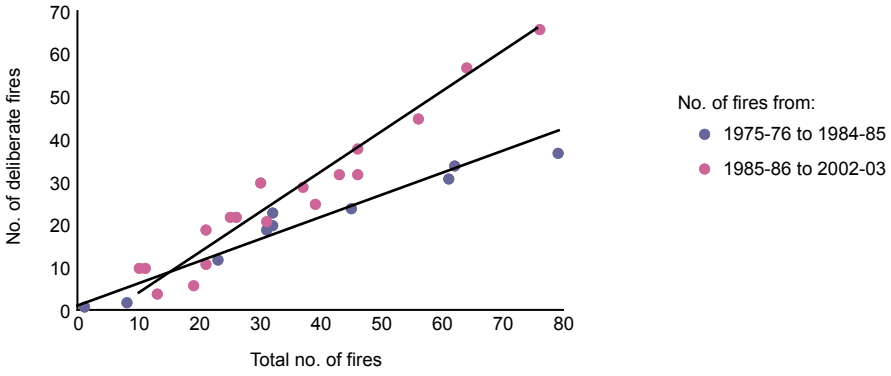
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 6: Cause of vegetation fires, by year



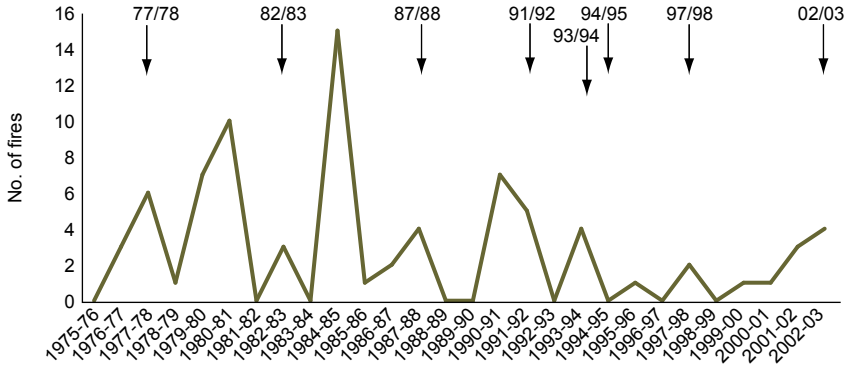
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 7: Deliberate and total fires each year for 1975–76 to 1984–85 and 1985–86 to 2002–03 (number)



Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 8: Fires started by lightning strikes each year[a] (number)



a: numbers annotating the graph indicate years for which the Australian Bureau of Meteorology documented a Southern Oscillation Index lower than –10, years recorded as an El Niño event)

Source: ACTPCL 1975–76 to 2002–03 [computer file]

Location

The location of fires is examined according to the remoteness and the district in which fires occurred, and by reserve for selected regions that experienced higher numbers of fires.

Remoteness and district

More than three-quarters of all fires document in the ACTPCL database occurred either within reserves in urban areas (61%) or reserves on the urban fringe (18 percent; Figure 9). Just 13 and 5 percent occurred in remote and rural (includes forestry plantations) locations, respectively. This is reflected in the observation that most fires occurred in the Tuggeranong (24%; Figure 10), Central Canberra (17%), Belconnen (12%) and Woden Valley (9%) districts; all areas within or in close proximity to urban areas (Figure 1).

A high proportion of all vegetation fires that occurred in urban and semi-urban areas were deliberate, as compared with non-urban areas. Between 80 and 95 percent of fires within largely urban districts were

deliberately lit (Figure 11). The notable exception was Weston Creek (58% deliberate), where there were a higher proportion of prescribed burns associated with managing neighbouring pine forests. One of the implications of Canberra's youth and large expansion since the 1950s is that the urban–rural interface has migrated substantially over time, affecting the distribution of vegetation fires.

The total number of deliberate vegetation fires in rural and remote regions was very low during the reporting period. The highest number of deliberate fires occurred in the Stromlo and Paddy's River districts. Deliberate fires were responsible for 77 and 35 percent of vegetation fires in these districts, respectively.

Reserve

Only five reserves recorded in excess of 50 fires in 28 years; Namadgi National Park (n=127), Mount Taylor (n=98), Black Mountain (n=78) Murrumbidgee Corridor (n=66), and Mount Ainslie (n=64; Figure 12). The majority of reserves bounded by urban development recorded an exceptionally high level of deliberate fires. For example, 87 of the 98 fires on Black Mountain were documented as incendiary. In contrast, approximately 90 percent of fires in the Namadgi National Park were non-deliberate in origin. Other areas to record a comparatively high level on non-deliberate fires included Tidbinbilla, and Googong Foreshores.

Tuggeranong district: Fifty of the vegetation fires in the Tuggeranong district occurred on the Mount Taylor reserve (the other 48 fires on Mount Taylor were included in the Woden Valley district). Comparatively high numbers of fires were also observed at Urambi Hills, Pine Island, Wanniassa Hills and Cooleman Ridge (Figure 13). With the exception of the Urambi Hills and Cooleman Ridge reserves, a high proportion of all vegetation fires lit in reserves in the Tuggeranong district were deliberate.

Thirty-six of the 50 fires recorded on the Mount Taylor Reserve in the Tuggeranong district occurred in the three seasons encompassing 1975–76 to 1977–78. These dominantly occurred over a short duration within any given year, in a period of intensive firesetting. Although some occurred during the bushfire danger period, others were in autumn and winter. Higher number of fires also occurred, albeit to a lesser degree, on neighbouring reserves (within walking distances of 2 to 3 km) during the same period. The timing of these fires directly overlaps with activity observed in the Mount Taylor Reserve and on several occasions fires were lit in two separate reserves on the same day. The timing of fires and the distribution along the three major ridges in the area implies the operation of a serial fire setter living in close proximity at that time. Fires lit on the Mount Taylor, Cooleman Ridge, and Urambi Hills Reserves and at Mount Taylor horse paddocks, were comparatively large given their location on the then margin of urban develop. Fifteen of the 39 fires burned 5 ha or more for the interval from 1975–76 to 1977–78; seven of these fires burned between 10 and 49 ha. Noteworthy is that elevated numbers of fires were also documented for the Woden Valley (also on Mount Taylor) from 1975–76 to 1977–78. This potentially indicates an even higher level of serial arson than outlined above.

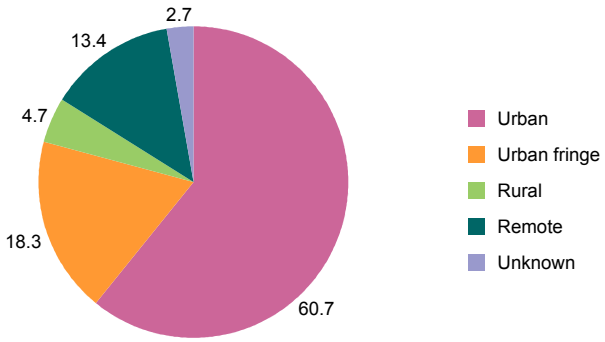
Central Canberra district: Black Mountain experienced the highest number of fires of any reserve in the Central Canberra District (Figure 14). Fifty-eight of the 76 (two other Black Mountain fires fell within the Belconnen district) were deliberately lit. A high proportion of fires on most other reserves in the district were deliberate (commonly 90%).

Many of the deliberate fires on the Black Mountain Reserve occurred during the three years encompassing 1993–94 to 1995–96; 46 of the 58 deliberate fires on that reserve occurred in these years, with 24 deliberate fires being lit in the 1994–95 season alone. This represents one-third of all fires that occurred in the Black Mountain reserve in the 28 years. Deliberate fires principally occurred during March and late July to mid September. Fires in 1995–96 primarily occurred during two consecutive weeks in early December.

The concentration of deliberate fires within a small area during restricted intervals implies that these fires are likely to have been the result of serial firesetting. As observed for fires in the Tuggeranong district, an increased number of fires occurred on the neighbouring Bruce Ridge and O'Connor Ridge reserves during the same intervals. The patterns of deliberate fires from 1993–94 to 1995–96 are consistent with an escalation from random infrequent fire lighting to intense periods of frequent and sustained fire lighting activity, with an abrupt decrease in the number of fires in November–December 1995.

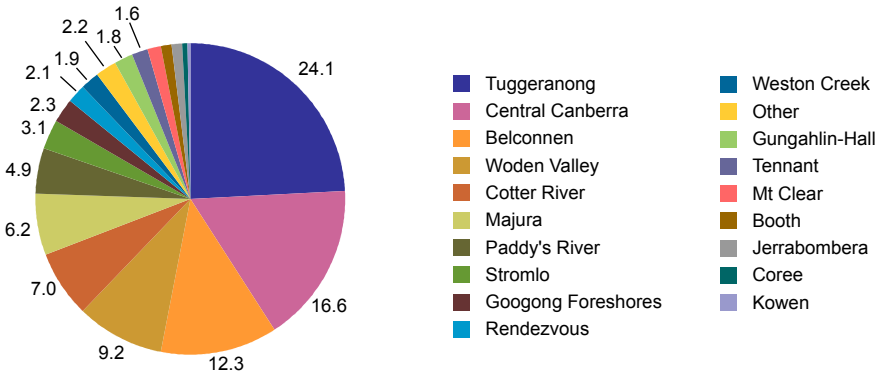
Belconnen district: Fires in the Belconnen district were more evenly distributed across reserves in the area. The reserves that experienced the most fires were The Pinnacle (n=18), Aranda Bushland and Bruce Ridge (Figure 15). High rates of deliberate fires occurred across most reserves in the district. Higher numbers of non-deliberate fires occurred on the Aranda Bushland and to a lesser extent at Gossan Hill.

Figure 9: Type of environment (percent)



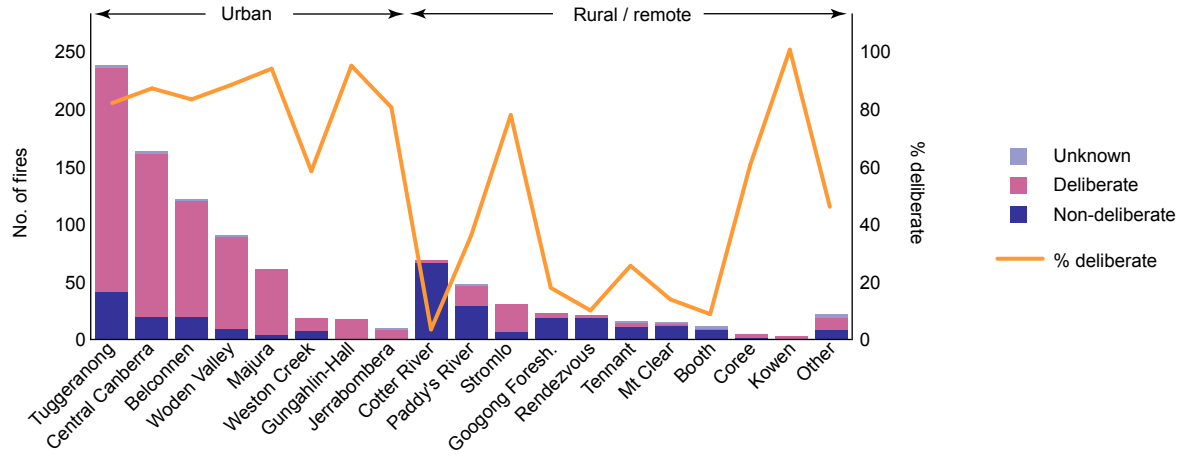
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 10: All vegetation fires, by district (percent)



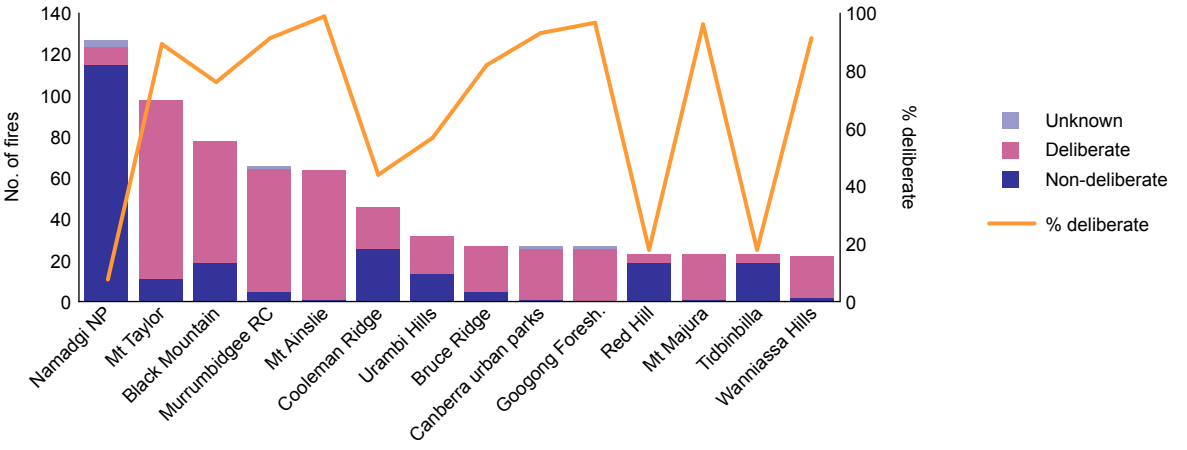
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 11: Cause of vegetation fires, by district



Source: ACTPCL 1975–76 to 2002–03 [computer file]

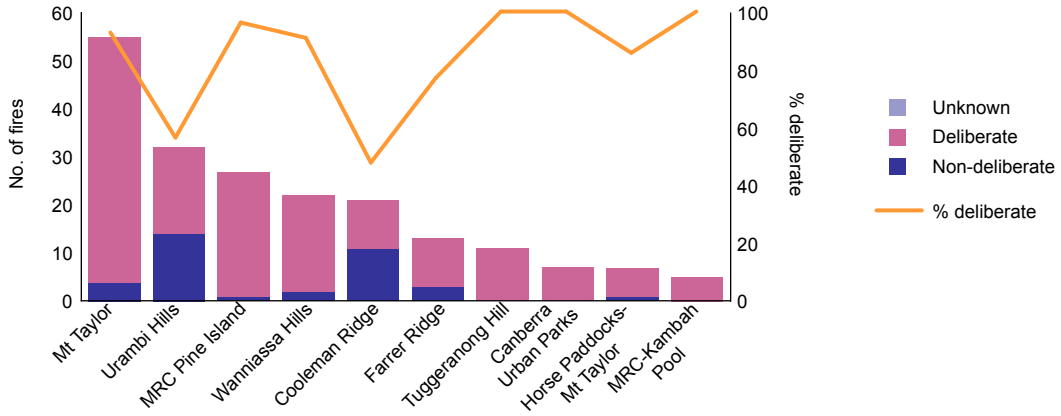
Figure 12: Cause of vegetation fires, by reserve[a]



a: only includes reserves documenting in excess of 20 fires during the observation interval

Source: ACTPCL 1975–76 to 2002–03 [computer file]

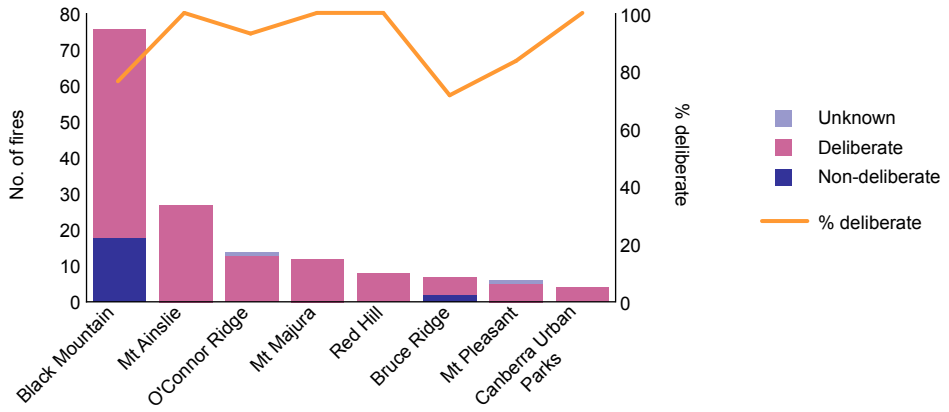
Figure 13: Cause of fires on reserves in the Tuggeranong district[a]



a: does note include 48 fires that occurred on Mount Taylor included in the Woden Valley district

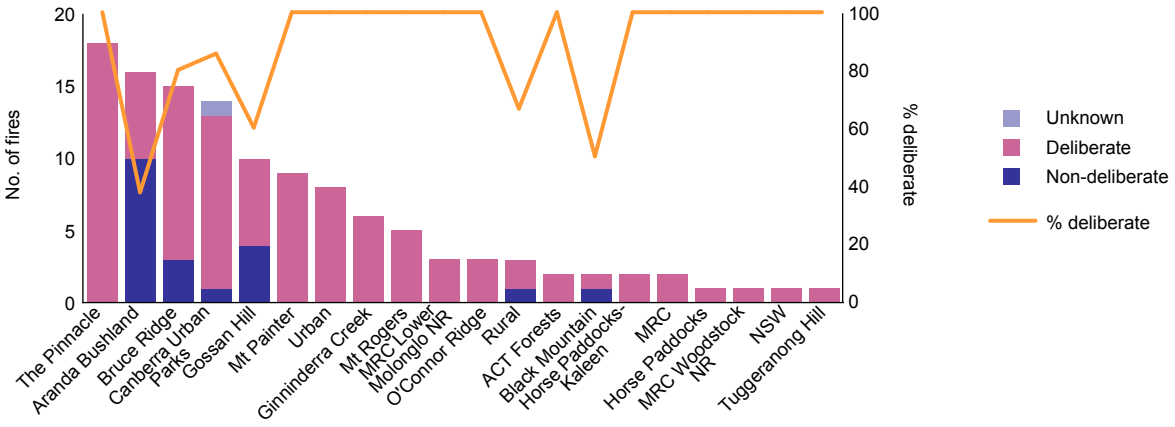
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 14: Cause of fires on reserves in the Central Canberra district



Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 15: Cause of fires on reserves in the Belconnen district[a]



Source: ACTPCL 1975–76 to 2002–03 [computer file]

Timing

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

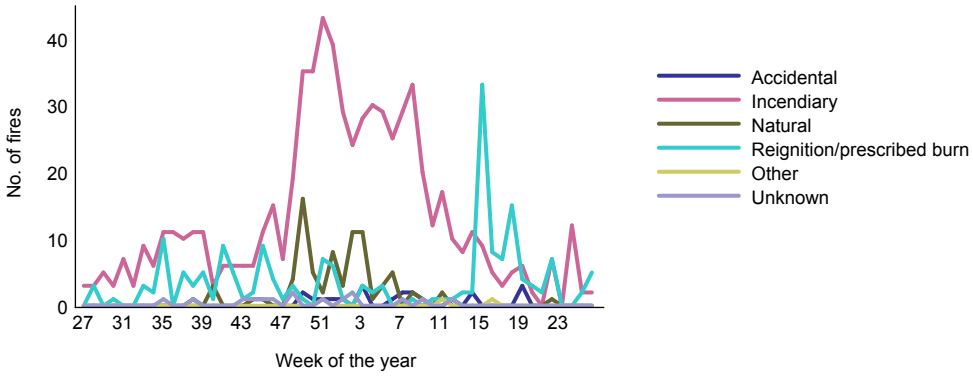
Week of the year

The vast majority of vegetation fires in the territory occurred from October to March, coinciding with hot and typically dry conditions that commonly characterise late spring, summer and in some cases early autumn in this region (Figure 16). Some differences in the timing of fires were evident, based on cause. Most natural fires on territory reserves occurred between mid December and mid February. The majority of prescribed burns occurred outside this danger window, principally during autumn, and to a lesser degree winter and spring (late April to November).

The greatest number of deliberate vegetation fires coincided with the most adverse bushfire danger period; the peak numbers of natural fires, but the number of deliberate fires remained elevated until the middle of March.

Although most fires in the territory occurred during the summer months, the timing of bushfires from year to year was highly variable. This reflects the highly erratic and unpredictable nature of rainfall in the Southern Tablelands region.

Figure 16: Week of the year[a], by cause (number)



a: week 1 corresponds to the first week of January

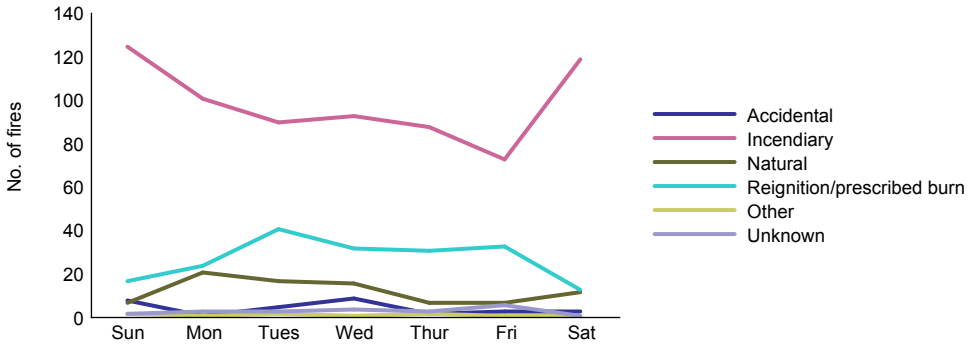
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Day of the week

The distribution of fires throughout the week varied considerably across causal categories. For deliberate fires a trend of increased numbers of fires on weekends is superimposed on an overall trend of decreasing fire frequencies as the week progressed (Figure 17). Deliberate vegetation fires were 41 percent more likely to occur on Sundays and 34 percent more likely to occur on Saturdays relative to the weekday average. This was particularly evident for the Tuggeranong district where deliberate fires were 55 to 60 percent more likely on Saturdays and Sundays than on the average weekday (Figure 18). In contrast, the number of fires in the Central Canberra district appears to decline from Sunday through to Saturday.

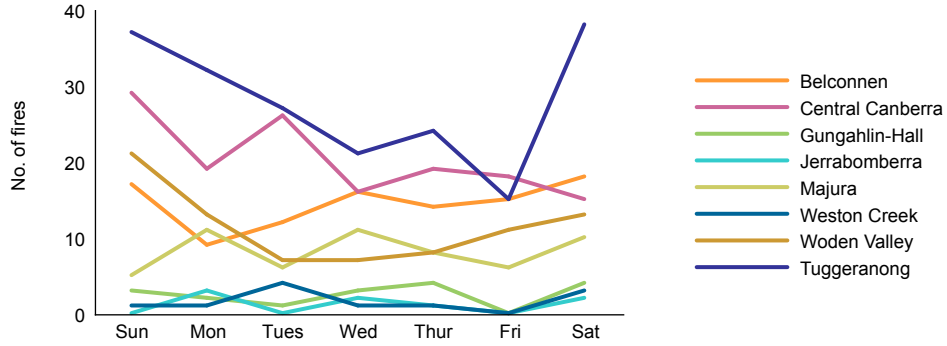
Given the comparatively low total number of fires documented for territory reserves, and that serial arson potentially accounts for a high number of fires in the Mount Taylor and Black Mountain areas, there is a high potential for the 'pattern' of a particular serial fire setter to strongly affect the principal timing of fires within that district. For example, half of all fires lit on the Mount Taylor, Cooleman Ridge and Urambi Hills reserves and at the Mount Taylor Horse Paddocks from 1975–76 to 1978–79, were lit on weekends. In contrast, only 16 of the 66 deliberate fires that occurred in Black Mountain, Bruce Ridge and O'Connor Ridge reserves from 1993–94 to 1995–96 were on weekends, and of those that did occur on weekends, most were on Sundays.

Figure 17: Day of occurrence, by cause (number)



Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 18: Day of occurrence, by district (number)



Source: ACTPCL 1975–76 to 2002–03 [computer file]

Area burned

The majority of fires attended on territory reserves were small, with 44 percent being less than one hectare and 70 percent less than five hectares in area. Overall, the number of vegetation fires within each area category decreased with increasing fire size, but a comparatively high number of fires still fell within the 10 to 500 ha range (Figure 19). This trend was evident for all fire causes with the exception of prescribed burns/reignitions, where five to 50 ha fires dominated. Large vegetation fires were comparatively rare in the territory with only 20 fires burning 500 ha or more in the 28-year fire history documented in the ACTPCL database.

Deliberate fires accounted for a decreasing proportion of fires within each area category as the size of the fires increased (Figure 20); that is deliberate fires were typically smaller than non-deliberate fires. However, that relationship breaks down to some extent for very large fires owing to poor representation of fires of those size categories. Deliberate fires accounted for 35 percent of the ACTPCL fires exceeding 500 ha. Of the seven deliberate fires that exceeded 500 ha, the three largest occurred during 1984–85, burning 18,800 ha, 5,620 ha and 4,380 ha in the Tuggeranong (urban fringe), Majura (urban) and Googong Foreshores (urban fringe) districts, respectively. Another deliberate fire during the same year burned 588 ha near Jerrabomberra (rural). A deliberate fire burned 1,100 ha in New South Wales, close to the territory's urban border, in 1977–78. Another deliberate fire burned 1,950 ha in the Cotter River area (remote) in 1978–79. The only deliberate fire larger than 500 ha since the mid 1980s burned 1,230 ha in the Stromlo area, on the urban fringe, in 2001–02.

Consistent with the frequency distributions described above, fires resulting from prescribed burns/ reignition accounted for an increasing proportion of fires as area size increased. However, only three prescribed burns exceeded 2,000 ha; all three occurred in New South Wales in either 1975–76 or 1976–77. The largest prescribed burn recorded in the database since 1995–96 burned 88 ha of rural property in the Belconnen area.

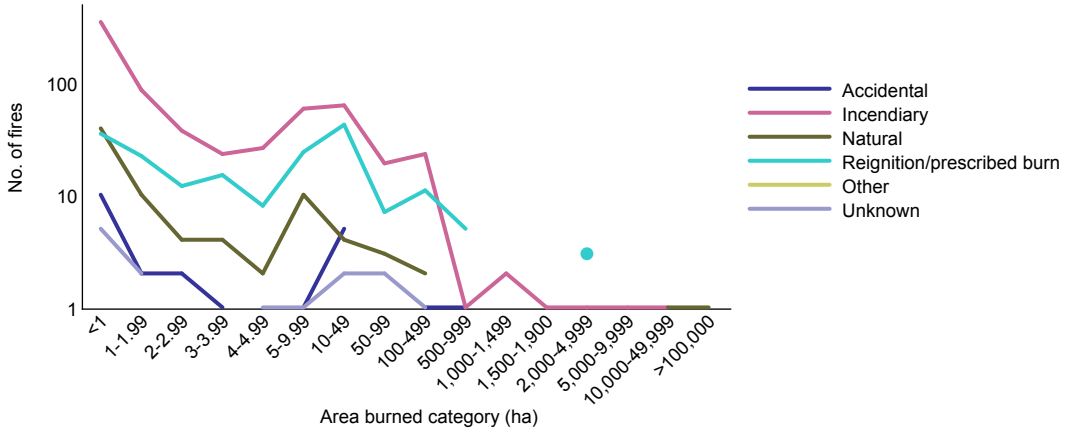
According to the ACTPCL database, fires started by lightning fell into two categories, either comparatively small (less than 500 ha) or very large. In 1982–83 fires started by lightning strikes burned 33,900 ha near Mount Kelly (Tennant). In 2002–03 numerous fires started by lightning to the west and southwest of Canberra burned 266,000 ha in the territory and New South Wales.

Approximately 377,000 ha were burned in ACTPCL-attended fires from 1975–76 to 2002–03. Statistics based on the total area burned are shaped by large fires events. Not surprisingly, fires started by lightning strikes accounted for 80 percent of total area burned in ACTPCL-attended fires (Figure 21). Seventy-one percent of the total area affected since 1975–76 was burned during 2002–03 (266,016 ha), with a further 9.2 percent (34,600 ha) of the total burned in 1982–83, reflecting the large areas burned by natural fires in those seasons (Figure 22).

Deliberate causes accounted for 11 percent of the total area burned (Figure 21), principally due to the series of large fires that occurred during 1984–85; deliberate fires collectively burned 31,600 ha in that year (Figure 23). Another 1,050 ha and 2,510 ha were burned in deliberate fires in 1977–78 and 1978–79, with 2,160 ha burned in deliberate fires during the 2001–02 season.

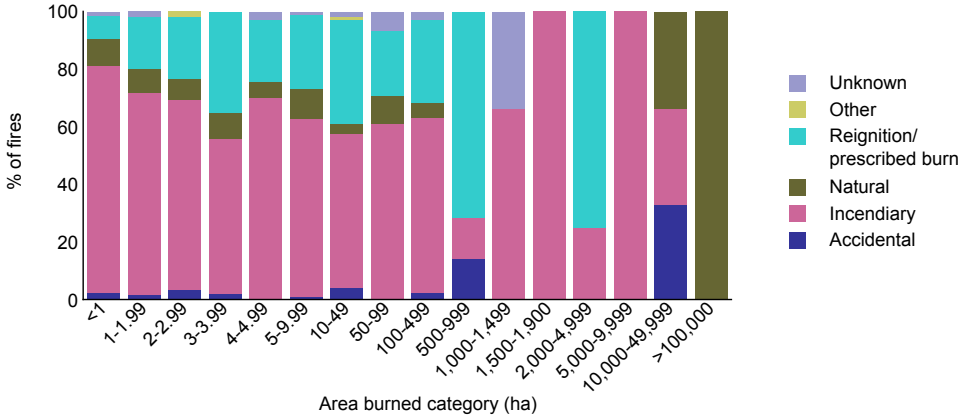
Prescribed burns and to a much less extent reignitions were collectively responsible for 3.9 percent of the total area burned in ACTPCL fires (Figure 21). The majority was burned in the large prescribed burns of the mid 1970s, principally 1975–76 and 1976–77 (Figure 24). A single large accidental fire burning 16,300 ha was responsible for the large area burned in 1978–79 (16,400 ha).

Figure 19: Area burned category, by cause (number)



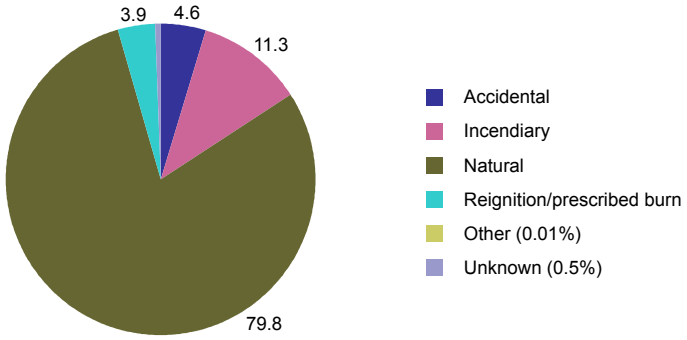
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 20: Area burned category, by cause (percent)



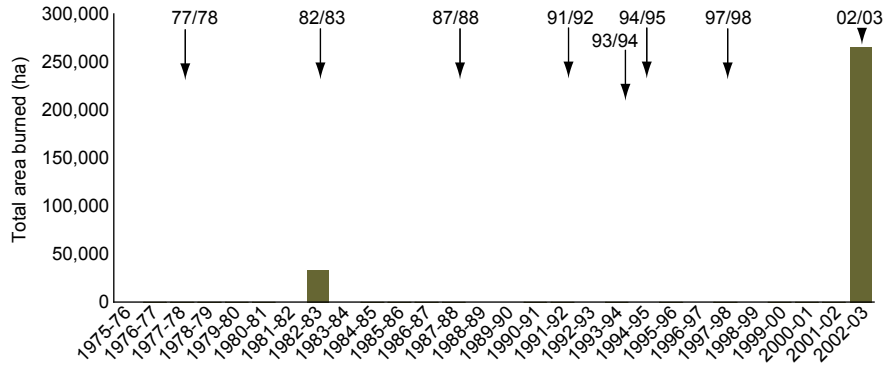
Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 21: Total area burned, by cause (percent)



Source: ACTPCL 1975–76 to 2002–03 [computer file]

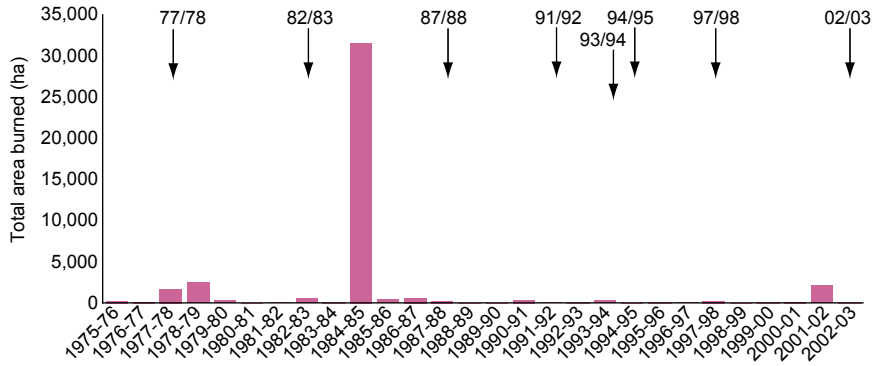
Figure 22: Total area burned (ha), by natural fires each year[a] (number)



a: annotated numbers indicate the timing of El Niño event (Bureau of Meteorology); numbers in red indicate years associated with severe drought

Source: ACTPCL 1975–76 to 2002–03 [computer file]

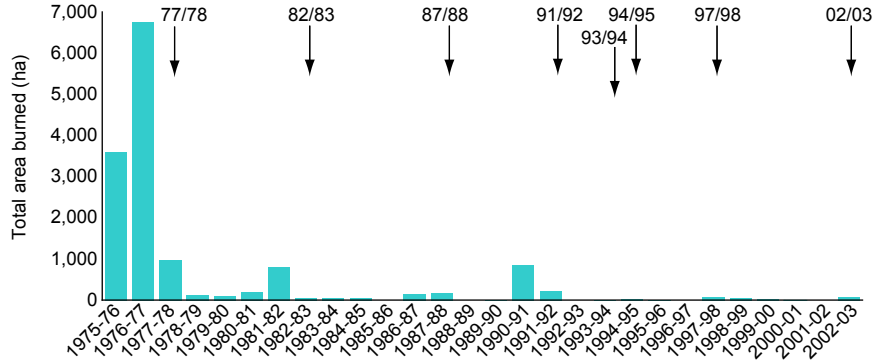
Figure 23: Area burned (ha) in deliberate vegetation fires, by year[a] (number)



a: annotated numbers indicate the timing of El Niño event (Bureau of Meteorology)

Source: ACTPCL 1975–76 to 2002–03 [computer file]

Figure 24: Total area burned by prescribed burns (majority) and reignition of previous fires, by year[a] (number)



a: annotated numbers indicate the timing of El Niño event (Bureau of Meteorology)

Source: ACTPCL 1975–76 to 2002–03 [computer file]

Relationships to climatic variations

Number of fires: There is not a strong correlation between the total number of vegetation fires recorded in the ACTPCL database and El Niño events (Figure 25). To a certain extent this is also evident for the historical data recorded in Firebreak. Although the Firebreak records indicate higher numbers of fires during 1993–94, 1994–95 and 1997–98, all seasons associated with El Niño events. This is not as evident for 1982–83, 1987–88 or 1991–92 and to a lesser extent 1977–78. Similarly, low numbers of fires were recorded during 2002–03. However, it may be argued that 2002–03 was an exception as low fire numbers may stem from the fact that by January much of the territory fires had already burned, and possibly that the psychological impact of devastating fires may have reduced subsequent human-caused ignitions during the remainder of the season in areas that were not affected. Allowing for the exception of 2002–03, these results suggest there may well be a greater link between higher vegetation fire numbers and El Niño events in the latter part of the observation period than during the 1970s and 1980s, although more concrete data is needed before this can be established with certainty.

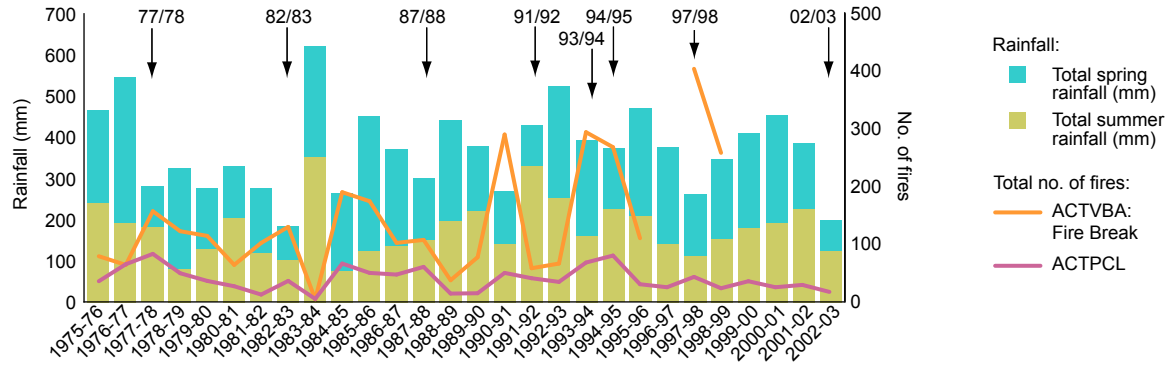
That a large number of fires did not occur during the 1991–92 El Niño event is not surprising given the low impact of this El Niño Southern Oscillation (ENSO) cycle on the territory (in terms of drought), as indicated by comparatively high summer rainfall. Conversely, high numbers of vegetation fires during 1984–85 and 1990–91, not years associated with an El Niño event, were characterised by low spring and/or summer rainfall.

Area burned: The ACTPCL and ACT Rural Fire Service (Firebreak data) recorded similar areas burned during the same years (Figure 26). This indicates that while the ACTPCL dataset only recorded a small proportion of all fires attended in rural and remote areas, that dataset does include most large fires attended in the territory over the 28-year history. As such, the ACTPCL data are broadly representative of the total area burned in the territory during this timeframe.

During this period, the two worst bushfire seasons (in terms of total area burned) occurred in 1982–83 and 2002–03, years in which the territory was gripped by drought. Both were associated with El Niño-like weather patterns (Figure 26). Large areas were not burned in years where El Niño weather patterns did not contribute to exceptionally low rainfall; not all El Niño events manifested in extreme drought conditions, and large tracts of land were not burned in the territory in those seasons.

Similarly, not all droughts or exceptionally dry conditions conducive to vegetation fires were associated with El Niño events. For example, large areas were burned in 1984–85 and in 1978–79, neither of which were associated with an El Niño event. Perhaps the distinguishing feature is that in 1982–83 and 2002–03 it was natural ignitions that gave rise to the large areas burned, whereas in 1978–79 and 1984–85 the ignitions resulting in large fires principally arose from human actions/factors. Although humans may have contributed to more fires in some El Niño years, these did not necessarily translate in greater areas burned in those years.

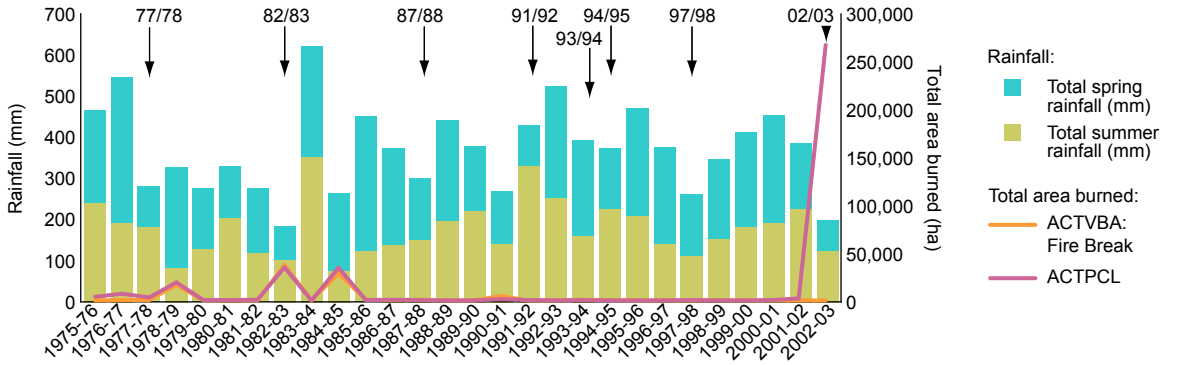
Figure 25: Number of fires (ACTPCL, ACTVBA Firebreak), and the total summer and spring rainfall, each year[a]



a: annotated numbers indicate the timing of El Niño event (Bureau of Meteorology)

Source: ACTPCL 1975–76 to 2002–03 [computer file], ACTESA 2006b, and the Australian Bureau of Meteorology [computer file]

Figure 26: Total area burned (ACTPCL, ACTESA Firebreak), and the total summer and spring rainfall, each year[a]



a: annotated numbers indicate the timing of El Niño event (Bureau of Meteorology)

Source: ACTPCL 1975–76 to 2002–03 [computer file], Firebreak, ACT Emergency Services Authority [computer file], and the Australian Bureau of Meteorology

Summary

The most important points about the ACTPCL analysis are summarised as:

- The ACTPCL database documented 988 vegetation fires from 1975–76 to 2002–03, with the total number of varying between one and 79 in any given year.
- The greatest number of vegetation fires occurred in 1977–78, 1994–95, and to a lesser extent 1976–77, 1984–85, and 1993–94; the lowest number of vegetation fires occurred in 1981–82 and 1983–84, seasons bracketing the 1982–83 drought.
- No net increase in the number of vegetation fires in territory reserves occurred through time; this is in contrast with the situation documented by the ACTVBA in Firebreak, where fire numbers climbed to 400 during 1997–98.
- 69 percent of ACTPCL fires were recorded as having been deliberately lit. On average, the proportion of deliberate fires increased from 49 percent for 1975–76 to 1984–85 to 88 percent for 1985–86 to 2002–03. This is not, however, reflected in a net increase in the number of deliberately lit ACTPCL fires; lower numbers of deliberate fires (ACTPCL only) have occurred since the mid 1990s.
- The greatest number of deliberate lightings occurred in 1994–95, followed closely by 1993–94. This coincided with an intensive period of deliberate firesetting (possibly serial arson) in the Black Mountain Reserve.
- More than three-quarters of all ACTPCL fires occurred within reserves in urban area (61%) or on the urban fringe (18%), with comparatively fewer in rural and remote locations.
- Districts that experienced the highest numbers of fires included Tuggeranong, Central Canberra, followed by Belconnen and Woden Valley Districts; serial arson appears to have been a contributing factor in both the Tuggeranong and Central Canberra areas.
- Reserves near urban developments typically experienced very high rates of deliberate fires; commonly more than 80 to 90 percent of fires were deliberately lit than were lit in more remote and rural locations.
- The majority of deliberate fires between mid December and the end of March coincide with, but also extend beyond, the peak bushfire season.

- A greater number of deliberate fires occurred on weekends than weekdays, although development of this trend varied between regions; increases in the number of fires on weekends was not observed for other causes.
- A total of 377,000 ha were burned, mostly during the 2002–03 season; 80 percent of this was burned in natural fires, principally in 1982–83 and 2002–03, two years in which the territory was badly affected by drought.
- Deliberate fires burned 11 percent of the total area. This was principally due to a number of large fires in 1984–85. The only large areas burned by deliberate fires in the territory since that time occurred in 2001–02. The number of deliberate fires or the area burned in ACTPCL did not increase during adverse seasons.
- The largest vegetation fires in the territory have originated from natural ignitions during exceptionally dry seasons associated with El Niño events. However:
  - Not all El Niño events are characterised by adverse bushfire seasons (large areas burned or significant property loss) – the impact of El Niño weather patterns on the territory are variable.
  - Adverse bushfire seasons occurred in years other than those characterised by El Niño weather patterns; human beings have contributed to the large areas burned in both 1978–79 (accidental) and 1984–85 (incendiary), but both years were characterised by unusually dry conditions.

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