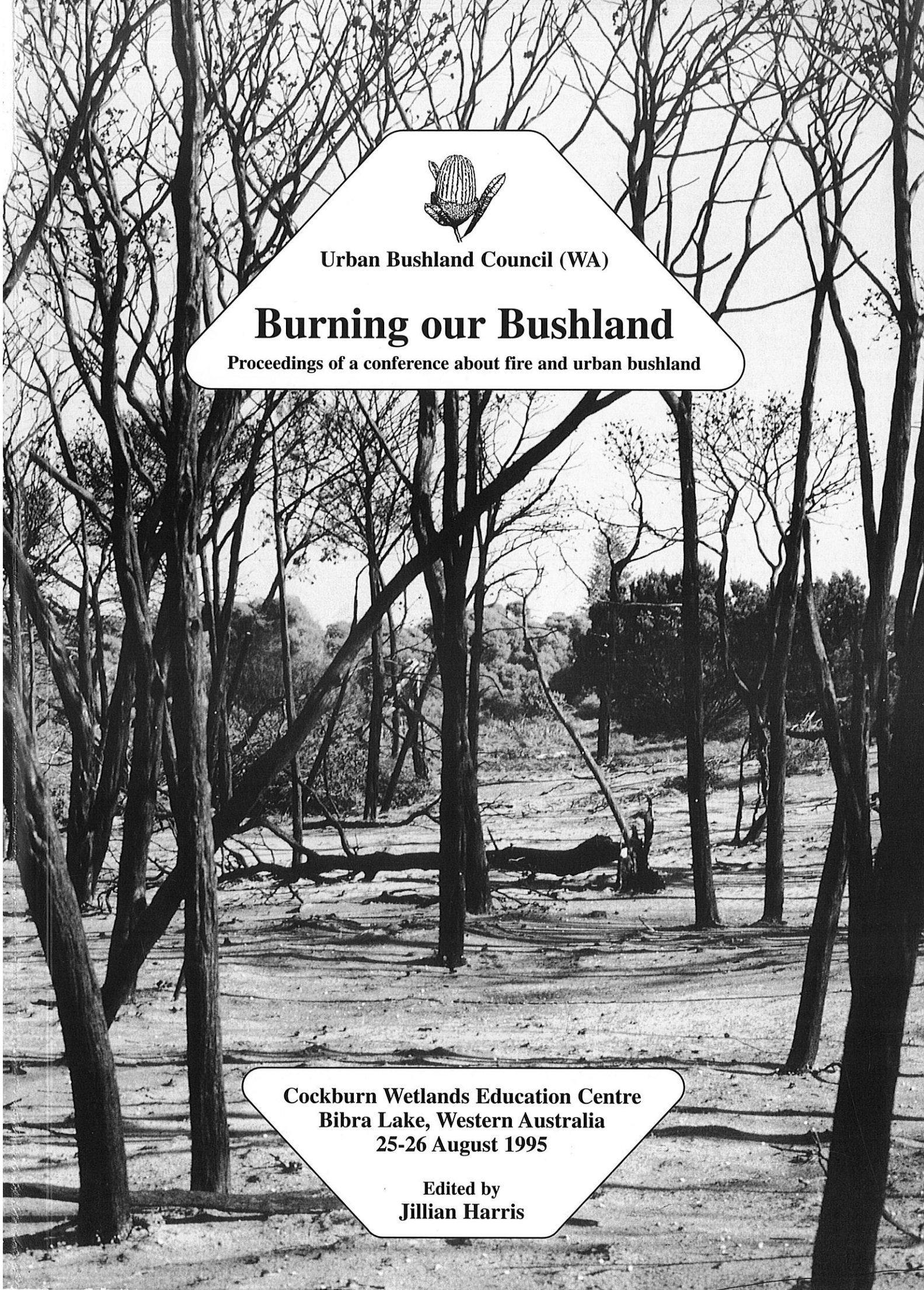

Urban Bushland Council (WA)

Burning our Bushland

Proceedings of a conference about fire and urban bushland

Cockburn Wetlands Education Centre
Bibra Lake, Western Australia
25-26 August 1995

Edited by
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Cover photograph by Greg Keighery
Burnt *Callitris preissii* woodland, Woodman Point.

URBAN BUSHLAND COUNCIL (WA)

PO Box 326, West Perth WA 6872

To promote the recognition and conservation of urban bushland, our natural heritage.

Contents

Fire and human disturbance regimes and impacts on plant communities at the Star Swamp Bushland Reserve

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Introduction

Star Swamp Bushland Reserve is an 'A' Class Reserve located at North Beach in Perth's northern suburbs and is vested in the City of Stirling for conservation of flora and fauna and passive recreation. The reserve contains about 100 hectares of mainly Banksia woodland with scattered tuart and jarrah overstorey, tuart woodland and heathland.

Most of the bushland around Star Swamp was earmarked for development in the early 1970s, but concerted community action influenced its conservation. Community involvement remains an important feature of management of the reserve.

The determination of human disturbance and fire regimes is useful in understanding how the present composition of plant communities has changed over time and, likewise, important to properly determine future management practices. Human disturbance regimes include clearing, trampling and grazing of domestic animals. Fire regime attributes include fire coverage, season (timing) and frequency. The link between the two regime types to weed invasions and reduced conservation values of urban vegetation is widely accepted (e.g. Wycherley 1984).

Methods

Human disturbance and fire regimes of the reserve over 39 years (1948-1985) were determined from several sources. Tracks, clearing and fire scars were traced from aerial photographs and maps from the Battye Library, City of Stirling and Department of Land Administration, and corroborated in part by oral history from local residents. A grid reference system comprising 184 data points was used as the basis of a database for a range of ecological data in wider study of the reserve (Pigott 1994). Geographic Information Systems (ARC/INFO® and ArcView 2®) were used to capture and store data in the reserve database, create the coverages and required maps. Fire coverage, timing, number of fires and length of fire-free period were determined by hand and stored in the database. Fire frequency values were calculated by dividing the number of fires by 39 (number of record years). Floristic data were collected at the reference sites for classification and mapping of plant communities.

Results and Discussion

Human disturbance

Figure 1 illustrates the many human activities which have occurred at the reserve since the turn of the century. Grazing, clearing, pipeline excavation and the proliferation of tracks have fragmented and degraded the remnant bushland, resulting in weed invasion and increasing the risk of fire (see Hobbs 1987).

Before the development of housing, which began in the 1960's, the area now known as the reserve was easily accessed through the large area of surrounding uncleared bushland. The layout of tracks found at the reserve shows that some of these were a direct result of concentrated periods of activity at various times (Fig. 1).

Since the early 1980s, community action, combined with the development and implementation of a management plan for the reserve (City of Stirling 1987), has moderated the impacts of human activity. Actions taken include restricting access by fencing the reserve, closing and rehabilitating tracks, and using signs to educate the general public about managing the bushland.

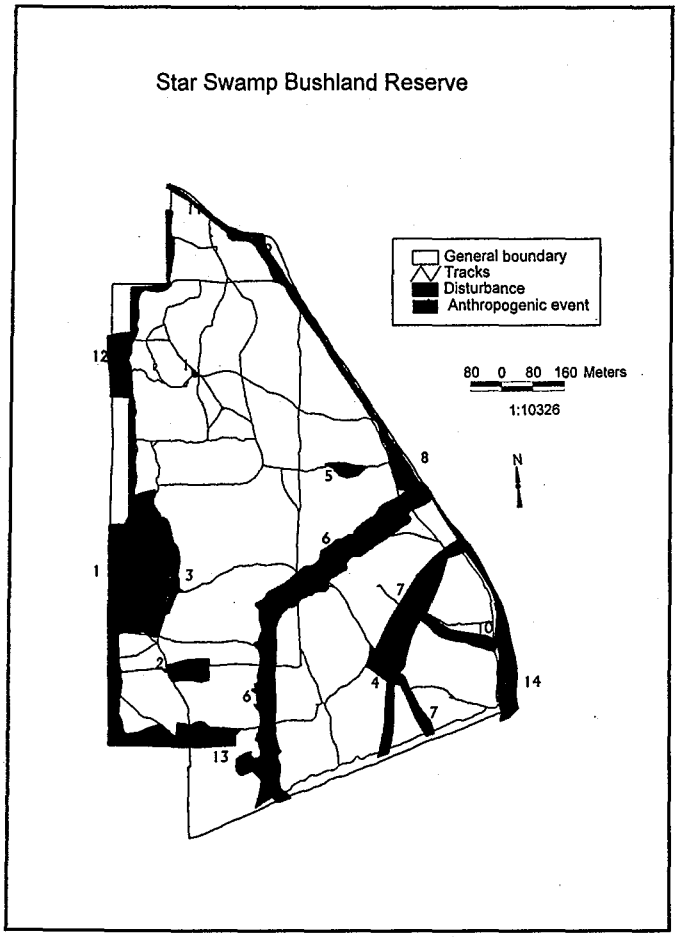

Figure 1: Patterns of human disturbance for the Reserve from circa 1900 to 1987.

Fire regimes

Fire coverage and timing

A total of 34 fires were recorded in the area now known as the reserve for the period 1948 to 1987, and occurred every two to five years (Pigott 1994). As a consequence of changing human activity in and around the reserve, fire coverage has diminished from 100 per cent of the area between 1953 and 1961 to smaller fires covering about 25 per cent of the reserve. Recent data show that a fire covering 25-50 per cent of the reserve in 1989 is the only major fire recorded from 1987 to the summer of 1994/95 (Table 1). The earlier pattern of broadscale burns has been replaced by the small-scale mosaic burning pattern, except in 1981 when backing-burning was used to control a wildfire resulting in an extensive fire.

A feature of the recent burning pattern is that areas unburnt in one fire are burnt in successive years, typified by six separate fires that occurred between 1984 and 1987 (Table 1). Most of the significant fires at the reserve between 1948 and 1990 occurred in summer (Table 1), the period when urban bushland around Perth is most prone to burning because annual grasses (mostly introduced) have dried off and there is little rainfall. An exception was the extensive autumn fire of 1985, which occurred after drought conditions in the area (Pigott 1994). Since 1989, most fires have been brought rapidly under control by fire brigade units after they have been alerted by local fire-spotting volunteers. Control of grasses with selective herbicides along major tracks has assisted in reducing reducing fuel loadings in parts of the reserve by up to 80 per cent, allowing natural regeneration to reduce flammability (B. Wilkins[1], personal communication).

Fire frequency and fire-free periods

At least four fires were recorded for each reference point, a maximum number of 14 fires and a median of nine fires, less than half the average for Kings Park bushland during the same period (Pigott 1994). Relative fire frequency for the reserve was mapped for the period 1948-1987 (Fig. 2). Fire frequency values were assigned to one of five arbitrary classes where each class is a relative description of the values for fire frequency (e.g. very high, high etc.).

The pattern of fire frequency appears to be complicated by the locations and intersection of several main fire breaks. Very high classes of relative fire frequency (Fig. 2) show up near track intersections but mostly away from access points. Areas of relatively very low and low fire frequency occur in the wetlands on the west side of the reserve and also in woodlands in the northwest and southeast corners of the reserve, indicating some protection by tracks (Fig. 2). The relatively high fire frequency in southern part of the

Year	% cover of fire(s)	Timing of fire
1948	>75%	na
1953	100%	na
1958	100%	na
1961	100%	Summer
1963	50-75%	Summer
1964-66	25-50%	na
1968	50-75%	Summer
1970-72	25-50%(x2)	Summer (72 only)
1974	25-50%	Summer
1976	>75%	Summer
1977	50-75%	Summer
1981	>75%	Summer (Jan 81)
1984	25-50%	Summer
1985	50-75%	Autumn (16 Apr)
1986	25-50% (x 4)	Summer (Dec 85 & Jan 86)
1987	25%	Summer (Feb 87)
1989	25-50% (x2)	Summer
1990-94	Spot fires (var)	Summer
1995	Spot fires (x2)	Summer

*area approx 500m²

Table 1: Coverage and timing of fire at the Reserve between 1948 and 1995.

reserve appears to be associated with the major drain and sewerage pipeline installations between 1972 and 1987 (Pigott 1994). Details of fire regimes for other urban reserves are limited, however, the number of fires recorded at the reserve is more than the number reported for Woodman Point and Yule Brook Reserves, but considerably less than the number reported for bushland at Kings Park over a similar period. The differences between numbers of fires at these urban remnants can be explained in terms of vicinity to urban development and levels of human activity (Pigott 1994).

Between 1948 and 1987, fire-free periods at the reserve have ranged between two and 20 years with an average of 4.5 years (Pigott 1994). No sites were found to have been burnt in successive years or fire-free for one year only but, the majority (>80 per cent) were fire-free for five years or less. A strong negative correlation between mean fire-free period and fire frequency was calculated for the period 1948-1987 Fig. 3), that is, the lowest mean fire-free periods corresponded with samples of high fire frequency and vice versa.

Using the periodicity data a prediction is made that areas of bushland not burnt for five years or more are likely to be burnt the following summer. As there are other important factors prevailing on the likelihood of bush fires such as public usage, fuel accumulation for vegetation in different parts the Perth area and the time of year, this prediction is conservative (Pigott 1994).

Impacts on vegetation

Vegetation communities

Five plant communities were defined by classification for the reserve (Fig. 4). Sites with *Melaleuca raphiophylla* were easily defined as the Swamp Paperbark (community I). The four remaining communities, mainly of the upland, were named after prominent physiognomic species in their respective sets of floristically important species (Table 3). Mixed Banksia community being the most common (40 per cent of the reserve), the Macrozamia community (25.9 per cent), the Mixed Eucalypt community (18.6 per cent) and the Bottlebrush community (11.3 per cent) (Fig. 4).

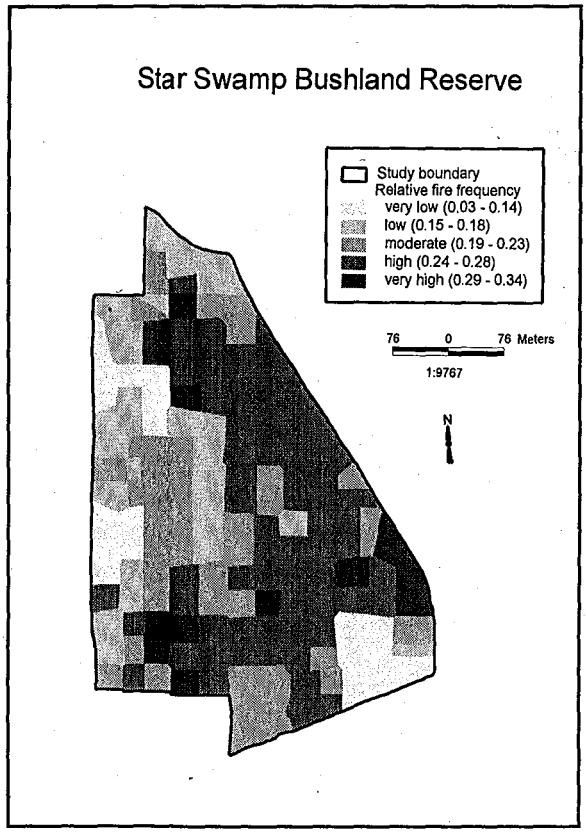

Figure 2: Relative fire frequency for the Star Swamp Reserve based on fire regime data for reference sites, 1948-1987.

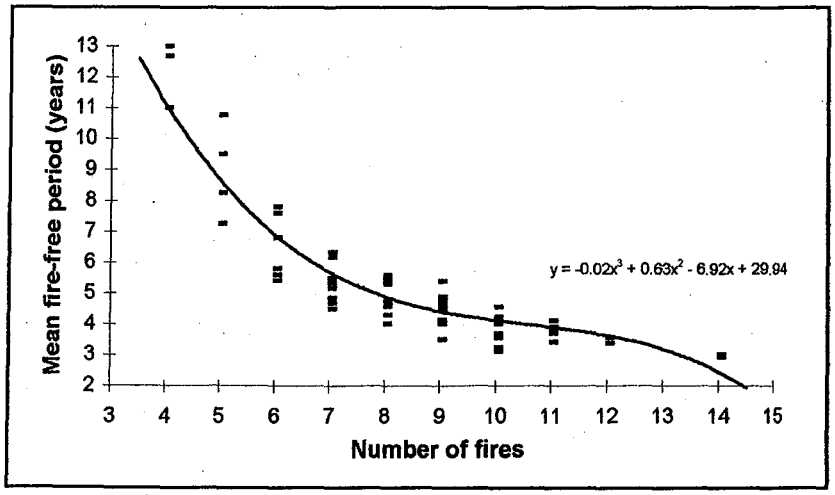

Figure 3:
Correlation between fire frequency and fire-free periods

The post-fire regeneration mode of the floristically important species for the communities were determined (Table 2). Native resprouters were found to be dominant for the Swamp Paperbark, Bottlebrush, Macrozamia and Mixed Eucalypt communities and to a lesser extent the Mixed Banksia community. This pattern indicates that despite increased fire frequency and reduced fire-free periods at the reserve plant communities are dominated by native species capable of resprouting. Many important weed species (e.g. *Arctotheca calendula*) were found to be seeders although some perennial weeds (e.g. *Homeria flaccida*) resprout vigorously after fire.

Individual species

Altered fire regimes pose particular difficulties for conserving plant communities characterised by species killed by fire [e.g. the obligate seeder *Banksia prionotes* (Loneragan et al. 1984]. These species require a minimum of three to five years for the juvenile period and up to 11 years to reach maximum seed production (Cowling and Lamont 1986).

Vegetation community	Mode of regeneration (based on Bell et al. 1994 and field obs.)
I **Swamp Paperbark**	
Melaleuca raphiophylla.	Resprouter
II Bottlebrush	
Calothamnus quadrifidus, Eucalyptus marginata, Allocasuarina humilis, Lomandra caespitosa, Homeria flaccida.*	Resprouters
Arctotheca calendula, Carpobrotus aequilaterus* , Ehrharta longiflora*, Bromus diandrus*.*	Seeders
III Macrozamia	
Sowerbaea laxiflora, Haemadorum paniculatum, Lomandra hermaphrodita, Phyllanthus calycinus, Macrozamia riedlei.	Resprouters
Cerastium glomeratum.*	Seeder
IV Mixed Banksia	
Lechenaultia linarioides, Banksia attenuata, Burchardia umbellata, Laxmannia aff. *squarrosa, Ptilotus polystachius, Cerastium glomeratum*.*	Resprouters
Ursinia anthemoides, Trachymene pilosa.*	Seeders
V Mixed Eucalypt	
Hardenbergia comptoniana, Eucalyptus calophylla, E. gomphocephala,. Sparaxis grandiflora, Oxalis* sp.*	Resprouters

* Weed species

NB. The species referred to in this table only assist in separating communities in the classification and are not necessarily exclusive to a particular community.

Table 2: Vegetation communities showing floristically important species and their mode of regeneration.

NB. The species referred to in this table only assist in separating communities in the classification and are not necessarily exclusive to a particular community.

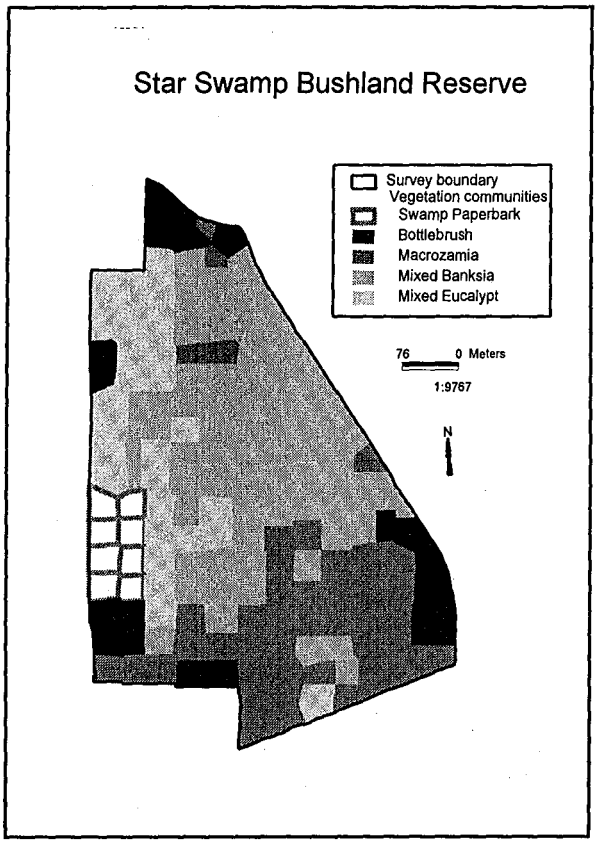

Figure 4. Plant communities for the Star Swamp Reserve.

Despite these problems, species such as *Banksia prionotes* has survived high fire frequencies and reduced fire-free period at the reserve. Some mature individuals on the edges of tracks are not killed during fire and others survive in patches where the fire is cooler (unpublished data). However, overall population sizes can be dramatically influenced. For example, before the 1981 fire one area with a population of *Banksia prionotes* had a population of 50 stems per hectare which increased to 2150 seedlings per hectare following the fire (Loneragan et al. 1984). Ten of these individuals survived a fire in 1986 to reach juvenile status, flower and set seed (Pigott 1994). Although another fire in 1989 killed all 10 individuals, 51 seedlings were counted at the site in 1990.

Altered fire regimes are also thought to be responsible for the rapid decline in tuart (*Eucalytus gomphocephala*) (Fox 1980), an important overstorey tree in the Perth area, including the reserve. Tuart canopy in woodland around Star Swamp is estrmated to have declined from 27.8 per cent in 1953 to 11.8 per cent in 1973, then to 4.8 per cent in 1988 (Pigott 1994). Seven or eight fires, a relatively moderate fire frequency for the reserve, were associated with Tuart and Tuart/Banksia woodland in the west and south of the reserve (Fig. 2 and Fig. 4). These fires, combined with other factors such as insect prediction, have caused sufficient crown scorch and bole damage during the period to be responsible for this decline.

Conclusions

Human disturbance and fire regimes

Past and present clearing practices have reduced areas of native vegetation available for conservation at the reserve. Lack of planning for development of utilities left a legacy of negative disturbance requiring attention and application of rehabilitation procedures. Since the implementation of a management plan in 1986, access has been restricted by fencing the reserve, tracks have been closed and rehabilitated and major tracks sealed for use as firebreaks and walk trails.

Increasing frequency of summer fires, from complete coverage to a mosaic of smaller fires, and shorter fire-free periods have posed a major problem of control for the community and management authorities. A prediction made that a fire could occur every five years in most parts of the reserve has serious implications for fire protection of the bushland and component species as well as for adjoining houses. At present the policy of fire exclusion in the reserve recommended by the current management plan is successful, due to a volunteer fire warning system and prompt fire control by local fire brigades. However, the threat of a serious fire such as occurred in 1985 remains.

Impacts on vegetation

Five plant community types were classified floristically and mapped for the reserve. Despite altered fire regimes and the invasion of exotic species, native resprouters remain important components of the remnant bushland. Two important tree species, *Banksia prionotes* and *Eucalytus gomphocephala*, have been negatively affected by altered fire regimes, but improved fire protection and planting of seedlings will allow these species to regenerate and sustain their populations.

To restore the conservation values to urban reserves such as Star Swamp Bushland requires a management plan as well as community support. Various programs since 1986, such as restricting access, building sealed firebreaks and controlling flammable grasses with herbicides, have significantly reduced the likelihood and subsequent spread of wildfires at the reserve.

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1 Mr Brian Wilkins is a parks and natural areas superviser with the City of Stirling.