

Fire Management Branch
Department of Natural Resources and Environment
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**ANALYSIS OF FIRE CAUSES
ON OR THREATENING PUBLIC LAND IN VICTORIA
1976/77 - 1995/96**

Research Report No. 49
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SUMMARY

This report analyses twenty years of fire cause data, taken from the Department of Natural Resources and Environment's FIRES (Fire Information Resources and Equipment System) database. This database lists fires which the Department attended which were on or threatening public land in Victoria. The period covered in this report includes all fire seasons from 1976/77 to 1995/96. The report identifies which fire causes are responsible for the greatest number of fires and the largest areas burnt. Patterns in the percentage distribution of total number of fires and total area burnt by each fire cause over the twenty year period are also highlighted.

This report is intended to describe major trends at both the State and Fire Region level. There is little discussion regarding the underlying reasons for changes in fire cause patterns. This is a conscious decision, as it is felt that local personnel will have the greatest knowledge regarding the fire cause history of their particular area. The information contained within this report is however useful, in that it allows a Fire Region to identify and target fire causes which are consistently causing large or numerous fires in their local area.

The following sections are covered in the report. A brief introduction is followed by the methods section which outlines how the data were obtained, grouped and analysed. The results and discussion section is divided into separate analyses of the number of fires and the area burnt by each fire cause group. Average number of fires and area burnt figures are covered, as well as trends in both of these statistics. The conclusion states which approaches were most useful in analysing the data, highlights significant fire causes, and notes the major trends which were observed.

INTRODUCTION

This report analyses twenty years of fire cause data, taken from the Department of Natural Resources and Environment's FIRES (Fire Information Resources and Equipment System) database. This database lists fires that the Department attended which were on or threatening public land in Victoria. The period covered in this report includes all fire seasons from 1976/77 to 1995/96. The report identifies which fire causes are responsible for the greatest number of fires and the largest areas burnt. Patterns in the percentage distribution of total number of fires and total area burnt by each fire cause over the twenty-year period are also highlighted.

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METHODS

Each fire entered into the FIRES database has a cause source code assigned to it. These causes are selected from the list of twenty-five that are shown in Table 1. The Cause Summary Report available in FIRES was used to download the information needed to analyse the number of fires in each cause at a State and Fire Region level (refer to Figure 1). A similar report was then constructed to obtain the data required for analysing the area burnt by each fire cause for the State and each Fire Region. This was accomplished using the ad-hoc report building capabilities of the FIRES database.

Table 1. Descriptions of the cause source codes as used on FIRES.

Code	Description
1	Lightning
2	Exhaust, chainsaw
3	Exhaust, other
4	Snigging, hauling
5	Burning vehicle, machine
6	Pipe, cigarette, match
7	Campfire, barbecue
8	Burning off (Departmental prescribed)
9	Burning off, railway
10	Burning off, stubble, grass, scrub
11	Burning off, windrow, heap
12	Train
13	Deliberate lighting (malicious)
14	Waste disposal - domestic
15	Waste disposal - industrial, sawmill, tip
16	Power transmission
17	Burning house, stove, flue
18	Burning building
19	Fireworks
20	Relight -wildfire
21	Relight - prescribed fire
22	Relight - burning off
23	Other
24	Unknown
25	Not reported*

*The *Unknown* cause source code differs from the *Not reported* cause source code in that *Unknown* means that the cause of the fire was investigated, but no conclusive evidence indicated the cause of the fire. *Not reported* is for fires at which the cause was not investigated.

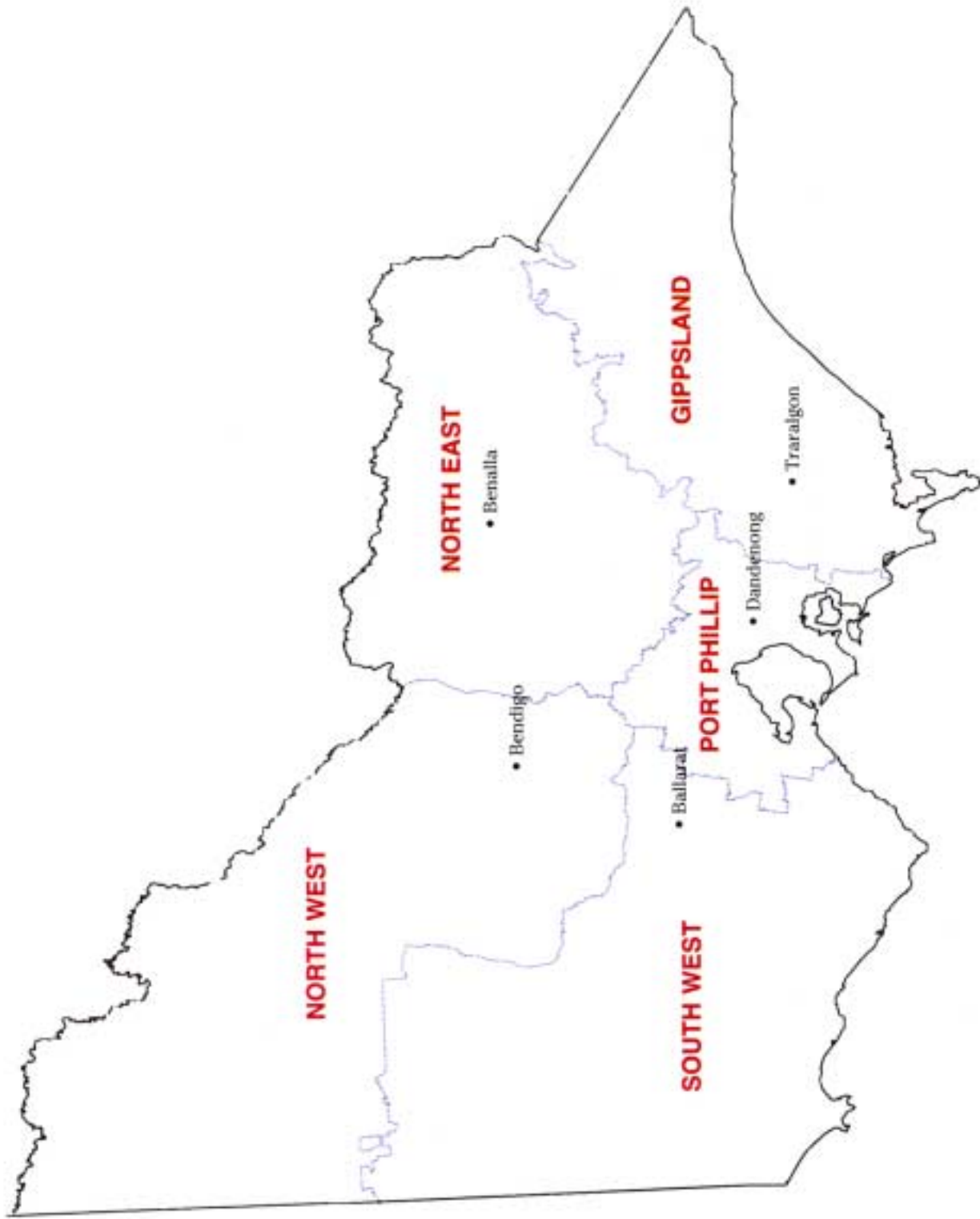


Figure 1. Map showing the location of each Fire Region for the Department of Natural Resources and Environment, Victoria. (Regional boundaries are shown by - - - - -.)

For the analysis, the twenty-five possible fire causes that can be assigned in the FIRES database (as shown in Table 1) were condensed into the ten fire cause groups shown in Table 2. The groups were formed by determining which causes could be targeted from a fire prevention point of view.

Table 2. Descriptions of the ten fire cause groups used in this study.

Codes	Description
1	Lightning strikes
5, 13	Deliberate lighting
9, 10, 11, 14, 15, 22	Escapes - burning
7	Escapes - campfire, BBQ
8, 21	Departmental burns
12, 16	Public utilities
2, 3, 4	Machines
6	Pipe, cigarette, match
17, 18, 19, 20, 23	Miscellaneous
24, 25	Unspecified

Once the data were obtained in a raw form they were transferred to an Excel spreadsheet to enable a graphical analysis. Two basic types of graphs were then produced. The first depicts the number of fires in each cause group whilst the second shows the total area burnt. Both types of graph were created for the State, for each Fire Region, and for each Fire District.

The twenty-year period under study was initially analysed as one continuous block. This allowed for the overall distribution of fire cases to be determined. Potential trends in fire causes were then detected by breaking down the data into successively smaller periods. Thus, ten- and five-year periods were also analysed as listed below, as well as the most recent five individual fire seasons:

- twenty-year period (1976/77 - 95/96);
- ten-year periods (1976/77 - 85/86, 1986/87 - 95/96);
- five-year periods (1976/77 - 80/81, 1981/82 - 85/86, 1986/87 - 90/91, 1991/92-95/96);
- individual seasons (1991/92, 1992/93, 1993/94, 1994/95, 1995/96).

The graphical analysis undertaken proved to be extremely useful in describing fire cause distributions, down to the Fire District level. Unfortunately, due to the sheer volume of graphs produced, it was not possible to include them as a part of this report. It was also impractical to examine fire cause trends at the Fire District level. This report was therefore confined to trends at the State and Fire Region levels.

If any of the original graphs (including those at the Fire District level) are required, they can be obtained by contacting Fire Management Branch, Melbourne.

RESULTS AND DISCUSSION

For the twenty-year period analysed in this study, there were 11,676 fires, which corresponds to an annual average of 584 fires. The median number of fires is reasonably close to this figure at 566 fires per season. The number of fires per season ranged from a low of 243 to a high of 878. These figures indicate a relatively even distribution of number of fires per season.

There was over 2.3 million hectares of land burnt over the twenty-year period, corresponding to an annual average of approximately 115,500 ha each season. The median area burnt, however, is much lower at approximately 29,300 ha each season. The difference between average and median figures indicates that although most seasonal totals for area burnt were lower than the average figure, there were a few seasons in which much larger areas were burnt (see Figure 2). The area burnt per season ranged from 4,817 ha to 732,302 ha.

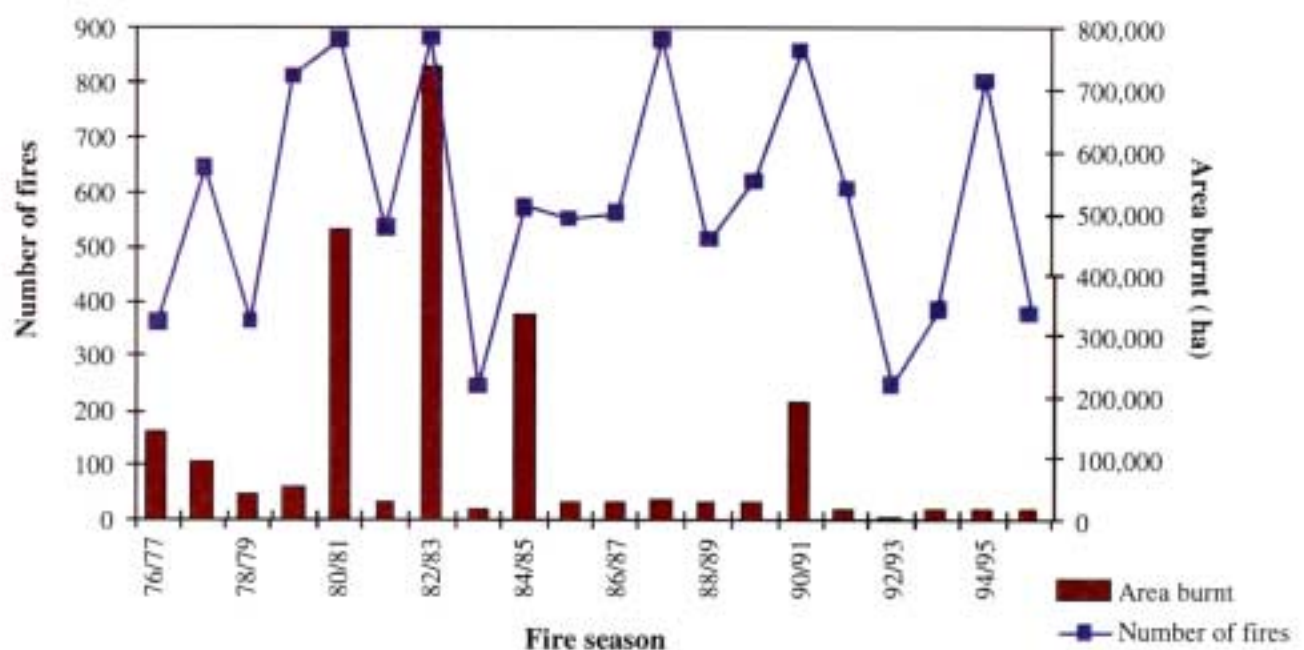


Figure 2. Total number of fires and area burnt for each season for the State from 1976/77 to 1995/96.

NUMBER OF FIRES**Twenty-year Period**

The twenty-year period spanning the fire seasons from 1976/77 to 1995/96 was analysed. The Statewide data for this period are shown in Table 3.

Table 3. Statewide fire cause group frequency for the period from 1976/77 to 1995/96.

Cause group	Number of fires	Percentage (%)
Lightning strikes	3024	25.9
Deliberate lighting	2499	21.4
Escapes - burning	2098	18.0
Escapes - campfire, BBQ	1109	9.5
Departmental burns	232	2.0
Public utilities	224	1.9
Machines	296	2.5
Pipe, cigarette, match	913	7.8
Miscellaneous	596	5.1
Unspecified	685	5.9
Total	11,676	100.0
Average	584	

The percentage figures of Table 3 are useful in assessing the relative importance of each cause group as a source of fires on or threatening public land in Victoria (hereafter termed *NRE fires*) over the last twenty years. Clearly *Lightning strikes*, *Deliberate lighting* and *Escapes - burning* are the major fire cause groups, accounting in total for over 65% of all NRE fires. The fire cause groups *Escapes - campfire, BBQ* and *Pipe, cigarette, match* are the next most numerous groups, each accounting for between 7% and 10% of all fires in this period.

The distribution of causes alters slightly for each Region, but generally shows the same major causes as for the Statewide summary. In all Regions except for the North West, the major cause groups of *Lightning strikes*, *Deliberate lighting* and *Escapes - burning*, account for over 60% of all fires. In the North West however, these three cause groups account for only 45.8% of all fires, with *Escapes - campfire, BBQ* causing an additional 19.7% of fires (much higher than the

Statewide average of 9.5%). Other significant Regional deviations from the Statewide averages are summarised in Table 4.

Table 4. Fire cause frequency showing significant Regional deviations from the Statewide averages for the period from 1976/77 to 1995/96.

Fire region	Total no. of fires	Avg. per season	Cause group	Percentage (%)	Deviation from Statewide avg(%)
North East	2669	133	Lightning strikes	33.3	+7.4
			Deliberate lighting	12.0	-9.4
North West	1954	98	Lightning strikes	13.6	-12.3
			Escapes - burning	11.3	-6.7
			Escapes - campfire, BBQ	19.7	+10.2
			Pipe, cigarette, match	15.6	+7.8
Gippsland	3023	151	Lightning strikes	40.2	+14.3
			Pipe, cigarette, match	3.3	-4.5
Port Phillip	1041	52	Lightning strikes	8.1	-17.8
			Deliberate lighting	39.0	+17.6
South West	2930	147	Lightning strikes	19.0	-6.9
			Escapes - burning	23.7	+5.7
Unreported	59	3	Lightning strikes	20.3	-5.6
			Escapes - burning	5.1	-12.9
			Pipe, cigarette, match	0.0	-7.8
			Unspecified	44.1	+38.2

It must be noted that when comparing Statewide and Regional graphs, the "Unreported Fire District" does not contribute to any of the Regional totals. The Statewide totals were obtained by adding the total number of fires for the Unreported Fire District to the total number of fires for all other Fire Regions. Fires assigned to the Unreported Fire District in the FIRES database have not been analysed for trends.

Ten-year Periods

Two ten-year periods spanning the fire seasons from 1976/77 to 1985/86 and from 1986/87 to 1995/96 were analysed. The Statewide data for these periods are shown in Table 5.

Table 5. Fire cause frequency for the two ten-year periods from 1976/77 to 1985/86 and 1986/87 to 1995/96.

Cause group	1976/77-85/86		1986/87-95/96	
	No.	%	No.	%
Lightning strikes	1531	26.3	1493	25.5
Deliberate lighting	1043	17.9	1456	24.9
Escapes - burning	1140	19.5	958	16.4
Escapes - campfire, BBQ	518	8.9	591	10.1
Departmental burns	140	2.4	92	1.6
Public utilities	157	2.7	67	1.1
Machines	151	2.6	145	2.5
Pipe, cigarette, match	503	8.6	410	7.0
Miscellaneous	334	5.7	262	4.5
Unspecified	315	5.4	370	6.3
Total	5832	100	5844	100
Average	583	-	584	-

When analysed as two separate ten-year periods, it is clear that the Statewide data is very consistent, showing only minor changes in the distribution of fire causes and number of fires per season. The major difference in the two periods is an increase in the incidence of *Deliberate lighting* by 7% in the latter period.

Five-year Periods

The four five-year periods spanning the Fire Seasons from 1976/77 to 1980/81, 1981/82 to 1985/86, 1986/87 to 1990/91, and 1991/92 to 1995/96 were analysed. The Statewide data for these periods are shown in Table 6.

Table 6. Fire cause frequency for the four five-year periods from 1976/77 to 1980/81, 1981/82 to 1985/86, 1986/87 to 1990/91 and 1991/92 to 1995/96.

Cause group	1976/77-80/81		1981/82-85/86		1986/87-90/91		1991/92-95/96	
	No.	%	No.	%	No.	%	No.	%
Lightning strikes	763	25.0	768	27.6	998	29.1	495	20.5
Deliberate lighting	558	18.3	485	17.5	708	20.6	748	31.0
Escapes - burning	578	18.9	562	20.2	577	16.8	381	15.8
Escapes - campfire, BBQ	259	8.5	259	9.3	334	9.7	257	10.6
Departmental burns	81	2.7	59	2.1	55	1.6	37	1.5
Public utilities	88	2.9	69	2.5	45	1.3	22	0.9
Machines	79	2.6	72	2.6	98	2.9	47	1.9
Pipe, cigarette, match	225	7.4	278	10.0	292	8.5	118	4.9
Miscellaneous	191	6.3	143	5.1	147	4.3	115	4.8
Unspecified	231	7.6	84	3.0	175	5.1	195	8.1
Total	3053	100.0	2779	100.0	3429	100.0	2415	100.0
Average	611	-	556	-	686	-	483	-

When analysed as four separate five-year periods, the variability in the average number of fires per season becomes apparent. Periods with a high average numbers of fires (i.e. from 1986/87 to 1990/91) are counteracted by periods with lower averages (i.e. from 1991/92 to 1995/96).

Many of the cause groups show a similar Statewide tendency to fluctuate slightly up and down in their percentage incidence. There are however, five cause groups that appear to show definite trends. *Deliberate lighting* and *Escapes - campfire, BBQ* show increases in their percentage occurrence, whilst *Escapes - burning*, *Departmental burns* and *Public utilities* show decreases. This is clearly illustrated in Figure 3.

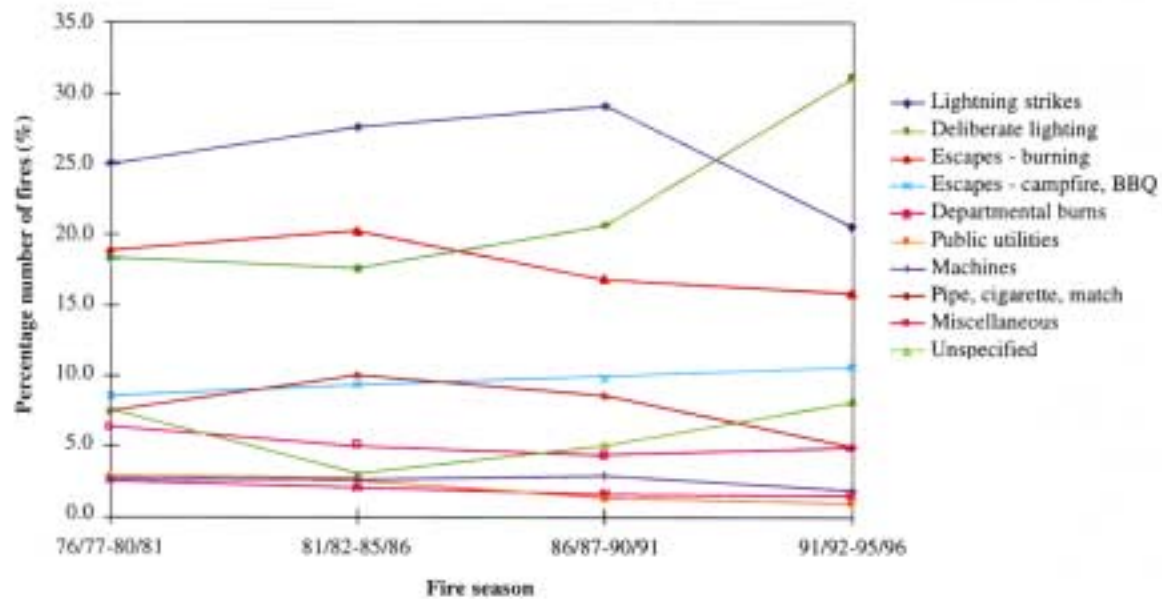
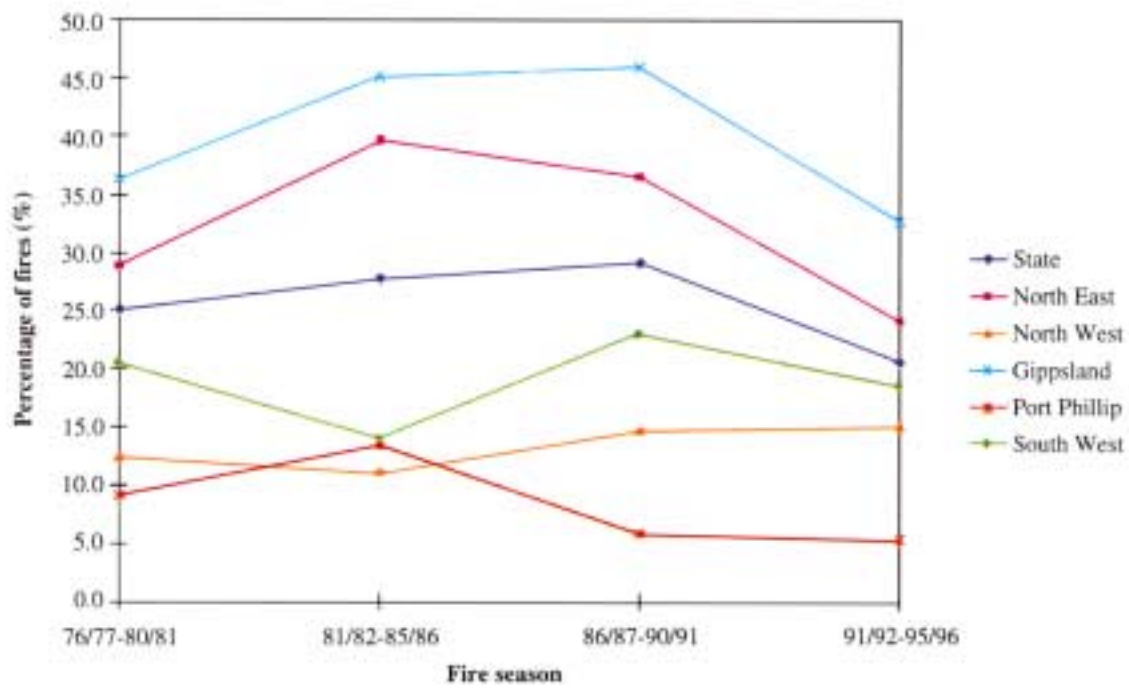


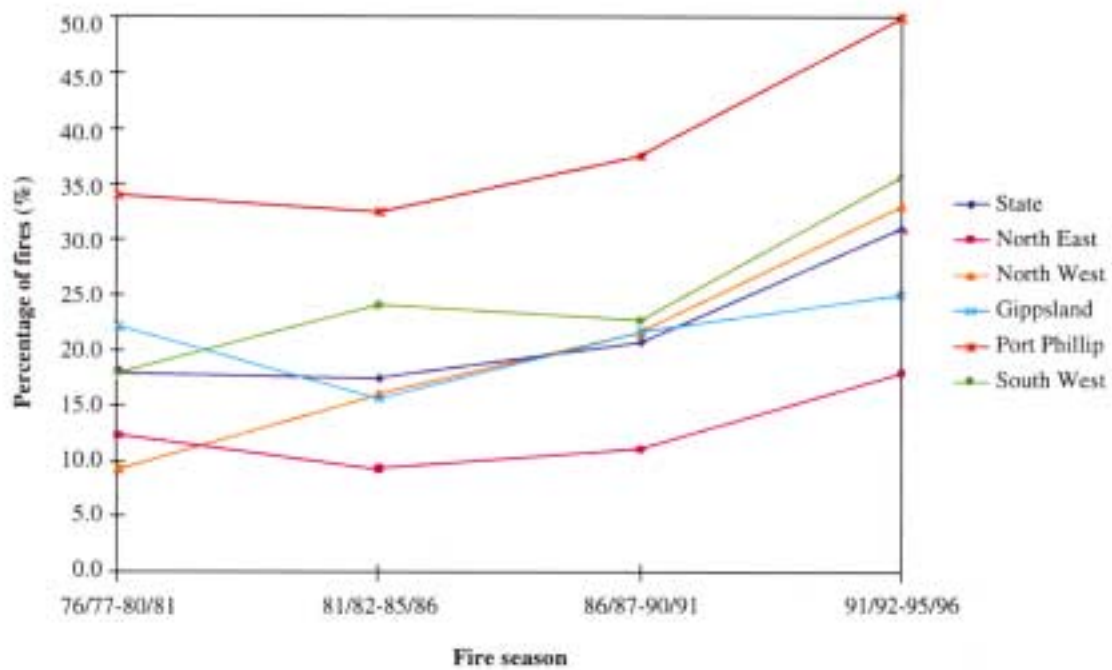
Figure 3. Statewide fire cause frequency for the each of the five-year periods.

When viewed at the Regional level, the relative importance of each cause category can alter markedly from the Statewide averages. Table 4 has already pinpointed some of the larger Regional deviations from these averages. Figure 4 illustrates just how the relative importance of each category can alter over time, whilst also aiding in the identification of trends.

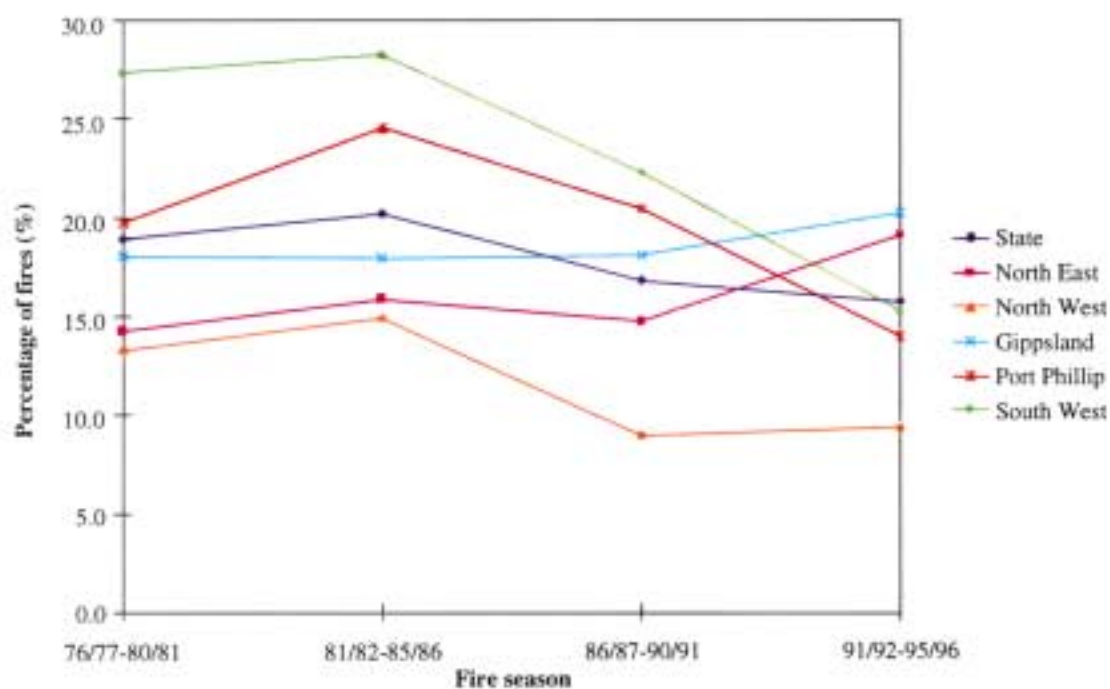
(a) Lightning strikes



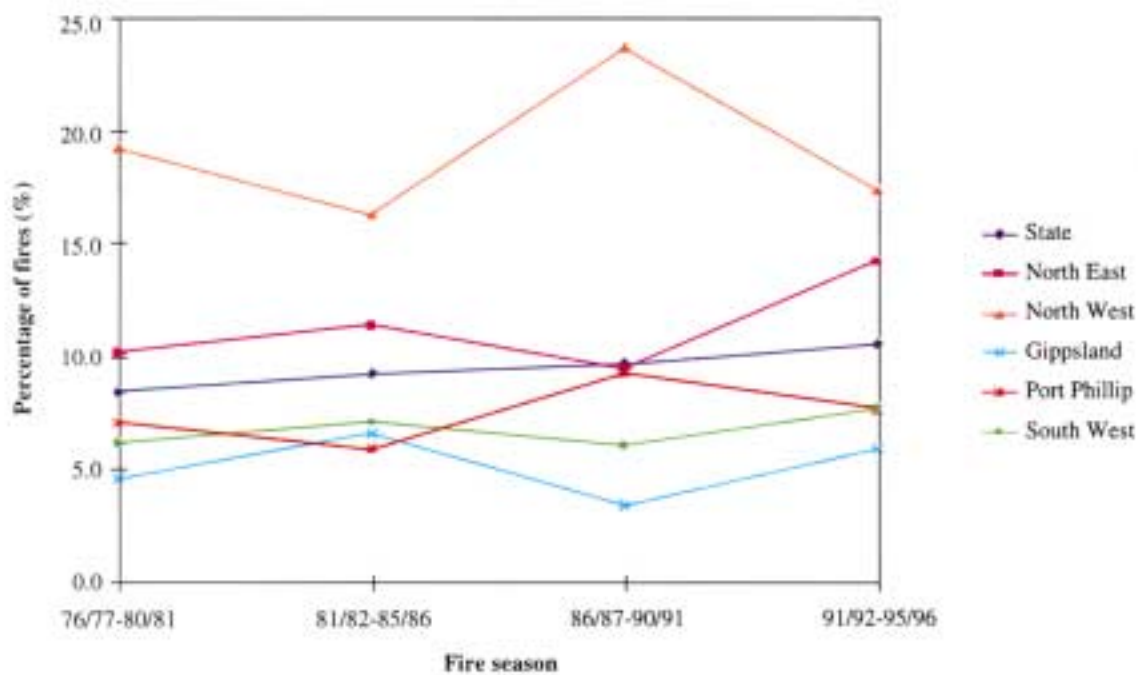
(b) Deliberate lighting



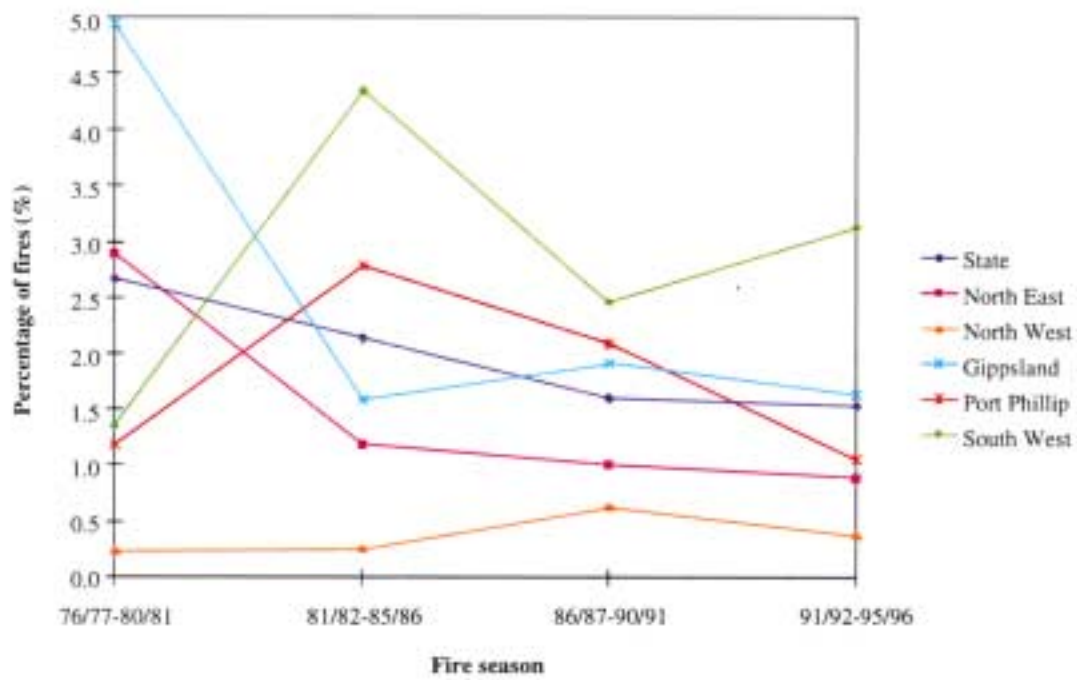
(c) Escape - burning



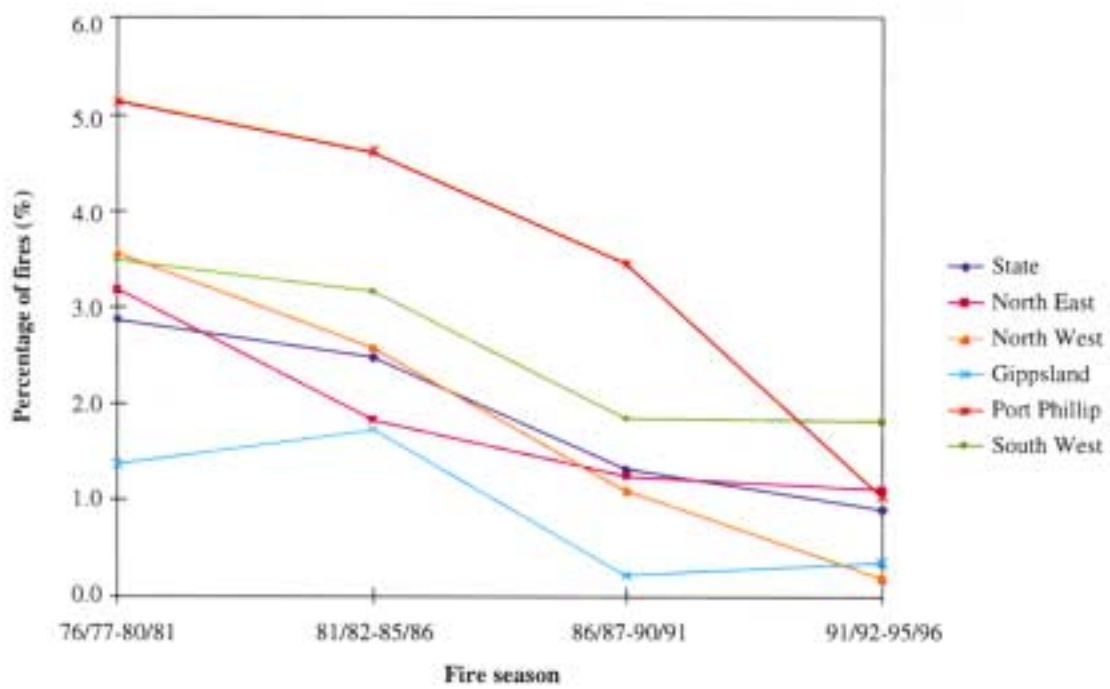
(d) Escapes - campfire, BBQ



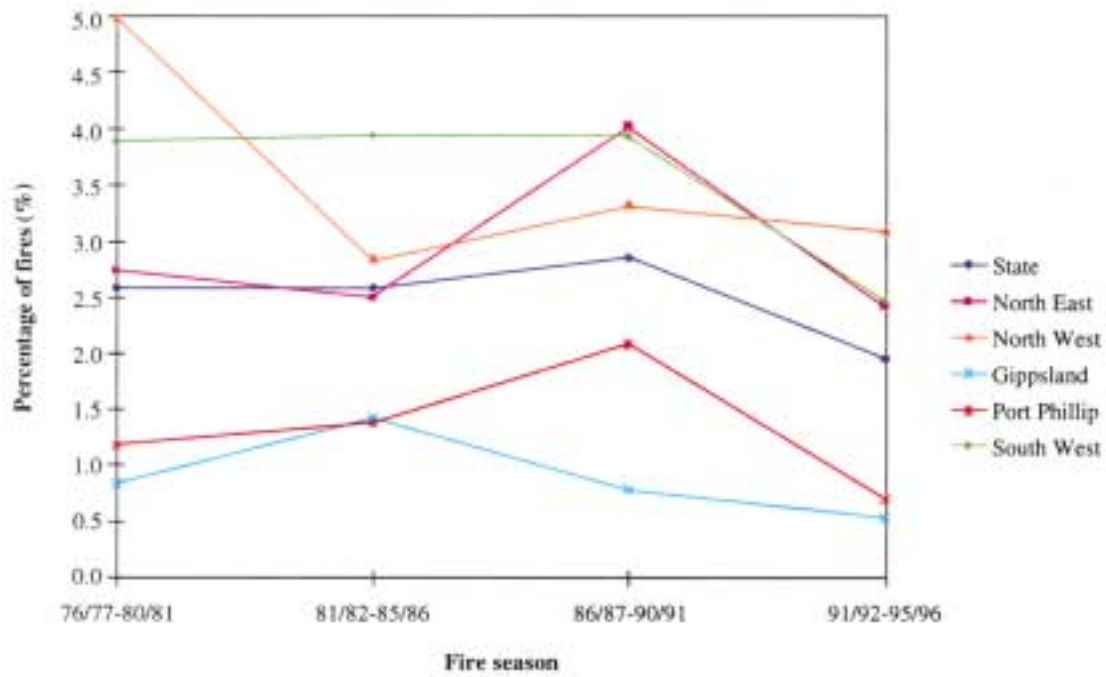
(e) Departmental burning



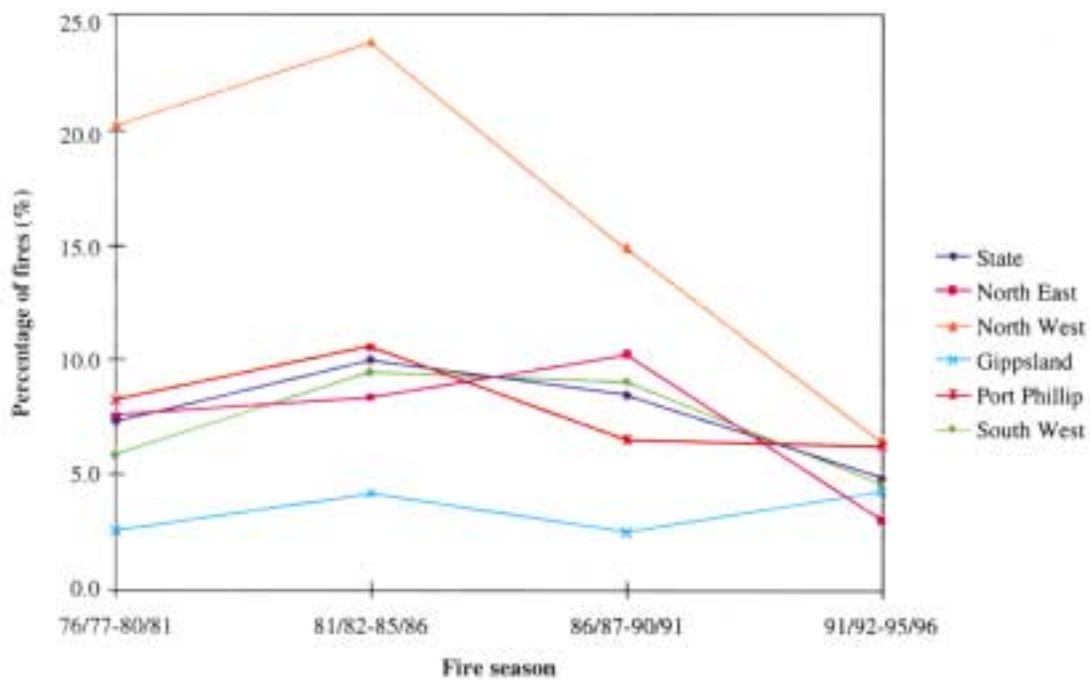
(f) Public utilities



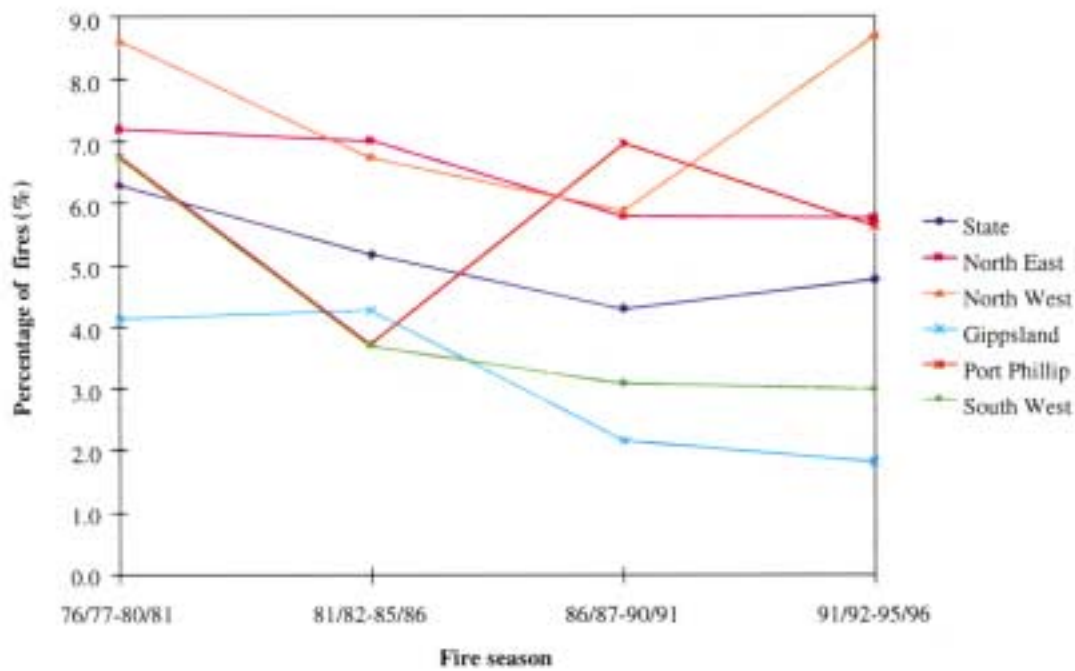
(g) Machines



(h) Pipe, cigarette, match



(i) Miscellaneous



(j) Unspecified

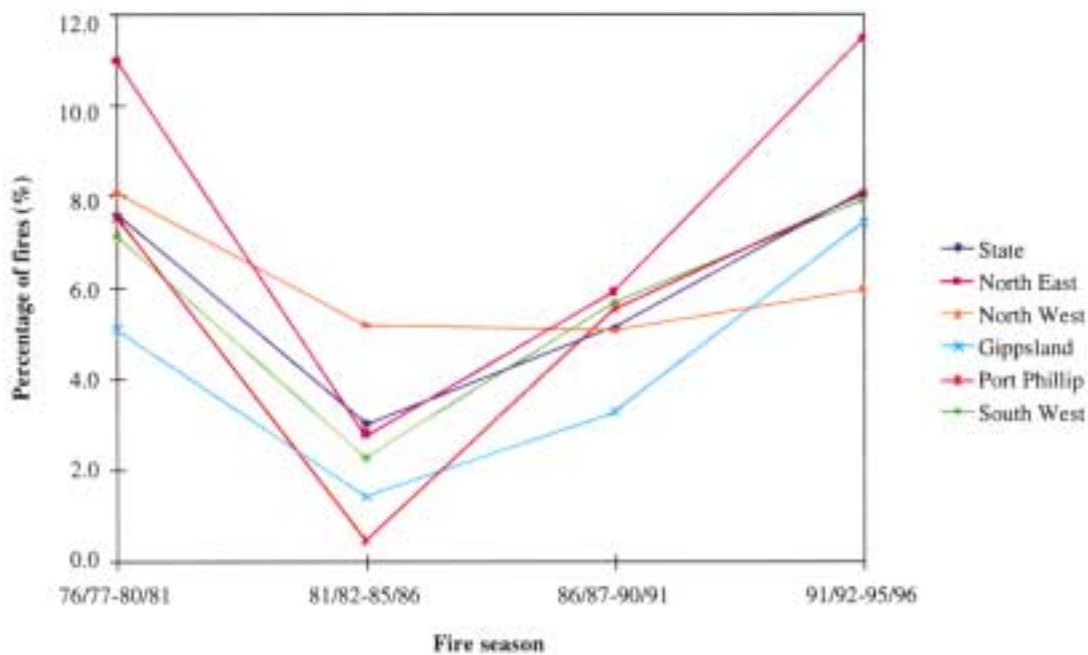


Figure 4. Fire cause frequency for the State and each Region, for each fire cause: (a) Lightning strikes, (b) Deliberate lighting, (c) Escape - burning, (d) Escape - campfire, BBQ, (e) Departmental burning, (f) Public utilities, (g) Machines, (h) Pipe, cigarette, match, (i) Miscellaneous and (j) Unspecified.

Individual Seasons

The individual fire seasons of 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96 were analysed. The Statewide data for these seasons are shown in Table 7.

Table 7. Statewide fire cause frequency for the individual fire seasons of 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96.

Cause group	1991/92		1992/93		1993/94		1994/95		1995/96	
	No	%	No.	%	No.	%	No.	%	No.	%
Lightning strikes	83	13.7	49	19.8	95	24.7	170	21.2	98	26.1
Deliberate lighting	202	33.3	86	34.8	121	31.5	227	28.3	112	29.8
Escapes - burning	114	18.8	34	13.8	62	16.1	127	15.8	44	11.7
Escapes - campfire, BBQ	61	10.1	31	12.6	30	7.8	94	11.7	41	10.9
Departmental burns	6	1.0	7	2.8	8	2.1	10	1.2	6	1.6
Public utilities	3	0.5	2	0.8	1	0.3	11	1.4	5	1.3
Machines	14	2.3	3	1.2	8	2.1	12	1.5	10	2.7
Pipe, cigarette, match	46	7.6	12	4.9	14	3.6	39	4.9	7	1.9
Miscellaneous	27	4.5	9	3.6	16	4.2	42	5.2	21	5.6
Unspecified	50	8.3	14	5.7	29	7.6	70	8.7	32	8.5
Total	606	100.0	247	100.0	384	100.0	802	100.0	376	100.0

The variability in the number of fires per season is even more apparent when individual seasons are analysed. Trends in the percentage composition of fire causes are also apparent over these five fire seasons, as illustrated in Figure 5.

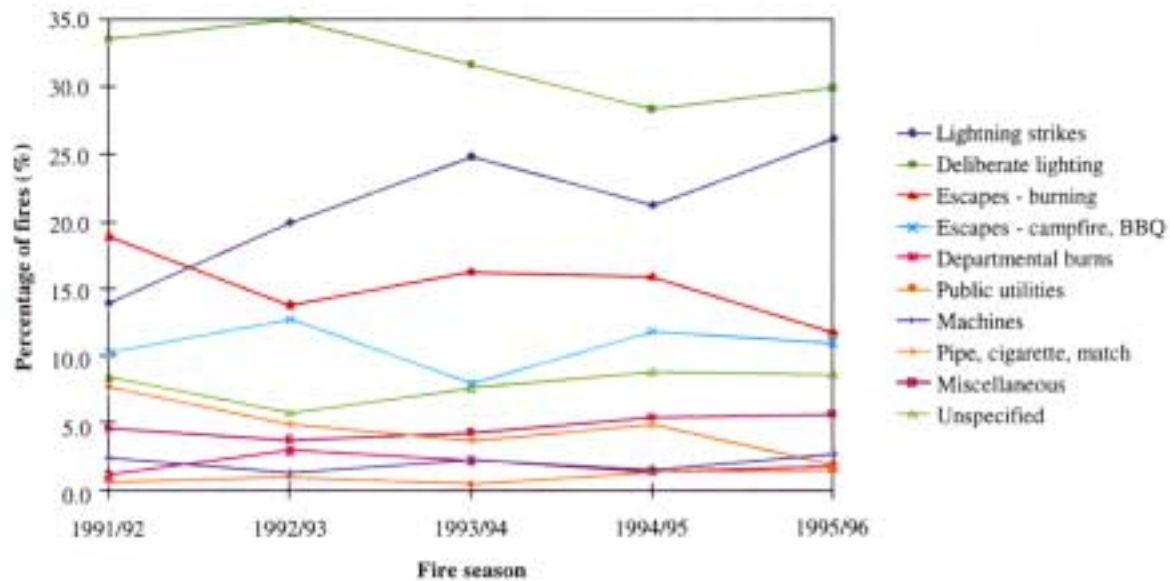


Figure 5. Statewide fire cause frequency for the individual fire seasons of 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96.

Figure 5 shows that *Lightning strikes* is the only cause group that seems to be increasing its percentage contribution to a significant extent over the last five fire seasons. Note that an increase in the percentage frequency of a particular fire cause group may not be accompanied by an increase in the total number of fires in that group. Percentage frequency is dependent upon the total number of fires for that period.

There has also been an overall decrease in the percentage of fires caused by the *Deliberate lighting*, *Escapes - burning* and *Pipe, cigarette, match* fire cause groups. The other fire cause groups show no definite increase or decrease in percentage of fires.

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Twenty-year Period

The Statewide area burnt data for the twenty-year period spanning the fire seasons from 1976/77 to 1995/96 are shown in Table 8.

Table 8. Statewide area burnt by each fire cause group for the twenty-year period from 1976/77 to 1995/96.

Cause group	Area burnt (ha)	Percentage (%)
Lightning strikes	1,061,927.7	46.0
Deliberate lighting	312,982.9	13.5
Escapes - burning	155,977.2	6.8
Escapes - campfire, BBQ	29,332.5	1.3
Departmental burns	105,477.7	4.6
Public utilities	325,120.9	14.1
Machines	51,029.8	2.2
Pipe, cigarette, match	8,871.7	0.4
Miscellaneous	200,187.8	8.7
Unspecified	59,472.6	2.6
Total	2,310,380.8	100.0
Average	115,519.0	-

Lightning strikes account for the largest proportion (46%) of land burnt by NRE fires over the twenty-year period from 1976/77 to 1995/96. This is followed by the *Public utilities* and *Deliberate lighting* fire cause groups that account for 14.1% and 13.5% of the area burnt respectively. Both *Lightning strikes* and *Deliberate lighting* also accounted for a large proportion (25.9% and 21.4% respectively) of the total number of fires in this same period. In contrast with this, the *Public utilities* cause group only accounted for 1.9% of the total number of fires, indicating that *Public utilities* fires are relatively infrequent but are often large in size.

The *Escapes - burning* and *Escapes - campfire, BBQ* fire cause groups showed relatively small percentage contributions (6.8% and 1.3% respectively) in terms of the total area burnt in the twenty-year period, however both groups represented significant proportions (18.0% and 9.5% respectively) of the total number of fires in this period. This indicates that although a large proportion of fires is caused by these sources, these fires are generally small. Another fire cause group that shows a similar pattern (with a relatively large frequency (7.8%) but a small percentage proportion of the area burnt (0.4%)) is *Pipe, cigarette, match*.

Table 9 shows the percentage composition of fire causes for area burnt, for each Fire Region.

Table 9. Percentage of area burnt by each fire cause group within each Fire Region from 1976/77 to 1995/96.

Cause group	North West	Gippsland	South West	North East	Port Phillip
Lightning strikes	86.9	31.1	14.0	54.8	0.2
Deliberate lighting	7.3	11.8	13.8	6.0	82.2
Escapes - burning	2.9	10.2	9.0	5.6	3.0
Escapes - campfire, BBQ	0.2	0.4	2.3	5.8	0.2
Departmental burns	0.1	8.8	6.1	2.7	4.7
Public utilities	0.3	12.2	41.5	4.4	2.0
Machines	0.2	4.8	1.9	2.5	0.3
Pipe, cigarette, match	0.2	0.1	0.2	2.5	0.4
Miscellaneous	1.9	20.2	2.7	11.8	6.6
Unspecified	0.1	0.3	8.5	3.7	0.5
Total area burnt (ha)	755,685.4	689,562.3	548,668.1	207,254.3	107,290.4
Percentage of Statewide area burnt total (%)	32.7	29.8	23.7	9.0	4.6

The total area burnt figures of Table 9 help to isolate which Fire Regions have had the largest areas of land burnt. The North West, Gippsland and South West Fire Regions have each had areas of between one-half and three-quarters of a million hectares burnt over the twenty-year period, each of these regions accounting for between 23% and 33% of the total area burnt across the State. The North East and Port Phillip have had much smaller areas burnt over this time, each of these regions accounting for less than 10% of the total area burnt across the State.

The distribution of the major causes by area burnt for each Fire Region appears to be much more variable than for the total number of fires. It is clear however, that in three of the five Fire Regions, there is one major cause that is responsible for the majority of the area burnt. In the North East and North West it is *Lightning strikes*, which are responsible for over 50% and 85% of the area burnt in each Fire Region respectively. In Port Phillip, *Deliberate lighting* accounts for more than 80% of the area burnt in the region.

In the Gippsland Region, *Lightning strikes* account for the greatest percentage of area burnt (31.1%), but there were also substantial areas burnt by *Miscellaneous*, *Public utilities*, *Deliberate lighting* and *Escapes - burning*. In the South West Region, *Public utilities* accounted for over 40% of the area burnt, with considerable additional areas being burnt by *Lightning strikes*, *Deliberate lighting* and *Escapes - burning*.

Ten-year Periods

The Statewide area burnt data for the two ten-year periods spanning the fire seasons from 1976/77 to 1985/86 and 1986/87 to 1995/96 are shown in Table 10.

Table 10. Area burnt by each fire cause group across the State for the two ten-year periods from

1976/77 to 1985/86 and 1986/87 to 1995/96.

Cause group	1976/77 - 85/86		1986/87 - 1995/96	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Lightning strikes	837,066.2	43.3	224,861.5	59.4
Deliberate lighting	269,198.5	13.9	43,783.6	11.6
Escapes - burning	124,817.1	6.5	31,185.1	8.2
Escapes - campfire, BBQ	9,434.6	0.5	19,712.7	5.2
Departmental burns	90,347.7	4.7	15,265.7	4.0
Public utilities	324,918.5	16.8	227.4	0.1
Machines	44,702.9	2.3	6,326.9	1.7
Pipe, cigarette, match	6,793.8	0.4	2,078.2	0.5
Miscellaneous	170,278.8	8.8	29,909.0	7.9
Unspecified	54,034.2	2.8	5,438.4	1.4
Total	1,931,592.3	100.0	378,788.5	100.0
Average	193,159.2	-	37,878.9	-

The most striking difference in the two ten-year periods shown in Table 10 is between the total area burnt figures. In the period from 1976/77 to 1985/86 there was over five times the total area burnt than there was in the 1986/87 to 1995/96 period. This is despite the fact that there were a very similar number of fires in each period (see Table 5). This difference is most likely due to the former period including the severe fire season of 1982/83.

Table 10 shows a 16.1% increase in the percentage area burnt by *Lightning strikes*. *Escapes - campfire, BBQ* has also seen a considerable Statewide increase in percentage area burnt, from 0.5% up to 5.2%. There is also a significant decrease in the percentage area burnt by *Public utilities*, from 16.8% down to 0.1%.

Five-year Periods

The Statewide area burnt data for the four five-year periods from 1976/77 to 1980/81, 1981/82 to 1985/86, 1986/87 to 1990/91 and 1991/92 to 1995/96 are shown in Table 11.

Table 11. Statewide area burnt by each cause group for the four five-year periods from 1976/77 to 1980/81, 1981/82 to 1985/86, 1986/87 to 1990/91 and 1991/92 to 1995/96.

Cause group	1976/77 - 1980/81		1981/82 - 1985/86		1986/87 - 1990/91		1991/92 - 1995/96	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Lightning strikes	480,953.6	60.2	356,112.6	31.4	197,377.0	64.0	27,484.5	39.0
Deliberate lighting	76,173.1	9.5	193,022.1	17.0	34,701.8	11.3	9,081.8	12.9
Escapes - burning	95,381.6	11.9	29,410.5	2.6	21,784.4	7.1	9,398.7	13.3
Escapes - campfire, BBQ	3,202.5	0.4	6,388.4	0.6	9,107.8	3.0	10,604.9	15.1
Departmental burns	68,185.1	8.5	22,071.2	1.9	4,784.4	1.6	10,481.3	14.9
Public utilities	18,000.0	2.3	306,893.5	27.1	210.7	0.1	16.7	0.0
Machines	10,142.9	1.3	34,560.0	3.1	5,658.3	1.8	668.6	0.9
Pipe, cigarette, match	1,636.3	0.2	5,145.9	0.5	1,749.8	0.6	328.4	0.5
Miscellaneous	35,561.8	4.4	134,717.0	11.9	29,056.2	9.4	854.8	1.2
Unspecified	9,980.7	1.2	44,053.5	3.9	3,918.1	1.3	1,520.3	2.2
Total	799,217.6	100.0	1,132,374.7	100.0	308,348.5	100.0	70,440.0	100.0
Average	159,843.5	-	226,474.9	-	61,669.7	-	14,088.0	-

The total area burnt for each five-year period in Table 11 shows significant variability. The period from 1991/92 to 1995/96 had less than one-sixteenth of the total area burnt when compared to the period from 1981/82 to 1985/86. Extreme fire seasons (such as 1982/83) obviously have a very large impact on area burnt data. This data is illustrated graphically in Figure 6.

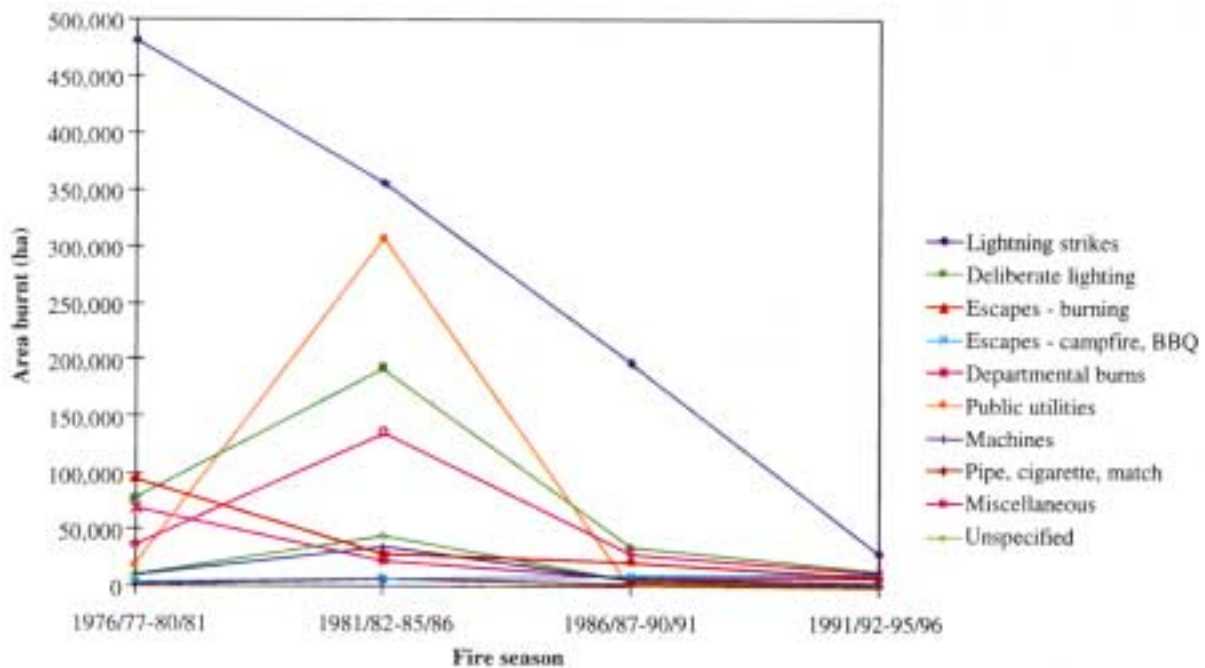
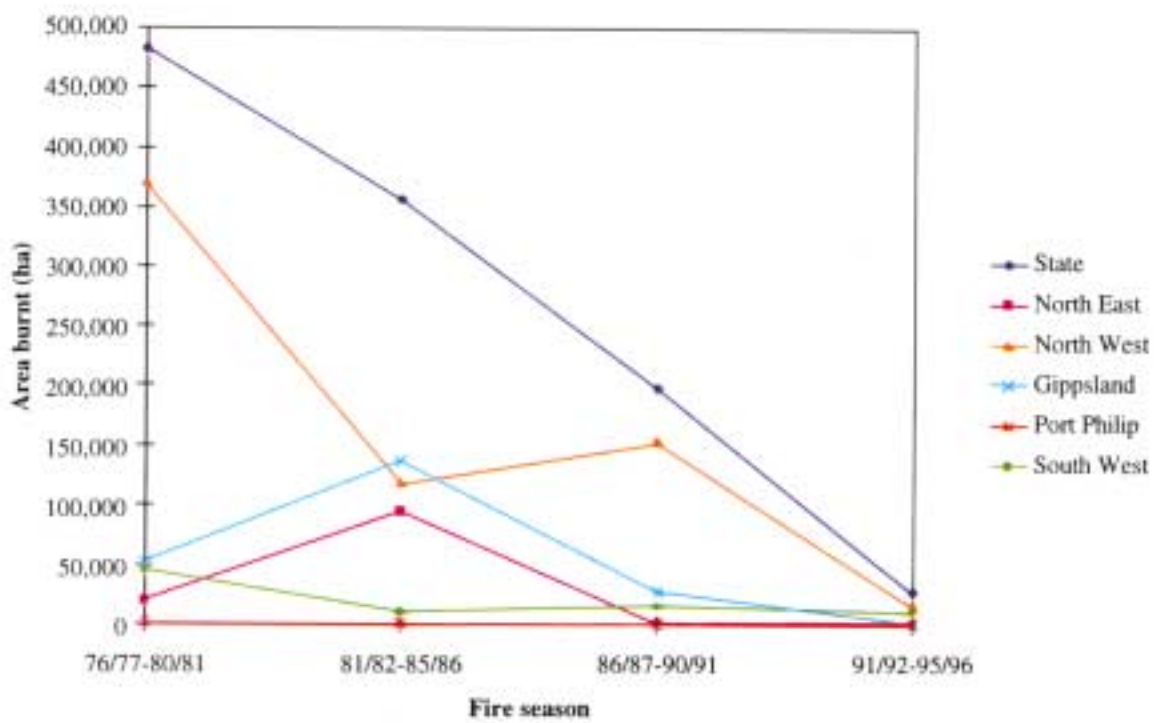


Figure 6. Statewide area burnt for each fire cause group for the five-year periods from 1976/77 to 1980/81, 1981/82 to 1985/86, 1986/87 to 1990/91 and 1991/92 to 1995/96.

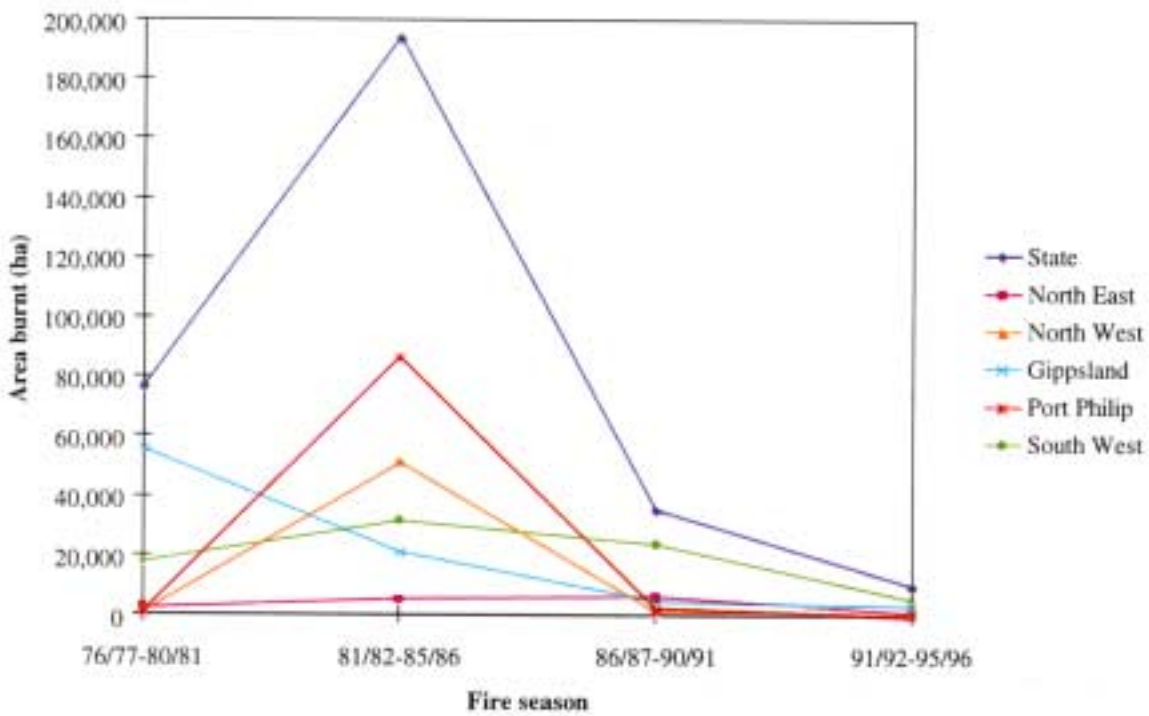
A notable feature of Figure 6 is the almost linear decrease in the area burnt by *Lightning strikes* over the consecutive five-year periods, from over 480,000 ha to less than 28,000 ha. *Escapes - burning* and *Departmental burns* have also shown sustained decreases in area burnt. *Escapes - campfire, BBQ* is the one cause group to have shown a sustained increase in area burnt at the Statewide level, rising from around 3,200 ha to over 10,600 ha. These trends are more easily observed in Figure 7, where the scale has been adjusted for each cause group, and Regional figures have been included.

It is also interesting to note that if the anomalous period of 1981/82 to 1985/86 is ignored, the remaining cause groups all show a decrease in area burnt. These groups include *Public utilities*, *Deliberate lighting*, *Miscellaneous*, *Unspecified*, *Machines*, and *Pipe, cigarette, match*. Once again, Figure 7 clearly illustrates this point. If it were found that large areas were burnt in the extreme 1982/83 season as a result of these fire causes, the anomaly could perhaps be explained.

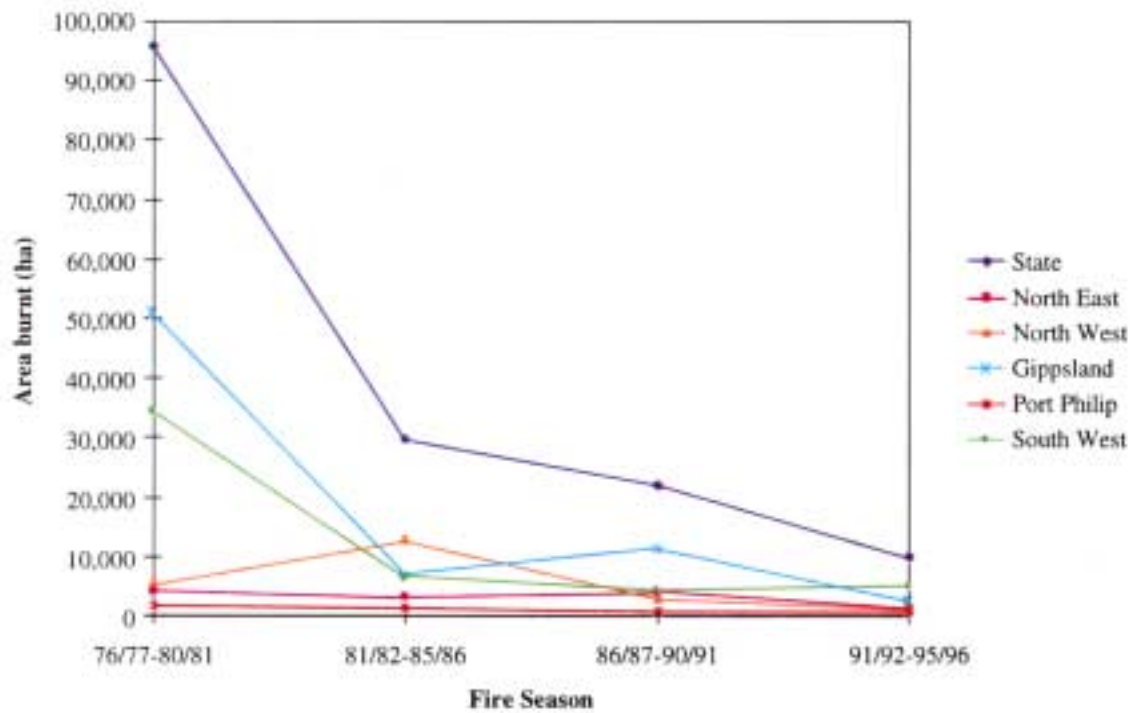
(a) Lightning strikes



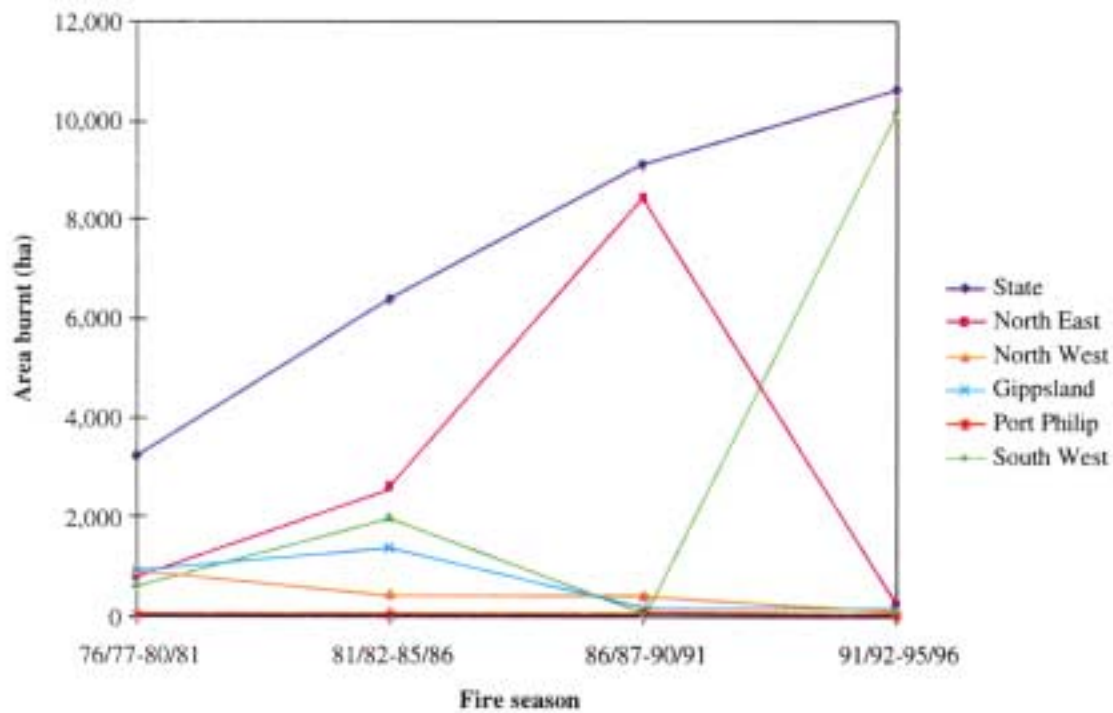
(b) Deliberate lighting



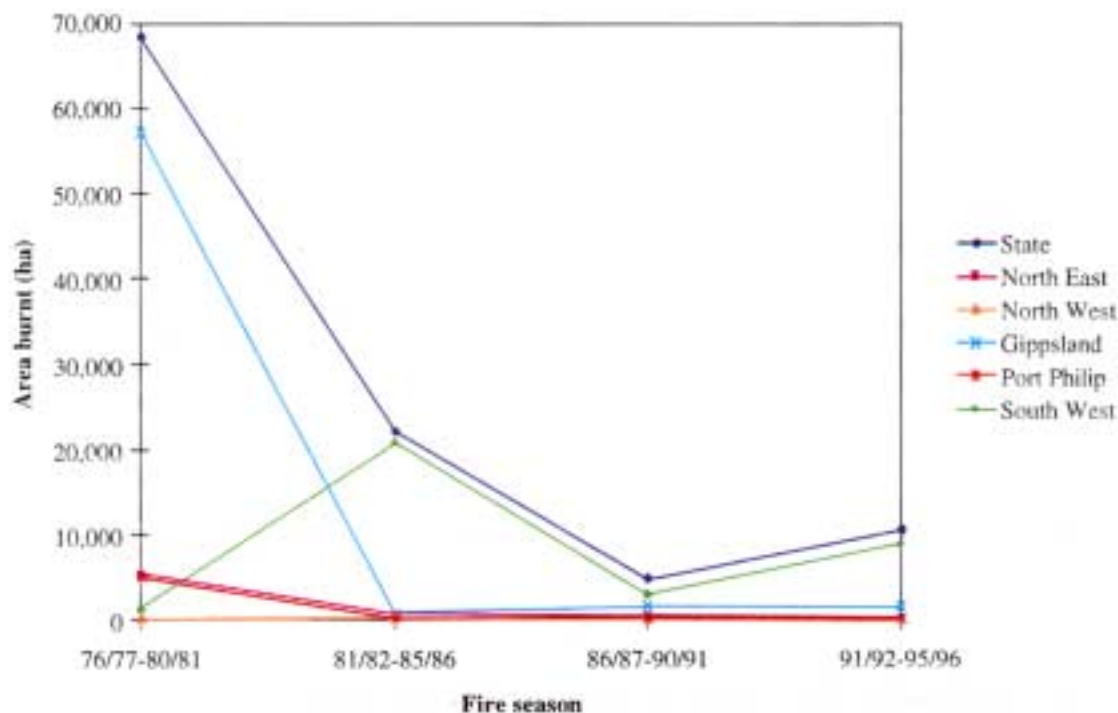
(c) Escape - burning



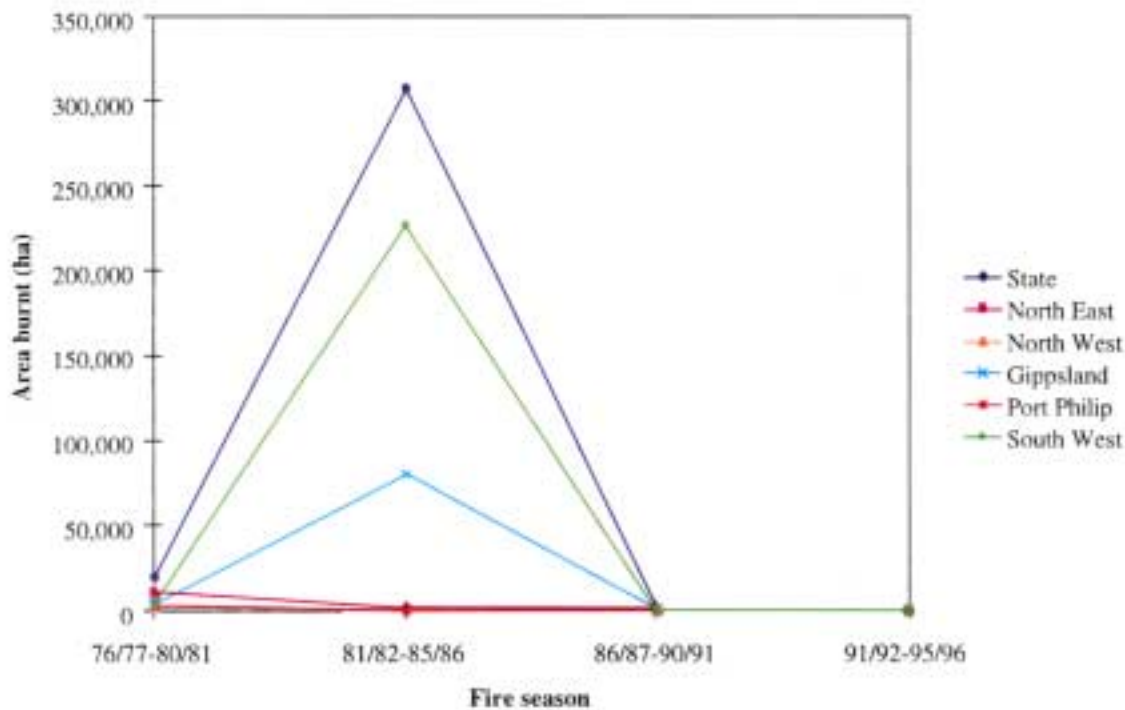
(d) Escapes - campfire, BBQ



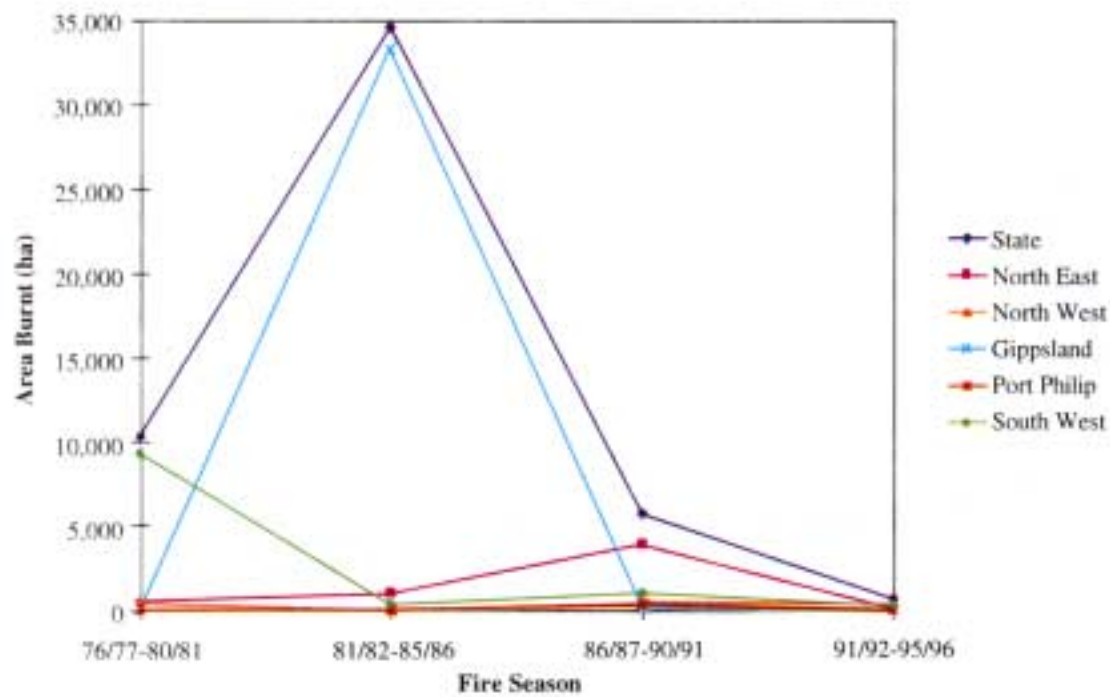
(e) Departmental burning



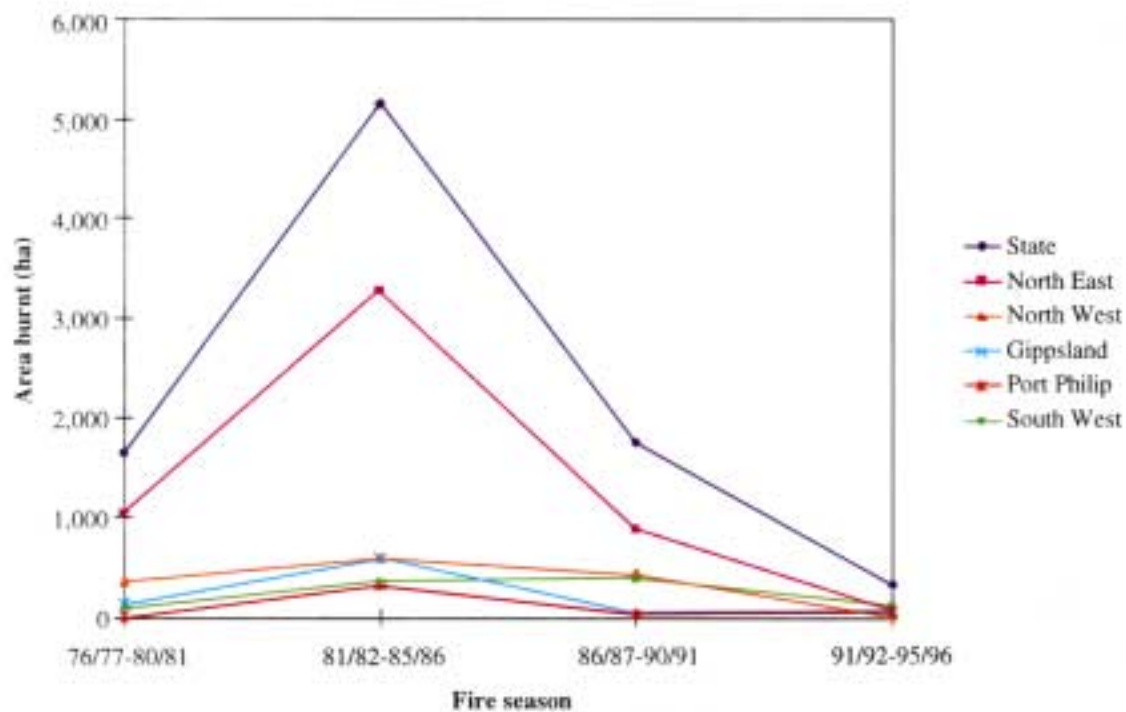
(f) Public utilities



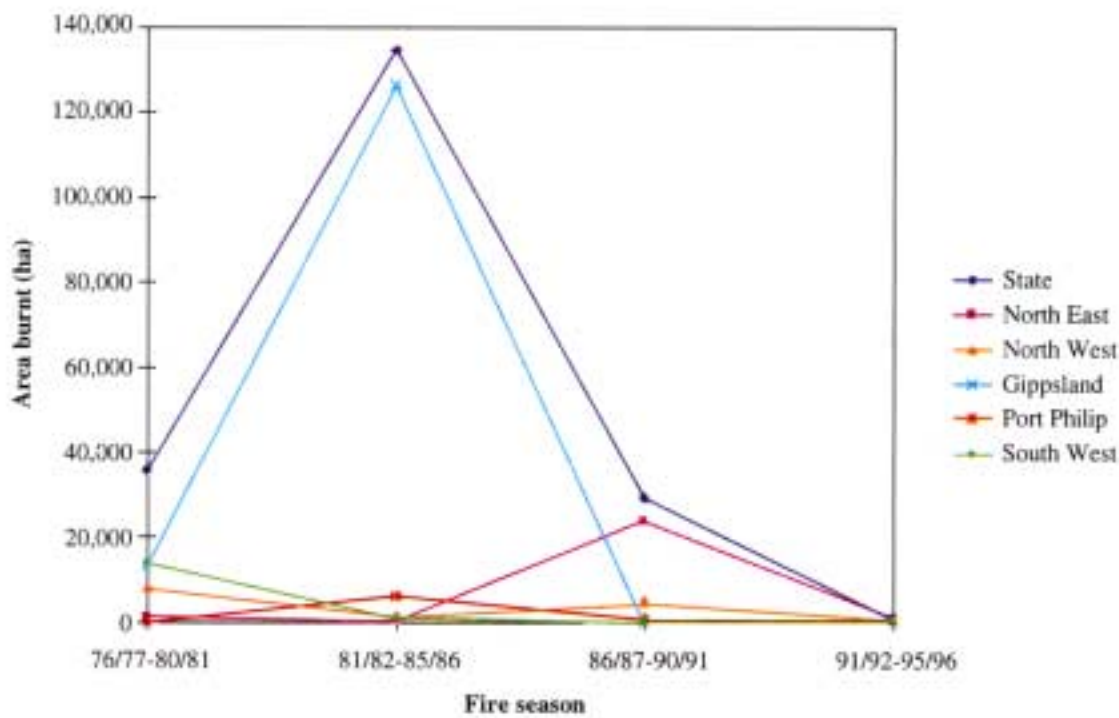
(g) Machines



(h) Pipe, cigarette, match



(i) Miscellaneous



(j) Unspecified

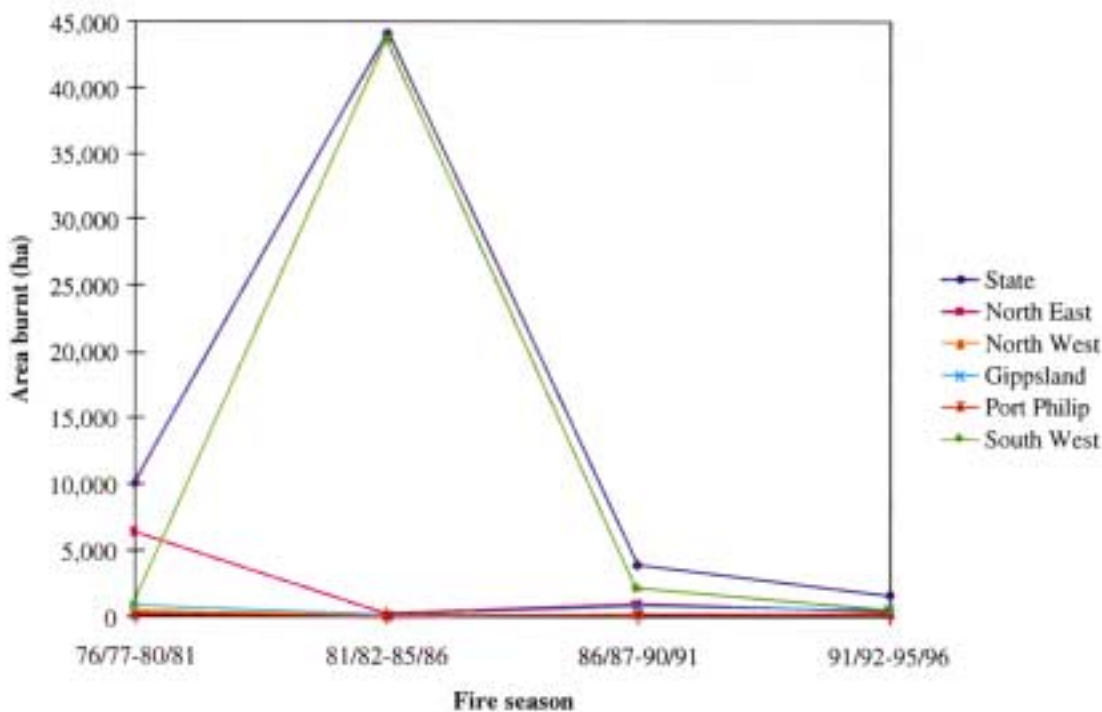


Figure 7. Area burnt for the State and each Region, for each fire cause: (a) Lightning strikes, (b) Deliberate lighting, (c) Escape - burning, (d) Escape - campfire, BBQ, (e) Departmental burning, (f) Public utilities, (g) Machines, (h) Pipe, cigarette, match, (i) Miscellaneous and (j) Unspecified.

Individual Seasons

The Statewide area burnt data for the individual fire seasons of 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96 are shown in Table 12.

Table 12. Statewide area burnt in the individual fire seasons 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96.

Cause group	1991/92		1992/93		1993/94		1994/95		1995/96	
	Area (ha)	Percent %	Area (ha)	Percent %	Area (ha)	Percent %	Area (ha)	Percent %	Area (ha)	Percent %
Lightning strikes	9668.7	57.8	597.8	12.4	1704.2	10.7	3760.6	20.1	11753.2	83.0
Deliberate lighting	3125.9	18.7	2217.6	46.0	601.4	3.8	1895.9	10.1	1241.0	8.8
Escapes - burning	1896.7	11.3	1162.7	24.1	3920.5	24.5	1628.2	8.7	792.6	5.6
Escapes - campfire, BBQ	188.7	1.1	39.0	0.8	63.7	0.4	10301.3	55.0	12.2	0.1
Departmental burns	1060.4	6.3	612.1	12.7	8375.0	52.3	335.9	1.8	97.9	0.7
Public utilities	0.7	0.0	1.0	0.0	2.0	0.0	8.8	0.0	4.2	0.0
Machines	24.7	0.1	12.4	0.3	464.6	2.9	161.5	0.9	5.4	0.0
Pipe, cigarette, match	120.8	0.7	21.8	0.5	20.4	0.1	66.1	0.4	99.3	0.7
Miscellaneous	297.2	1.8	42.8	0.9	66.7	0.4	375.3	2.0	70.8	0.5
Unspecified	353.4	2.1	110.0	2.3	782.5	4.9	182.3	1.0	92.1	0.7
Total	16737.2	100.0	4817.2	100.0	16001.0	100.0	18715.9	100.0	14168.7	100.0

The variability in the percentage of area burnt per season is quite clear when individual seasons are analysed. There is, however, some correlation between the total number of fires per season (refer to Table 7) and total area burnt per season for the five fire seasons listed in Table 12, resulting in a r^2 value of 0.62. This correlation is not sustained throughout the entire period under study. When all data is analysed together (the twenty-year period), the correlation between number of fires and the area burnt is not nearly as strong, resulting in a r^2 value of only 0.24.

Figure 8 attempts to detect any possible trends in the area burnt by each cause category over the past five seasons.

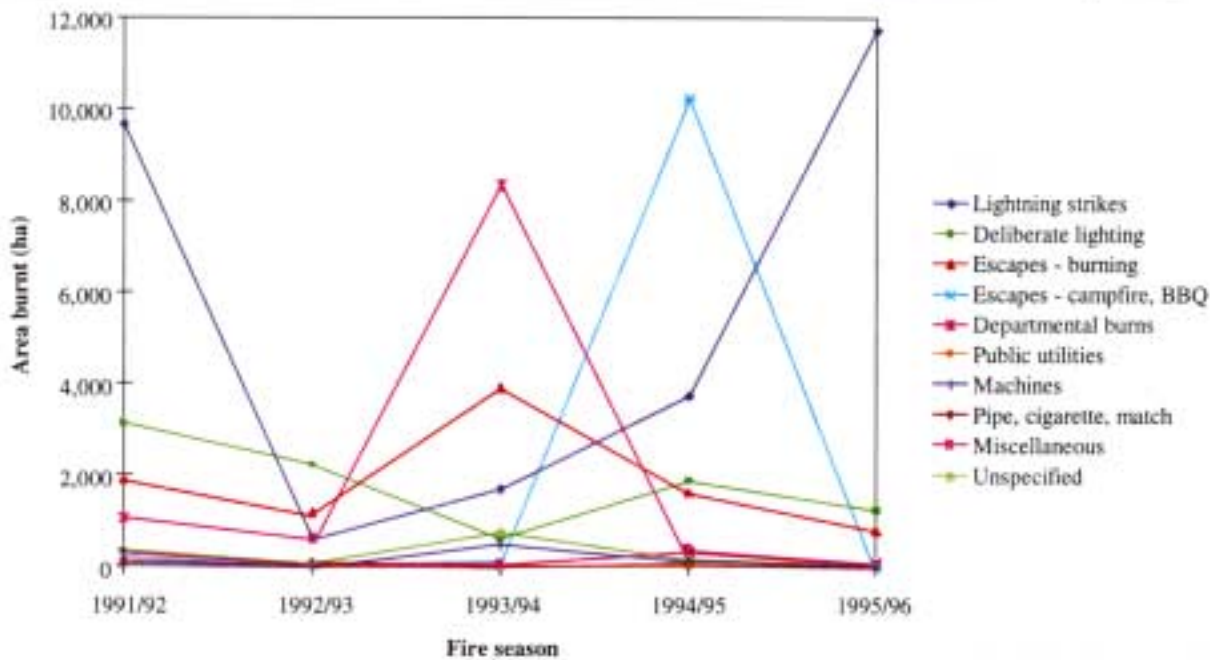


Figure 8. Area burnt for each fire cause across the State for the fire seasons 1991/92, 1992/93, 1993/94, 1994/95 and 1995/96.

There are no clear trends visible in Figure 8.

CONCLUSIONS

Analysing the fire cause data as five-year periods appears to be the most useful way of identifying trends in their percentage incidence and area burnt. By aggregating fire seasons into five-year periods, the number of fires in each period are similar enough to allow meaningful comparisons in the percentage compositions to be made.

At the State level *Lightning strikes*, *Deliberate lighting* and *Escapes - burning* are the most numerous fire causes, accounting on average for over 65% of all NRE fires. There can however, be large Regional deviations from these figures. At the State level *Deliberate lighting* and *Escapes - campfire, BBQ* show definite increases in their percentage occurrence over the twenty-year period studied. These increases are counteracted by decreases in *Escapes - burning*, *Departmental burns* and *Public utilities*.

Lightning strikes clearly accounted for the greatest area burnt by NRE fires over the twenty-year period, being responsible for 46% of the total area burnt. The *Deliberate lighting* cause group was also significant, accounting for 13.5% of the total area burnt. Both of these groups were also identified as the major fire cause groups in terms of the total number of fires. The other cause group that accounted for a large proportion of the total area burnt was *Public utilities*, which was

responsible for 14.1% of the total area burnt. Unlike *Lightning strikes* and *Deliberate lighting* though, the *Public utilities* cause group was found to be a relatively infrequent cause of fires within the State, being a source of only 1.9% of the total number of fires.

There is an almost linear decrease in the area burnt by *Lightning strikes* over the twenty-year period. *Escapes - burning* and *Departmental burns* have also shown sustained decreases in area burnt. *Escapes - campfire, BBQ* is the one cause group to have shown a sustained increase in area burnt at the Statewide level. All of the other fire cause groups would show decreases in area burnt if the anomalous five-year period of 1981/82 to 1985/86 was ignored.

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