PROCEEDINGS OF A SEMINAR HELD ON 20 SEPTEMBER 1983

BY THE DEPARTMENT OF FISHERIES AND WILDLIFE

THE MANAGEMENT OF SMALL BUSH AREAS

IN THE

PERTH METROPOLITAN REGION

EDITED BY

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We are particularly grateful to Margaret Pieroni for designing and drawing the cover to these proceedings.

INTRODUCTION

The idea of a one-day seminar on the management of small bush areas in the Perth Metropolitan region grew out of the need to bring together ideas and discuss the management problems of small bush areas. The Department of Fisheries and Wildlife is playing an increasing role in this area, particularly as an advisory organisation. Thus, the seminar and these proceedings provide an ideal opportunity for the dissemination of information. A seminar was also needed to highlight that planned, active management, is vital for the survival of small bush areas in an urban setting.

The audience came from a diversity of backgrounds - government departments, local government authorities, conservation groups, members of tertiary institutions and interested members of the public. The seminar program was comprehensive, based on 22 papers, varying in length from 10 to 20 minutes. Speakers were drawn from a similar diversity of backgrounds.

A wide range of topics was covered during the day's proceedings. The day began with a description of the region's flora and its associated fire risk, with Kings Park being used as an example. Following this, management of bush in the Metropolitan area was discussed by members of the National Parks Authority, Fisheries and Wildlife, tertiary institutions and conservation groups. The need for planning, in terms of capability assessment, landscaping and town planning was discussed. Small animals, particulary birds, were considered as an important component. The need for regional planning, planning for individual reserves and continuing management concluded the seminar.

The day's proceedings served to emphasise and re-emphasise two important points. First, such a venue for information exchange had long been needed. Second, acquisiton or reservation of an area for conservation must be accompanied by the preparation and implementation of a management plan.

Susan A. Moore 1984

FLORA OF THE PERTH REGION

N.G. Marchant
Botanist, W.A. Herbarium

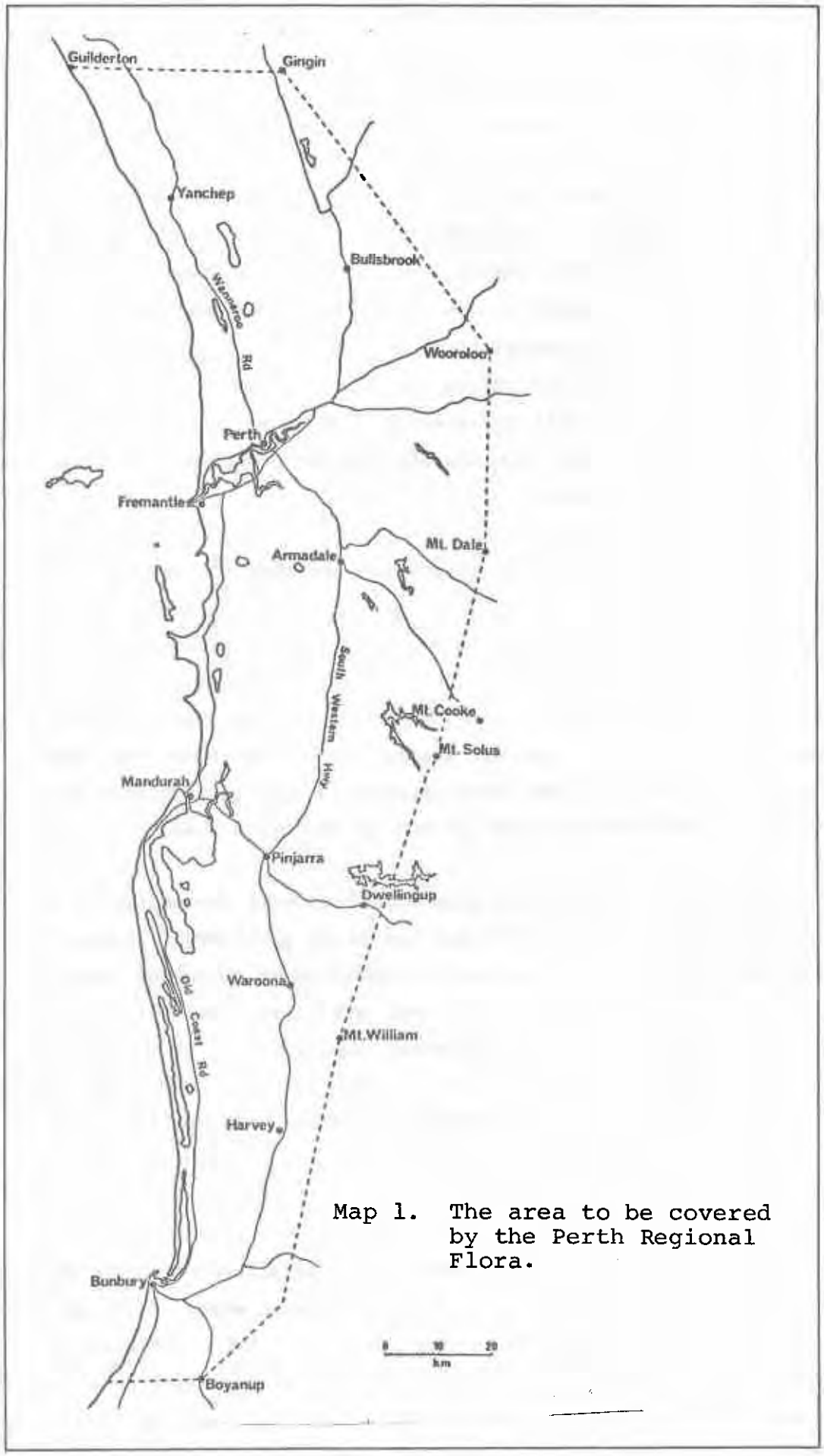
The Western Australian Herbarium is preparing a handbook to the vascular flora of the Perth Region. The area defined for this purpose encompasses the entire Perth metropolitan region and extends from Gingin in the north to south of Bunbury, a total of approximately 10 500 km^2 (Map 1). The region includes only the central part of the Swan Coastal Plain and a western portion of the northern Jarrah forest. The eastern boundary of the Region follows a more or less north-south line drawn between the highest points of the Darling Range; the western boundary follows the coastline, including the off-shore islands.

A total of 2 010 species in 153 families are recorded in the region. This includes 546 naturalised aliens which comprise 27% of the total flora. The high proportion of aliens is not surprising when one considers the amount of disturbance caused by urban as well as primary and industrial development which has occurred between Perth and Bunbury. Although species counts for other areas of similar size are not available, it seems that the number of native species (1 464) in the Perth Region is not particularly high in comparison with other areas of similar size in the South West.

Vegetation patterns of the Perth Region have been well documented by Seddon (1972), Heddle (1979), Beard (1979) and Heddle *et al*. (1980). Essentially, the vegetation of the Region consists of north-south trending zones which closely follow the geomorphological and soil patterns which in turn parallel the Darling Scarp. The geomorphology and geology of the Region have been described by Seddon (1972), Biggs *et al*. (1980) and Sappal (1983). The soils have been dealt with by Churchward and McArthur (1980).

Vegetation

The Swan Coastal Plain supports a number of vegetation complexes ranging from closed heath to open forest. There are extensive areas of Jarrah-Banksia -Sheoak woodlands on sandy soils and numerous small sedgelands and shrublands in winter-wet depressions. This latter habitat type, particularly in the case of those on the heavier soils near the Darling Scarp, are



Map 1. The area to be covered by the Perth Regional Flora.

species rich. There are no figures yet available for the number of species recorded on the Coastal Plain.

The Darling Scarp and Darling Range vegetation complexes occupy a greater range of habitats due to the varying rainfall, complex mosaic of soil types and varying soil depths. The vegetation of the Darling Scarp has been discussed by Heddle and Marchant (1983). In this area there are some woodlands of Wandoo and Marri on the younger, red soils and extensive heathlands associated with shallow soils. Herblands commonly occur on the granitic outcrops which are a feature of the Scarp.

Extensive areas of Jarrah forest occur on the lateritic soils of the Darling Range. There are only three tree species commonly encountered and only a total of approximately ten tree species for the whole Darling Range near Perth. There are many shrub species which constitute a dense, species rich, heath-like understorey.

Floristics

It is possible that 60-65% of the total number of species recorded for the Perth Region occur on the Coastal Plain and of these probably one-third are restricted to various habitats found only on the Plain but extending well north and south of Perth. There are few recorded examples of localised endemics on the Plain.

At least ten plant species are thought to be confined to various habitats along the Scarp (Heddle and Marchant 1983). Some of these are very restricted in distribution and others may occur more widely but have not been sufficiently collected.

Of the 153 plant families recorded for the Region, 35 families contain naturalised aliens only. Of the remaining families, the ones with the highest numbers of indigenous species are as follows:

Proteaceae	112	indigenous species
Myrtaceae	111	" "
Fabaceae	111	" "
Asteraceae	70	" "

These families are thus well represented in the Region and, although few figures are available, it is probable that they occur in the same proportion in the flora of other regions of the south west.

Approximately 667 genera occur in the Perth Region. The largest of these is Acacia with 51 species, representing aproximately 13% of the total W.A. species of the genus.

The number of species of Stylidium (Stylidiaceae), Schoenus (Cyperaceae) and Drosera (Droseraceae) on the other hand represent 32%, 56% and 50% respectively, of the total W.A. species in those genera. These figures probably indicate the frequency and species richness of the winter-wet depressions referred to earlier. They may, on the other hand, be the result of the more comprehensive and systematic collecting activities because of proximity to Perth.

In conclusion, the flora of the Perth Region is not exceptionally species rich in indigenous species despite great habitat diversity. In comparison, the naturalised alien flora is species rich which is an indication of the degree of habitat alienation, particuarly of the Swan Coastal Plain.

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THE BUSH FIRE RISK IN THE PERTH METROPOLITAN REGION

John Robley

Director, Bush Fires Board of Western Australia

The "fire season" for the Perth region extends over a 6 month period each year generally from November to April.

Typical of this season are hot days with moderate to low relative humidities, strong overnight and early morning easterly winds, and afternoon sea breezes from the west to south-west.

The most serious fire weather conditions occur with the easterly movement of low pressure troughs following periods of rising temperatures. In these circumstances winds back from the north-east to the north-west and strengthen, and there is associated atmospheric instability giving rise to thunderstorms, lightning and erratic fire behaviour.

During a typical summer there will be approximately 110 days of high fire danger, 26 days of very high fire danger and 3 to 5 days of extreme fire danger.

On days where the fire weather forecast is Very High or Extreme there is a total ban on the lighting of fires in the open air, this includes barbecue and picnic fires.

Occasional "blow up" days occur such as those experienced during the passage of cyclone Alby in April 1977, when fire danger conditions exceeded the scale of 1 to 100 on the McArthur fire danger meter.

Annual drought (moisture deficiency) factors calculated on the Mount Soil dryness index reach an upper level of 1700 in most years and the maximum of 2000 on the index was reached in 1983.

In a summer climate such as this, vegetation reaches a peak of flammability by December in most years and maintains this condition until significant autumn rains are experienced.

Administration of fire hazard reduction rules and the formation, equipping

and maintenance of volunteer bush fire brigades is vested in local authorities.

The Bush Fires Board assists with the co-ordination of fire hazard reduction schemes, training bush fire brigades and provides an administrative, liaison and advisory service.

Within the Perth metropolitan fire district the West Australian Fire Brigades Board provides for fire protection, while within State Forests this reponsibility is vested in the Conservator of Forests.

Despite determined efforts to overcome the fire problems in the area controlled by bush fire brigades, the number of fires attended annually continues to increase.

In 1976 volunteer brigades in this area attended 192 fires and by 1983 this has risen to 1 000.

Over the same period however, the average size attained by fires has reduced from 17.25 ha to 6.6 ha.

The increase in the number of fires attended can be largely attributed to a continuing shift in the population towards the suburbs and the popularity of a "rural zone" lifestyle. The reduction in size the fires reach before they are suppressed can be related to an actively maintained fuel reduction and strategic firebreak construction programme covering areas of defined high fire risk.

This latter programme was fully vindicated during 1978 when fires associated with cyclone "Alby" were contained with little significant damage and no loss of life despite weather conditions which approximated to those of the 1983 "Ash Wednesday" fires in Victoria and South Australia.

The causes of fires have varied little over recent years, the most significant being escapes of fire from burning off and rubbish disposal (30%), deliberate lighting - arson (30%) and escapes from previous fires, children playing with matches and operation of plant and machinery accounting for a further 23%.

Under extreme fire weather conditions however, when fires are the most difficult to contain, fires associated with lightning and power lines assume a significant importance.

Given the weather conditions which prevail in this area each summer and fire causes which are very difficult to control, the sole technique available to the bush fire organisation to reduce the damage which fires may cause lies in fuel reduction and firebreak construction.

The legal basis for this fire management work is contained in Section 33 of the Bush Fires Act which authorises local authorities to require owners or occupiers of land to construct firebreaks and/or remove fire hazards as specified in by-laws or a notice. These requirements however, do not bind the Crown.

Despite the general success of these requirements there is an obvious need to co-ordinate measures between local authority areas, to include within the management scheme government lands not covered by the notices and to prepare special provisions covering areas of defined high fire risk.

The Bush Fires Board has assumed this latter responsibility and formulated a fire protection plan covering the area. This plan relates to the areas of special high fire risk determined on the basis of known frequent fire occurrence, steep or rugged terrain, poor access for fire fighting and a mixture of bush areas and housing development.

These areas were defined in conjunction with local authorities.

Within these areas fire protection measures call for the construction of strategically located firebreaks and access for firefighting, fuel reduction in bush areas and the isolation, by cultivated or burnt breaks, of known fire sources such as barbecue and picnic sites.

Fire protection measures are designed to relate to the risk perceived rather than the category of land ownership.

Funding of these works is the responsibility of the landholders concerned, although a significant proportion of the work is carried out free of charge by volunteer brigades.

In all cases the management objectives of parties concerned are given due recognition and priority and the resulting plans are a compromise between the management objectives and the fire protection requirements of the community.

In the case of fuel reduction the aim is to maintain a maximum fuel loading of 6 tonnes per hectare which from experience is the maximum loading that can be handled by a brigade on a normal summer day.

Fuel reduction is programmed so that at no time does more than 20% of the overall area support fuels to the maximum loading and a mosaic of loadings from 0-6 tonnes/hectare is maintained. Depending on the vegetation found on the bush areas this represents a burning rotation of between 5 and 7 years.

Each season the burning and firebreak programme is discussed with the landholders by officers of the Bush Fires Board and burning prescriptions prepared specifying the season, fire intensity, lighting pattern and associated constraints which will apply.

Subsequent to the burns the areas are inspected and details of the burn recorded on fuel quantity maps.

The system allows for proper planning, consultation, execution and recording of the work; and to date has received a high degree of co-operation.

Those concerned in these schemes, in addition to private landholders, include the National Parks Authority, Forests Department, Metropolitan Region Planning Authority and various local authorities.

All concerned with the planning and implementation of these schemes are sensitive to the fact that there is a need to preserve the character of the environment in the region. Plans are therefore executed with a great deal of care and consultation. At the same time there is an absolute requirement to protect people, their homes and the environment itself from the devastating effects of bush fires.

The Bush Fires Board is happy to advise individuals and authorities on the

operation of these schemes and the measures which should be taken to protect bushland areas.

PEOPLE, FIRE AND WEEDS: CAN THE VICIOUS SPIRAL BE BROKEN?

Paul Wycherley
Director, Kings Park and Botanic Garden

Kings Park was set aside (in the planning sense) for public purposes in January 1831, but not until 1872 and 1890 were the main areas, approximating to the present 400 ha, gazetted as parkland for recreation. Meanwhile most of the usable jarrah timber was cut and probably large amounts of firewood and kindling, especially blackboys, were removed. However, the most serious problems in the management of the two-thirds of Kings Park which is still native bushland, have arisen during this century. One of the most serious problems is the invasion of the Park by perennial veldt grass (Ehrharta calycina). It is not known precisely when and how this grass was first introduced into Kings Park and other reserves in the Perth area. It may have been accidental due to its use as a packing material, or deliberate as a potentially useful agricultural species. Leonard Titshall, an employee of Kings Park Board from 1927 to 1968, states that veldt grass was encouraged as a source of revenue, because it was sold as fodder for horses stabled in Perth until the early 1930's, whereafter it was recognised as a competitive weed. Although veldt grass is the most obvious and probably the most damaging of the introduced plants naturalised in Kings Park, there are nearly fifty others such as Briza, Gladiolus, Homeria, Oxalis, Romulea and Watsonia.

Bushfires have also ravaged the bushland periodically, fragmentary records report extensive areas burnt, namely 240 ha (which is more than half the park) on 3 February 1933, 23 ha on 6 February 1939, 16 ha on 3 January 1941 and 100 ha three weeks later. Relatively complete and detailed records have been kept since November 1944, when a programme of fuel reduction control burns was introduced. Initially 250 ha was burnt in the first year and areas varying between 40 and 280 ha were so burnt each year up to 1962. It was intended to burn about one quarter of the bushland (approximately 100 ha) each year on a four year cycle, but various factors including involuntary fires upset the programme. After 1962 a policy of fire exclusion was tried until 1974, when a modified system of less frequent and extensive control burning was introduced.

Figures 1A, 1B and 1C, 2, 4 and 5 illustrate graphically the main

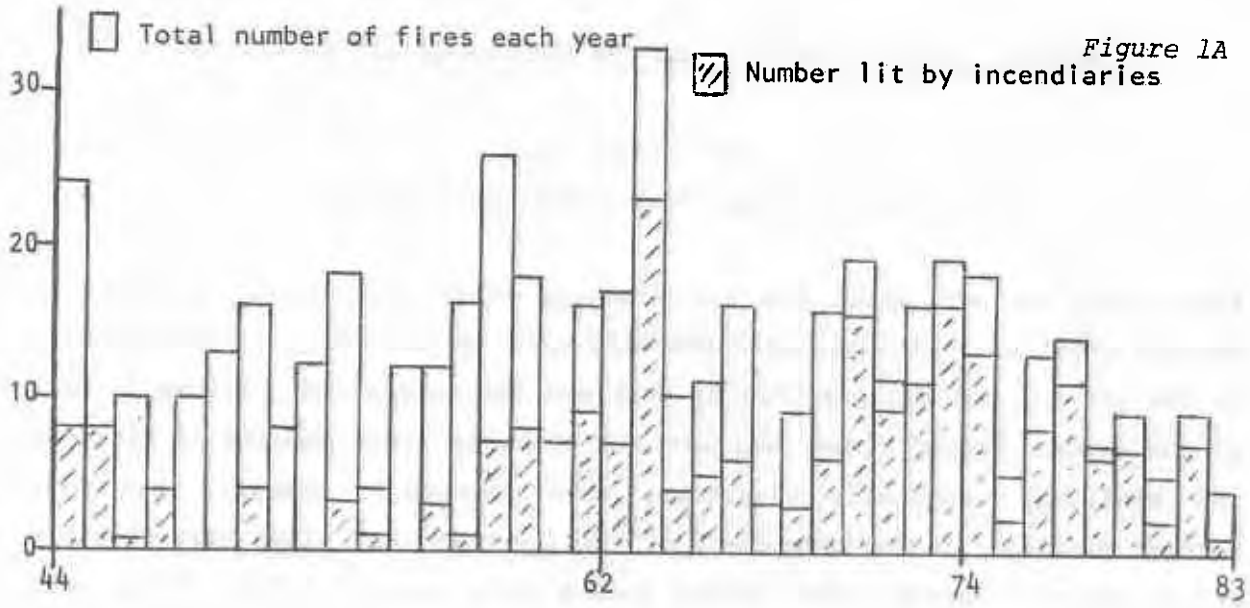


Figure 1A

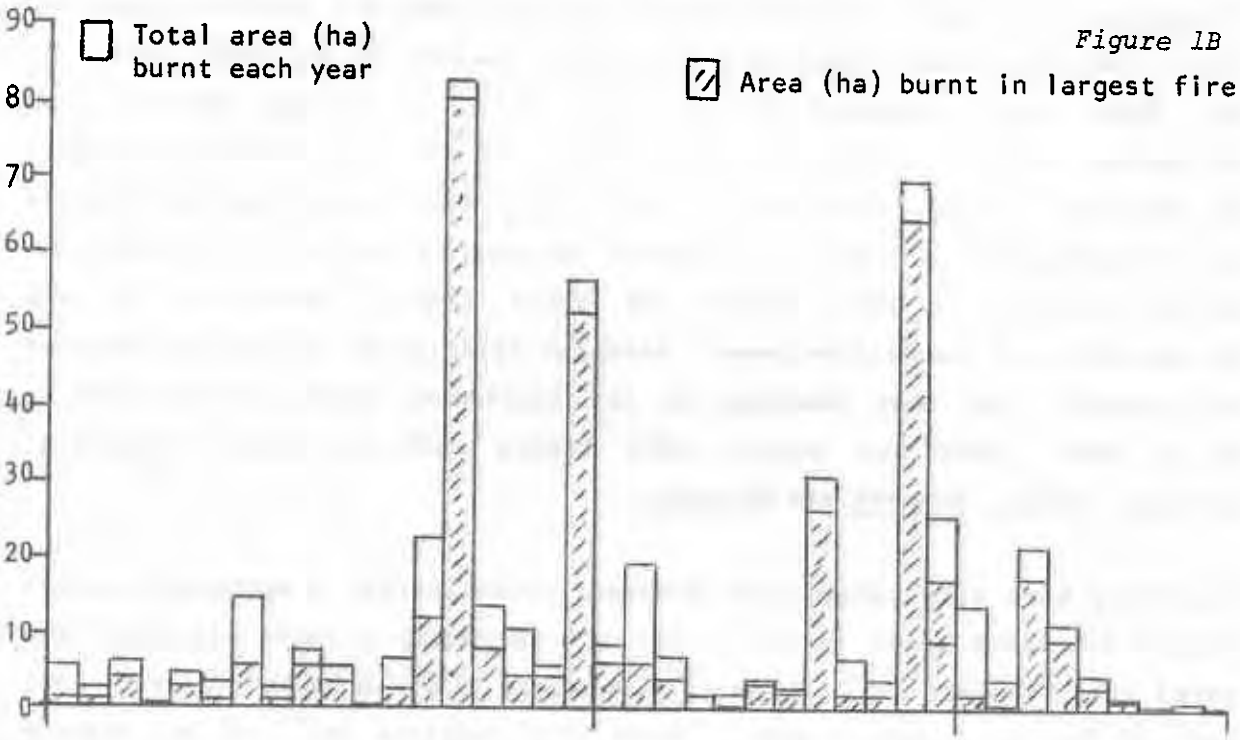


Figure 1B

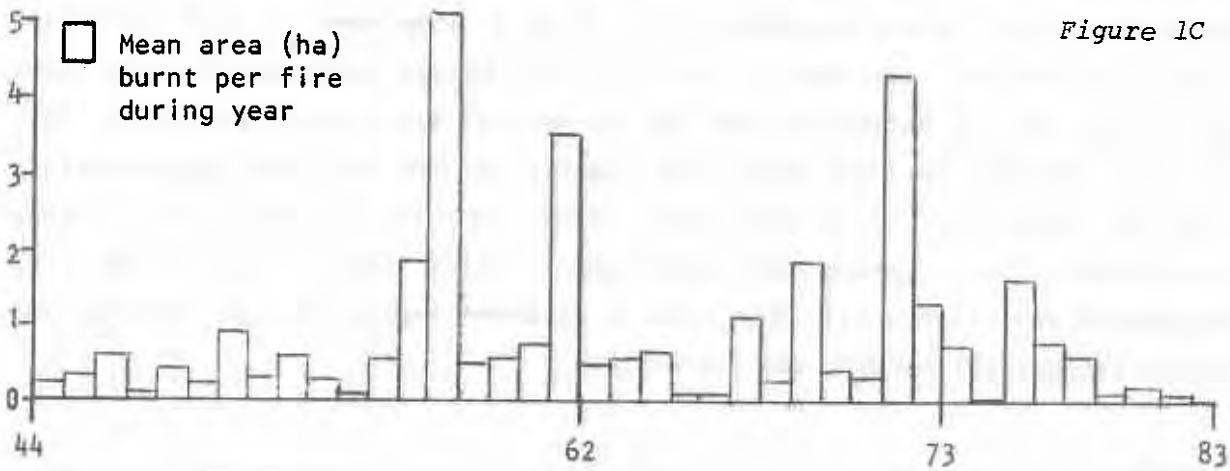


Figure 1C

Figure 2

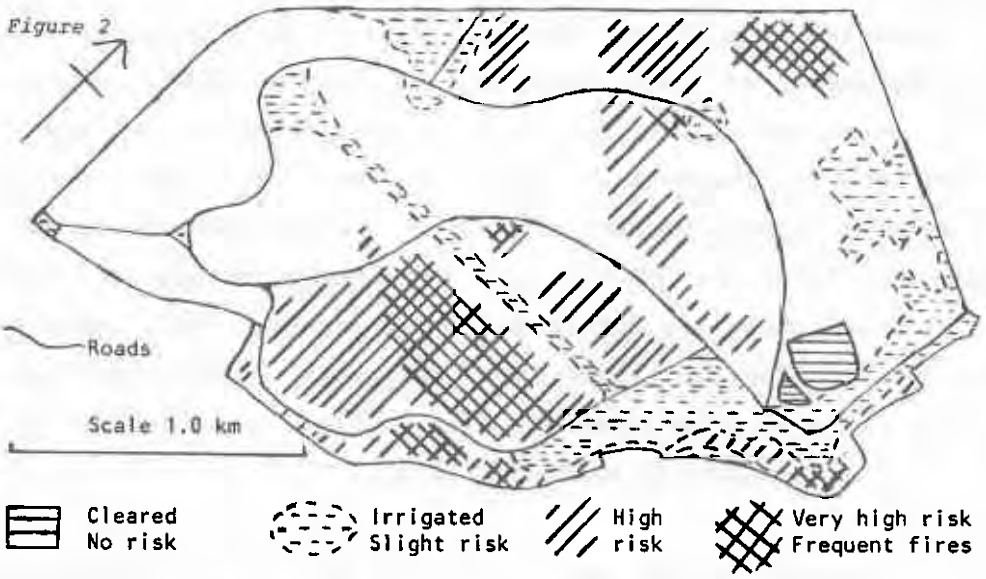


Figure 3

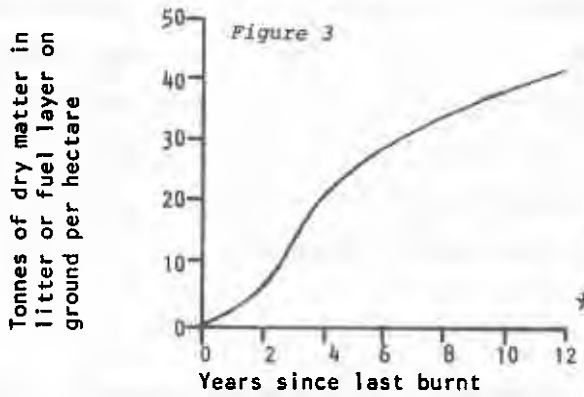


Figure 4

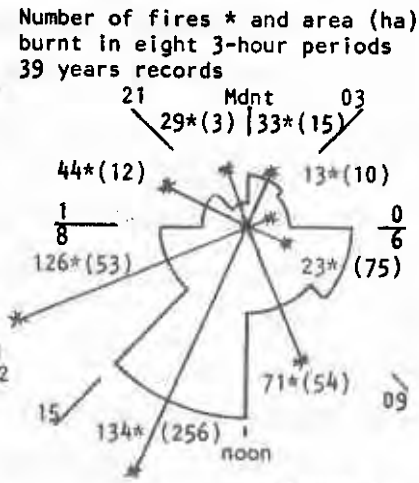
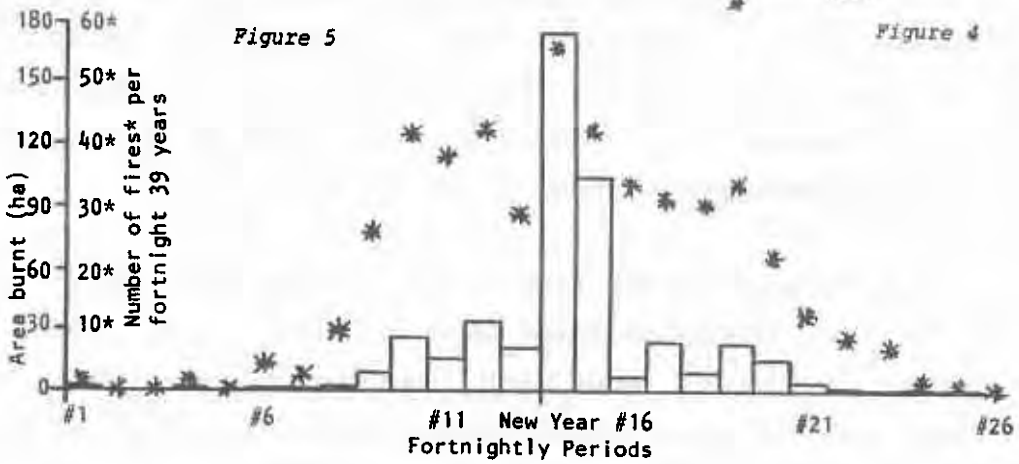


Figure 5



components of the records for the 39 fire seasons commencing with that for 1944/45 and concluding with that just ended, namely 1982/83. The years entered on the horizontal axis of Figures 1A, B and C correspond to changes in policy, especially in 1944, 1962 and 1974. No consistent trend is evident in the number of fires each year or in the number or proportion attributed to incendiaries (Figure 1A). The area burnt in the largest fire forms a considerable component of the total area burnt each year, which displays a somewhat cyclic pattern (Figure 1B), especially if the extensive areas prescribed burnt in 1944/45 and immediately subsequent years are taken into account (these are not shown in the figures, which refer only to involuntary fires). The cyclic pattern might merely reflect the time taken to build up (Figure 3) a critically dangerous fuel load in those portions of the park more susceptible to bushfires (Figure 2).

The physical character of the park has been modified during the period under review, for example the Botanic Gardens along the scarp and the 'Vista' transecting the park, both of low fire risk, have been added since 1962. At the same time the manpower and equipment available for fire fighting have been upgraded. The susceptibility to fire is mainly a matter of topography, steep slopes and exposure to wind, although in the northern corner of the park social factors over-ride to impose an exceptionally high frequency of fires.

The rate of accumulation of fuel (Figure 3) is alarmingly rapid. There is definitely a dangerous situation within four years of the last burn, whether deliberate or unintentional. This may be due to prevalence of Sheoak in the tree understorey and almost certainly to the dominance of veldt grass in the ground cover, both of which help fire to spread rapidly. Figure 1C shows the average area burnt in each fire.

The data permits analysis of the records according to year, date, day of the week, hour of the day and supposed cause of fire. Figure 4 shows that the most damage, or largest area burnt, was due to fires which began between 12 noon and 1500 hours (3 pm), these totalled 28% of all fires and contributed 54% to the area burnt. The number of fires and total area burnt in each 14 day period during the 39 years are given in Figure 5, both peak in fortnight No. 14, that is the first half of January. However, whereas the curve for number of fires plateaus from November to March, the total area burnt, and also the average area burnt per fire, displays a much

sharper peak in January alone. The high fire danger in January and in the early afternoon conforms with general experience.

These severe summer bushfires damage the tree canopy and destroy tree seedlings and shrubs. Consequently more light penetrates both vertically and laterally, which encourages strong regeneration of veldt grass from underground rhizomes, and root competition with the trees for moisture and nutrients, so depressing the restoration of the tree canopy. It is unlikely that any method of veldt grass reduction or control, for example by herbicides, will achieve broad scale, long term success unless the tree and shrub cover can be restored and maintained.

The responses of individual native species to veldt grass competition and the frequency, intensity and season of burning vary. Red and Green Kangaroo Paw (Anigozanthos manglesii) and Sea Crest (Helichrysum cordatum) seem to be relatively little affected by veldt grass and to respond favourably to more frequent burning. Milkmaids (Burchardia umbellata) and Conostylis aculeata are respectively slightly depressed and slightly favoured by frequent burning, but both are depressed by veldt grass competition. The Yellow Buttercup (Hibbertia hypericoides) has a very low reproductive capacity by seed and depends for its survival in nature on the individual plant's longevity which may be as much as a century; it seems to be scarsely affected by fire, but to be sensitive to veldt grass competition and to respond very adversely to trampling, mowing or other physical disturbance.

Orchids such as Cowslip Orchid (Caladenia flava) and Pterostylis species present a paradox in relation to fire, flowering specimens are more visible in recently burnt areas, but their populations decline in more frequently burnt areas, presumably due to burning of the tubers and loss of sub-surface mould. Superficially orchids do not seem to be affected by veldt grass competition over the range studied, but this may be because they are so sensitive that any grass invasion is detrimental. Prickly Moses (Acacia pulchella), which is important in Kings Park as it provides protective cover against feral cats, for the nesting of small birds, requires fairly hot fires at intervals of five or more years. Some species such as Ribbed Hakea (Hakea costata) are seldom seen except after severe burns.

Overall the native flora is adversely affected by veldt grass competition.

Veldt grass increases the rate at which dangerous fuel loads build up and the rate at which wildfires spread. In the absence of veldt grass severe bushfires have various natural effects, adverse and beneficial, on the different components of the native flora and their interactions, but where there is veldt grass severe wild fires are cumulatively detrimental. These fires increase veldt grass competition and dominance through the destruction of the tree canopy and suppression of tree and shrub regeneration. People who light fires, accidentally or deliberately, complete the vicious spiral.

When the known causes of the Kings Park bushfires are examined, none is found to be due to natural causes such as lightning or spontaneous combustion. There may be such cases among those whose cause could not be identified, however as far as can be determined all the fires considered in this review were lit by people either accidentally or deliberately, the latter being classified as incendiaries. The following table classifies, by cause, the bushfires in Kings Park over the last 39 years.

CAUSE	TOTAL AREA BURNT (ha)	NO. OF FIRES	MEAN AREA	LARGEST AREA
INCENDIARIES	351	208	1.69	80.0
	(73)	(42)	(172)	(100.0)
UNKNOWN	69	136	0.51	26.0
	(14)	(28)	(52)	(32.5)
SMOKERS	32	87	0.37	6.0
	(7)	(18)	(37)	(7.5)
VARIOUS*	30	59	0.51	8.4
	(6)	(12)	(52)	(10.5)
ALL	482	494	0.98	80.0
	(100)	(100)	(100)	(100.0)

*Campers, drunks, children, fireworks, escapes from control or rubbish fires, etc.

When several fires have been lit simultaneously or traces of the means of lighting the fire survive, there is little doubt that an incendiary was the cause. Most incendiaries presumably intend their fires to burn and therefore light fires so that they are not likely to be detected, do not report their fires or try to put them out. Incendiaries may be motivated by malice, pyromania or a belief that burning is good for the bush or will drive out snakes and undesirables. Apart from being the largest single cause, fires lit by incendiaries do the most damage, especially in area burnt. By contrast fires lit accidentally by smokers are usually promptly reported and efforts made by the causal party to put them out.

While we cannot afford to ignore any cause of fire or neglect any precautions, we must pay special attention to the incendiary during periods of high fire risk. While recognising the need to prescribe fire to manage the vegetation for positive purposes as well as protection, so powerful and dangerous a tool cannot be allowed to pass into the wrong hands. Parks are for people and Kings Park is freely open to the public at all times. Thus there is neither the intention nor prospect of excluding people. Perhaps the influence of incendiaries on the vicious spiral may be controlled by encouraging more people to use the Park more extensively, and thereby exercise surveillance over each other. Therefore access by dual use pedestrian and cycle paths is being improved. Educational and interpretative programmes have been initiated to make the bushland more attractive, understandable and enjoyable and to so motivate people to visit it and protect it.

OBSERVATIONS IN KINGS PARK

Alison Baird
Botanist

Sampling of Vegetation

Quantitative work by students in the Park was initiated by Dr Armstrong in 1936. Quadrats 6 yds x 6 yds were pegged out and mapped and were then re-mapped at intervals over succeeding years. Other quadrats were put down during the next few years. Some of these permanent quadrats were destroyed or lost, but a few lasted for 30 years or more.

Information from these showed:

A. The long persistence of the common small shrubs, such as Hibbertia, Daviesia, Oxylobium, Sterlingia, and some of the sedge clumps. The shrubs were burnt off several times but sprouted and regained their former size. The changes in size over 30 years were very small.

B. The entry and increase of veldt grass in the quadrats.

Other sampling of the vegetation was done by students, particularly during the 1950s, and considerable data was accumulated on the distribution and abundance of species. Distribution of veldt grass was also recorded. This sampling was done in the south-west half of the bush area of Kings Park.

Veldt grass was thought to have come into the Park through the university grounds and by 1939 it was well established in the open Tuart sites at the top of Lowkin Drive. By 1955, after two fires in 1939 and 1952, it had become very dense. The grass spread along firebreaks - the edges of ploughed firebreaks are particularly favourable for veldt grass germination - and from these firebreaks into the adjacent bush, particularly after fires. Establishment of veldt grass was, and still is, easier in open Tuart than in the denser Banksia-Casuarina stands.

Regeneration of the undergrowth after fire

This has been one of my special interests and notes and photographs have

been taken after particular fires. Almost all of the low shrub species, the wing monocots and Xanthorrhoeas and Macrozamias sprout vigorously; these are all shrubs with multiple shoots from woody rootstocks. This growth is rapid compared with the slow growth in unburnt bush and flowering is particularly good in the second, third and fourth years following the fire. In long unburnt bush the plants become very straggly, they are often insect infested, and may become partly smothered by fallen leaves, particularly under Casuarina.

The few species which are killed by fire - the tall shrubs Conospermum (Smoke Bush), Adenanthos (Woolly Bush) and Dryandra, each in rather restricted areas, with the widespread Acacia pulchella (Prickly Moses), also the Pimelea rosea (Rose Banjine) and the small Gompholobium tomentosum - all regenerate freely from seed. Two species which are killed, but which produce very few seedlings, are the tall handsome heath Leucopogon racemulosus and the purple Calytrix fraseri (Summer Fringe-Myrtle). These have become almost extinct in the western areas.

Fire stimulates flowering in some species, such as Xanthorrhoea and Sterlingia. Herbaceous species usually flower better with the shrub competition reduced by fire, due to the increased availability of light and nutrients from the ash. The most striking fire weed is the annual spear grass Stipa compressa, which is very conspicuous with its long golden awns, abundant after, and completely absent between fires.

The season of burn alters the sequence of the regeneration. Autumn burns favour the herbaceous species which have plenty of bare ground for seed germination or growth from corms or tubers, before the shrub cover is re-established. Unfortunately it is not only the native species which are aided but also the veldt grass, Gladiolus and Cape Tulip, which are much larger and more aggressive than the native herbs. Spring burns are more suitable as they give the shrubs time to become well established before the winter rains and the accompanying growth of herbs.

On the other hand, seedlings of native species are favoured by summer or autumn burns. Spring burns may however endanger nesting birds. Therefore selection of a burning regime is dependent on management priorities.

It is well known that summer wildfires severely damage adult trees and kill

saplings, whereas mild control burns do minimal damage. One of the former Directors of Kings Park, Dr Watson, had a policy of control burns in small areas, and this provided protection against wildfires. Magnificent displays of wildflowers resulted, but this was before the advent of veldt grass. Tree deterioration, particulary of the Tuart-Jarrah woodland, has been discussed in a paper by Dr Beard in 1967 and by Dr Wycherly in his paper today. Casuarinas are very badly damaged by fire. However, they do survive, albeit in a mutilated condition with hollowed out trunks, poor canopy and low foliage (which suppresses undergrowth and increases the fire hazard). Banksias appear to be the least damaged by fire.

Conclusion

The flowering undergrowth, with its low shrubs, Blackboys and sedges, is very stable, as it is composed of long lived slow growing plants well adapted to periodic fires (if these are not too frequent or intense). Providing the canopy or shrub cover is dense veldt grass does not penetrate easily. However, now that the seed is widely distributed any fire or similar disturbance will encourage its further spread.

In conclusion, anyone involved in ecology soon realises that there are no easy answers to the problems of complex vegetation associations faced with disturbance. Every association, in fact every species, behaves differently in response to fire, drought, competition and disturbance. Thus, what is good for one species may be bad for another.

More detail on the above topic is given in a paper in the Journal of the Royal Society of W.A. (1972).

NATIONAL PARK MANAGEMENT

Colin Sanders
Director, National Parks Authority of WA

INTRODUCTION

National parks are on the whole, superior elements of the landscape and of the biological system of a particular region.

In this regard they are usually large areas which are both scenically attractive, and contain a self-sustaining ecosystem. Moreover, national parks are a natural heritage conserved and presented for the community's recreational enjoyment and inspiration.

In this regard national parks are generally larger and more diverse reserves than most small bush areas in the Perth Metropolitan Region. However, it is worth setting national parks in context with these smaller areas.

The State's 65 national parks and reserves, vested in the National Parks Authority, are areas of significant scenic grandeur and they possess many attributes attractive to tourists. Last year 1.1 million people visited them and in this respect the national park system provides a major tourist drawcard.

HISTORY OF NATIONAL PARKS

The world's first national park was established in 1872 at Yellowstone in USA. It was recognised at that time that Yellowstone was a region which exhibited very high scenic attractions, as well as geological features and biological elements that were unique to the area and were not known (at that time), elsewhere in the United States, and in this regard they were of 'national' significance. Hence the title "National Park".

Australia set aside the world's second national park, the Royal National Park south of Sydney, in 1879. Moreover, soon afterward, NSW also reserved the third national park - Kuringai Chase, north of Sydney on the southern tributaries of the Hawkesbury River.

Western Australia was rather later, with national parks as such not being established until 1931 when Yanchep, which had been reserved since 1905 for Caves, Flora and Health, was declared a national park. A few other so-called national parks in the wider Metropolitan Region were set aside later, and tended to be small areas for parkland or recreation. These do not fall within present day criteria for national parks. These small reserves included John Forrest, Lesmurdie Falls, Gooseberry Hill, Kalamunda, Serpentine and Walyunga National Parks.

With respect to international criteria relating to national parks - the International Union for Conservation of Nature and Natural Resources (which is a division of UNESCO), established a definition of national parks in 1969, which embraces to varying degrees, the many national parks of this State.

> "A National Park is a relatively large area (1) where one or several ecosystems are not materially altered by human exploitation and occupation, where plant and animal species, geomorphological sites and habitats are of special scientific, educative and recreative interest or which contains a natural landscape of great beauty and (2) where the highest competent authority of the country has taken steps to prevent or to eliminate as soon as possible exploitation or occupation in the whole area and to enforce effectively the respect of ecological, geomorphological or aesthetic features which have led to its establishment and (3) where visitors are allowed to enter, under special conditions, for inspirational, educative, cultural and recreative purposes."

In respect of Western Australia, the National Parks Authority has published its Management Policies which note that national parks in this State, inter alia, should meet the following criteria. They should be:

a) spacious areas, outstandingly superior in natural qualities and beauty;

b) large enough to permit appropriate public use and enjoyment together with the continuous and effective management of the plant and animal communities;

c) capable of management permitting a wide range of opportunities for non-urban enjoyment, such activities being subject to the over-riding necessity to preserve the natural features;

d) containing a diversity of natural resources, including fine scenery and features of scientific interest, and

e) having sufficiently low boundary length to area ratio to withstand the deleterious effects of incompatible neighbouring land use.

Moreover, the Management Policies observe that ...

> "the purpose of National Parks is to preserve for all time, scenic beauty, wilderness, native wildlife, indigenous plant life and areas of scientific importance, while also providing for the appreciation and enjoyment of these things by the public in such ways and by such means as will leave them for future generations as little impaired as possible."

In the mid 1950's, the Australian Academy of Science sought the views of the Australian scientific community on the adequacy of national parks and nature reserves in Australia. In Western Australia a sub-committee of the Australian Academy of Science, which included academics and government officers, was set up in 1958, to prepare a report on the need for reserves. The document was finalised in 1962, and discussed the desirability of an extended network of conservation reserves for Western Australia based on the existing structure. Other recommendations were made regarding land acquisition for future conservation reserves. Consequently, by the late 1960's and early 1970's, a number of large ecologically self-sustaining national parks were dedicated, including Cape Arid, Cape Range, Chichester Range, Drysdale River, Geikie Gorge, Hamersley Range, Watheroo and Windjana Gorge.

In 1972, one of the first actions of the newly established Environmental Protection Authority was to set up a Conservation Through Reserves Committee (CTRC). This Committee divided Western Australia into 12 demographic and geomorphological systems, and each of these was considered in respect of representative areas of land worthy of reservation. The terms of reference given to CTRC were 'to review and update the 1962

recommendations of a sub-committee of the Australian Academy of Science (WA) with respect to national parks and nature reserves of the State.'

Subsequently, the Environmental Protection Authority brought forward, in a series of three 'Red Books', its own recommendations for the establishment of national parks and nature reserves throughout Western Australia. The System 6 area which embraces the greater Metropolitan Region has yet to be reported on by that Authority. (Released May 1984 - editor's note)

MANAGEMENT OF NATIONAL PARKS

The National Parks Authority Act requires the Authority to develop guidelines for the operation and conservation of its national parks. In this regard, policies have been established that are framed to:

a) conserve the natural environment, preserve and enhance natural beauty;

b) control and manage, maintain, study, care and restore the natural environment;

c) provide and maintain access and facilities for public recreation and utilisation whereby the community can enjoy the beauty of the natural environment;

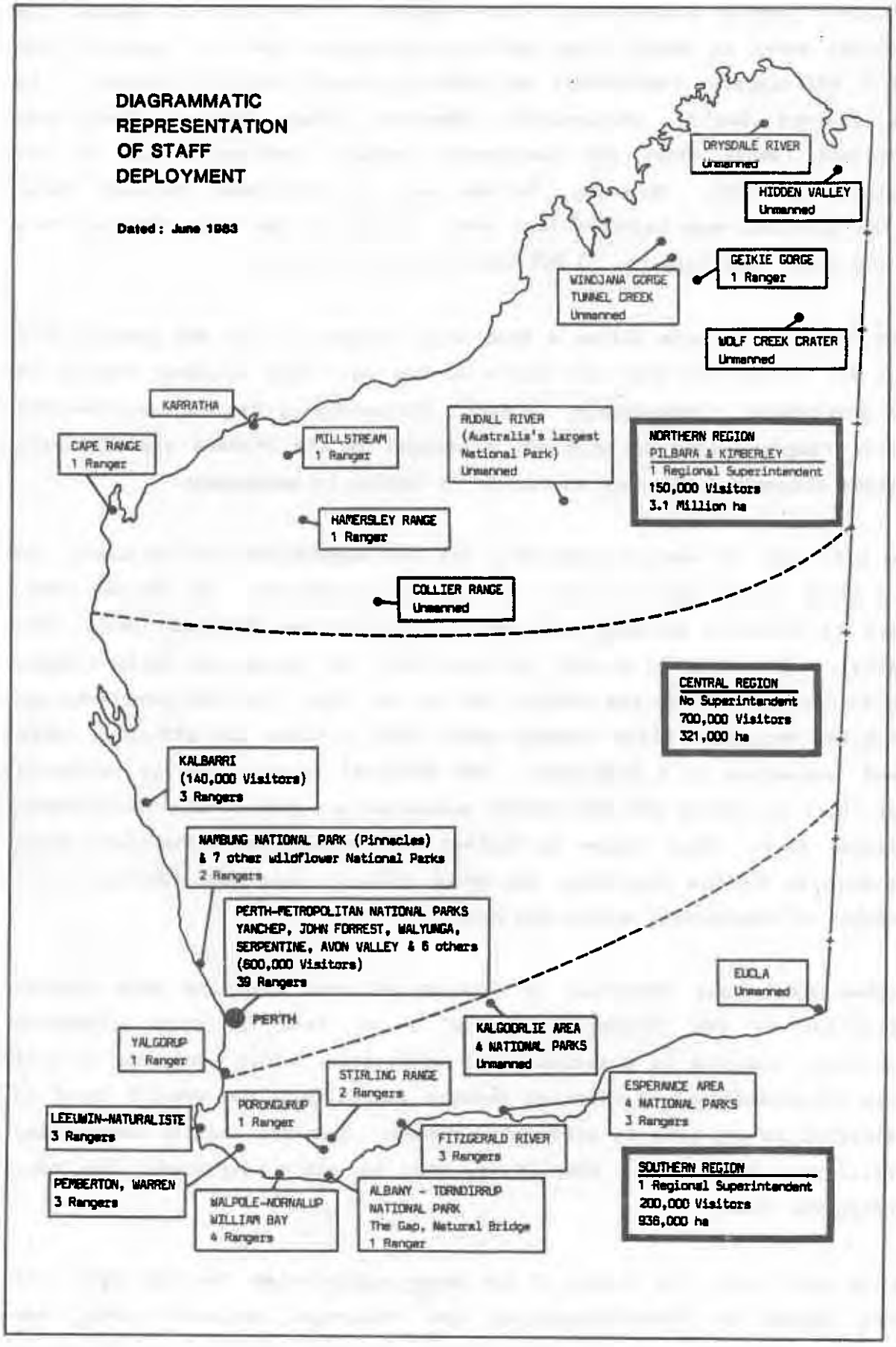
d) plan and control recreation and utilisation to be compatible with the preservation of the natural environment, and

e) provide information services and educate the community in relation to the use and enjoyment of the facilities available, and to the understanding and appreciation of the natural features.

However, because the State is so large with many remote regions, the Authority has great difficulty in fulfilling these criteria.

If we examine the parks near Perth which are regionally linked to the Metropolitan small bush reserves, we can demonstrate that about 600 000 people per year use our various recreational areas (see diagram).

Elsewhere in the State, tourist demands are not as high, but they are


DIAGRAMMATIC REPRESENTATION OF STAFF DEPLOYMENT
Dated : June 1983
DRYSDALE RIVER
Unmanned
HIDDEN VALLEY
Unmanned
GEIKIE GORGE
1 Ranger
WINDJANA GORGE
TUNNEL CREEK
Unmanned
WOLF CREEK CRATER
Unmanned
KARRATHA
CAPE RANGE
1 Ranger
MILLSTREAM
1 Ranger
RUDALL RIVER
(Australia's largest
National Park)
Unmanned
NORTHERN REGION
PILBARA & KIMBERLEY
1 Regional Superintendent
150,000 Visitors
3.1 Million ha
HAMERSLEY RANGE
1 Ranger
COLLIER RANGE
Unmanned
CENTRAL REGION
No Superintendent
700,000 Visitors
321,000 ha
KALBARRI
(140,000 Visitors)
3 Rangers
NAMBUNG NATIONAL PARK (Pinnacles)
& 7 other wildflower National Parks
2 Rangers
PERTH-METROPOLITAN NATIONAL PARKS
YANCHEP, JOHN FORREST, WALYUNGA,
SERPENTINE, AVON VALLEY & 6 others
(600,000 Visitors)
39 Rangers
EUCLA
Unmanned
PERTH
KALGOORLIE AREA
4 NATIONAL PARKS
Unmanned
YALGORUP
1 Ranger
STIRLING RANGE
2 Rangers
PORONGURUP
1 Ranger
ESPERANCE AREA
4 NATIONAL PARKS
3 Rangers
LEEUWIN-NATURALISTE
3 Rangers
FITZGERALD RIVER
3 Rangers
SOUTHERN REGION
1 Regional Superintendent
200,000 Visitors
936,000 ha
PEMBERTON, WARREN
3 Rangers
WALPOLE-NORNALUP
WILLIAM BAY
4 Rangers
ALBANY - TORNDIRRUP
NATIONAL PARK
The Gap, Natural Bridge
1 Ranger

certainly locally concentrated. For example, in the Kimberley Region, the national parks at Geikie Gorge and Windjana Gorge cater for about 15 000 and 4 000 campers respectively per tourist season (April to October). In the Pilbara Region, particularly Hamersley Range National Park near Wittenoom (where there are spectacular gorges) tourism reached 36 000 visitors in 1982. Moreover, further west at Millstream National Park, 18 000 tourists were recorded last year, whilst at Cape Range National Park on the coast near Exmouth, 23 000 visitors were recorded.

This level of tourism places a meaurable pressure on the NPA particularly when it is realised that the Authority has only four resident rangers in the North-West. Fortunately, however, the Authority has 13 caravan-based mobile rangers, some of whom are stationed in the Pilbara and Kimberely Regions throughout the tourist season, to assist in management.

The mid-coast of Western Australia has the magnificence of Kalbarri, an area which offers the visitor a variety of attractions. On the one hand, there is Kalbarri National Park which includes the Murchison Gorge, the coastal heath which is a riot of wildflowers in spring and early summer, and the coastal cliffs and gorges; and on the other, the town overlooks the beautiful Murchison River estuary where both in-shore and off-shore water based recreation is a highlight. The National Parks Authority estimates that there are about 140 000 tourist movements per year within the Kalbarri National Park. This figure is derived from honour box collections which are made at various loalities, and which indicate that most tourists visit a number of attractions within the Park.

Farther south near Cervantes in Nambung National Park the main tourist attraction is the 'Pinnacles Desert' - an area of stark limestone structures standing in a barren sandy wilderness. This landscape is well known in promotional pictures of Western Australia. The overall level of visitation to the area is presently unknown. However, visitor numbers are sufficiently high for a tourist operator to run a successful bus tour through the area.

In the South West, the beauty of the Leeuwin-Naturaliste National Park, the Karri forest at Walpole-Nornalup and Pemberton National Parks, and Torndirrup National Park at Albany (which includes the Gap, the Blowholes and the Natural Bridge) are all well known and well visited. Additionally,

the mountainous and botanically rich Stirling Range and Porongurup National Parks have been favoured areas for tourism for many years, particularly during the wildflower season.

To the east is the Fitzgerald River National Park, between Bremer Bay and Ravensthorpe, where approximately 600 endemic species of flora have been recorded. This national park, like Kalbarri, combines the various elements of scenic grandeur of the coast and hinterland, with both the mountainous terrain of the Barren Ranges, and its biological richness as demonstrated by the superb flora.

In the Esperance region there are four national parks which are visited by tourists following the "Leeuwin Way". These are Stokes and Peak Charles National Parks near Munglinup, Cape Le Grand National Park east of Esperance and Cape Arid National Park a further 100 km eastward. Cape Le Grand is a major tourist attraction for the Esperance region where features of landform, flora and fauna and the coast are beautifully interrelated. The same can be said of Cape Arid National Park, south of Balladonia, which encompasses a large area including Mt Ragged.

The successful management of this diverse suite of national parks which are spread regionally, and which include a range of climates and an enormous diversity of land forms, as well as of flora and fauna, can only reasonably be met through the services of a dedicated ranger workforce. In this regard, the ranger is the backbone of operations and the interface with the public, assisting the visitor in his understanding of the environment as well as providing and maintaining facilities. In addition to these activities in public relations, the national park ranger assists in the scientific assessment of natural areas, as well as instituting appropriate fire management practices. As noted in other papers at this Seminar, Western Australian flora is sensitive to fire, either being stimulated by it or preferring long periods without. Either way, such flora exists in national parks, and a knowledge of these plants and of the history of fire in the area, is necessary for successful management.

Moreover, the National Parks Authority has a dual responsibility to protect its many parks from the ingress of fires onto the reserves, and an equally weighted responsibility to ensure that if fire starts in a park, that it does not escape onto private property. This is an awesome task to fulfil.

In consequence, the Authority has a large annual fire management budget for the purpose of constructing fire breaks, fire lines for control burns, and for the purchase of appropriate equipment. This budget, however, is inadequate for the task at hand.

In these respects, national park management is not dissimilar to that of small bush reserves, it is just on a much larger scale.

CONCLUSIONS

This paper has been put forward in an endeavour to place in context the differences and similarities between national parks per se and small bush reserves.

National Parks and small bush areas suffer the same problems and there is a real need to marshal sufficient management support to protect and conserve these areas, and yet at the same time provide opportunities for the community to discover and to enjoy their heritage.

MANAGEMENT OF NATIONAL PARKS IN THE PERTH METROPOLITAN REGION

Ron Waterhouse
Superintendent, John Forrest National Park

INTRODUCTION

There are nine national parks within the Perth Metropolitan region. These parks have a total area of 8 600 ha and range in size from Yanchep (approximately 3 000 ha) to Gooseberry Hill (33 ha). Five of these parks are subject to considerable visitor pressure with total visitor numbers of about 600 000. Thus, we have 1 200 000 feet tramping about in these parks each year, but there is more to park management than just feet.

MANAGEMENT PRINCIPLES AND PROBLEMS

Under the National Parks Authority Act, one function of the Authority is "to preserve and enhance the natural beauty of the State, and to provide and maintain facilities for the enjoyment of that beauty by the community."

When analysed, this creates problems for management. How does one enhance the natural beauty or provide facilities for the enjoyment of that beauty without affecting it? Any facility provided would normally mean the destruction of part of the environment in the immediate surrounds. The provision of roads, parking areas, walk trails, toilets and so on must be at the expense of the environment, either by physical location, or as a result of the use of that facility by the public. The physical aspect is largely under our control, as steps can be taken to minimise damage, but the use of the facility by the public, and the resulting damage is much harder to control. Factors such as litter and erosion quickly become apparent. The effect of fire and spread of dieback are much slower to show, but are nonetheless important.

How do we handle these present day management problems?

Firstly, today's management has inherited development, that is the layout and facilities of many years ago. This is particularly the case in Yanchep and John Forrest National Parks, and to a lesser extent in Walyunga, Serpentine and Lesmurdie. Greenmount, Gooseberry Hill, Kalamunda and

Neerabup are undeveloped as far as facilities for the public are concerned. Thus in the former parks it is the maintenance, correction of faults and combatting the environmental effects of early development, which occupies much of our time.

Secondly, we have the visitor, whom we regard as a VIP, and as such, should be given every opportunity to enjoy the parks. The problem is, however, that the presence of the visitor in the park leads to degradation of the park environment. Thus we have the conflict of development and the visitor, versus the environment. Where development has been inherited little can be done to resolve the conflict, while there is still the maintenance and updating of these facilities to be considered. Visitor impact can be guided to some extent by careful management and planning, for example by discouraging use of paths prone to erosion and by good housekeeping.

Even when use is carefully planned degradation still occurs. The forms of degradation which must be faced are as follows:

Rubbish

The collection of rubbish involves about 20% of our time, thus it is a dominant factor. I attribute most of the rubbish to modern day trends in packaging and disposables. We have throw away cups, plates and even baby's napkins. In addition there are flip tops, fast food containers and fancy jackets on bottles which can be torn into incredibly long strips.

The majority of the public are litter conscious, particularly if there are easily assessible bins available, but some people don't seem to care how or where they dispose of their rubbish. The dumping of household rubbish in parks is easier to control because most of it is traceable, but car bodies and parts, building rubble, surplus concrete and general junk can rarely be traced. Refreshment retail outlets adjacent to, or within parks contribute considerably to the litter problems.

We find there are two prime factors which help reduce littering.

The first is housekeeping, and if road and walk trail verges, picnic areas and the bush are kept free of rubbish, the public tend to respect the

cleanliness.

The second factor is bins. Care and thought should be used in their placement, and in determining that there are sufficient to cope with the rubbish. In our situation it is important that lids are fitted to the bins. Cats and ravens can play havoc with an open bin and only add to the work of rubbish collection.

Erosion

Erosion is a major problem in parks along the Darling Range. The most severe erosion is gullying by water runoff, but sheet erosion at picnic sites and areas where pedestrian traffic is heavy, also causes concern. Badly sited tracks, firebreaks, horse trails and gravel parking areas are particularly prone to water erosion. It is essential that a continual awareness be maintained, and careful planning done to ensure that any erosion is checked before becoming too severe. We have overcome most of our serious erosion by filling gullies, controlling run off and re-siting tracks and paths when possible.

Our method of erosion control on tracks is to fill gullies and roughly form with a bulldozer, sheet with gravel where necessary, and finish off with a grader - the latter being used to install run offs wherever necessary. Pathways, because of the reduced width, need a different mechanical approach. Most of the work is done by hand, although we have found a bobcat mini loader useful, and a lasting job can be achieved by water binding the formed path with a vibrating roller. The control of water run-off by continual diversion is the most effective. Our forms of diversion include continuous one way camber on hillside tracks, left or right camber to drains away from the tracks, and for paths half buried logs are successfully being used to divert water. Ripping of unused tracks is very effective.

Once the initial control work is done continued maintenance is necessary. Tracks are graded when required, run-offs cleared of silt and debris, and a careful watch kept to contain any renewal of erosion - a few minutes with a shovel often prevents major repairs later.

Erosion control work is expensive in cost and labour time. Machinery hire

for a dozer and grader costs up to $100 per hour, plus our own machinery running costs. Constant supervision is necessary to ensure the desired results and maximum output. While we have overcome most of our severe erosion, there is still much to be done in control and maintenance.

Fire

Fire control presents problems in national parks, and must be carefully considered. Regular burning, before any plant species reaches its climax, will eventually destroy that species. Continual burning also promotes annual grasses - particularly in high risk areas such as road verges. Thus we have the conflict of fire versus preservation. Because the danger of fire escaping into or out of the parks, and any resulting danger to life and property, it becomes necessary to weigh up the value of preservation versus fire risk.

Thus we endeavour to reach a compromise, and as insurance against the spread of wildfire we maintain a buffer zone containing low fuel concentrations around larger park areas, and burn out blocks as they become too dangerous. As an additional reinforcement, we place a high priority on our ability to contain an outbreak of fire before it gains an uncontrollable hold.

The National Parks Authority recognises the importance of fire management. There are two heavy and nine light duty fire units available to cover these regional parks. These are radio equipped and are progressively being updated. All ranger staff are trained to the advanced fire course standard, and senior staff hold a fire weather officer's certificate. It is also policy to maintain a close liaison with neighbouring shires and their brigades, and participate in mutual fire control as either an attack or backup force.

A point of interest in the Mundaring area is that although the number of fires has increased in the last season, the area of the fires has decreased. This indicates fast attack and possibly greater efficiency. A disturbing factor though, is the high incident of deliberately lit fires.

Vandalism

Given that there are about half a million visitors per year to these parks,

the incident of vandalism is relatively low - possibly in the order of 0.01%. However, it exists; the main forms being graffiti, physical damage to structures, broken bottles and damage to flora.

Again, housekeeping plays an important part in reducing vandalism. A clean cared for toilet block does not attract vandals as does an unswept block covered in graffiti. Similarly, a fixture such as a water tap is less prone to damage if its riser is securely fixed to a solid stake - an unsupported tap riser invites destruction.

Other factors, such as using screen blocks instead of louvres in toilet blocks, and removing graffiti as soon as possible discourage vandalism.

When any facility is being upgraded, thought is given to ensure that the facility would not be prone to obvious vandalism. This is having good results, both from an aesthetic point of view, and in reducing costly repairs.

REGULATION BREACHES

The National Parks Authority has Regulations designed to protect the parks from damage, and ensure that the public enjoy the parks and the park facilities.

Common breaches include the removal of wood and rocks, taking pets into the parks, unauthorised use of tracks by vehicles and the dumping of rubbish. Most of the people apprehended obviously know they are breaching Regulations, but often plead ignorance. In most cases we use a policy of education rather than prosecution. There are a number of reasons for this, among which are lack of evidence or witnesses, the long process of prosecution, the need to maintain harmonious relations with our neighbours - who are often offenders - and reducing the possibility of retaliatory action.

Nevertheless, I would not hesitate to recommend prosecution for serious breaches such as the lighting of fires, deliberate damage, or apprehension a second time.

VISITOR PRESSURE

Visitor pressure can have an effect on parks and park management. Facilities, including car parks and the provision of barbecues and picnic tables, can come under pressures which must be carefully assessed. Recreational sports facilities are often requested, but these should be refused because sports ovals and similar facilities are not compatible with national parks. It is fortunate that there are increasing numbers of alternative venues for recreational activities becoming available. I feel that possibly these are relieving national parks of some pressure, but this relief is more than offset by the pressure of inherited activites which date back many years. Policies to exert control over these activities are working, generally by compromise which allows the activity to continue, while minimising the effect on the parks.

CONCLUSION

I have mentioned some of the factors embracing day to day management problems in national parks, but beyond these are factors which also should be considered. These regional national parks contain a number of species of declared rare flora, an Aboriginal site or two, the only caves close to this city which are open to the public, and provide a representative example of Jarrah, Wandoo and small areas of the almost vanished Tuart forests. The undeveloped parks are important in that they provide sanctuaries for wildlife displaced by urban sprawl.

These points highlight the need for preservation, and one must be aware of them when making management decisions. So we must be concerned not only with the million feet this year - but also with preserving a heritage for the millions of feet of the future. This is what national parks are all about!

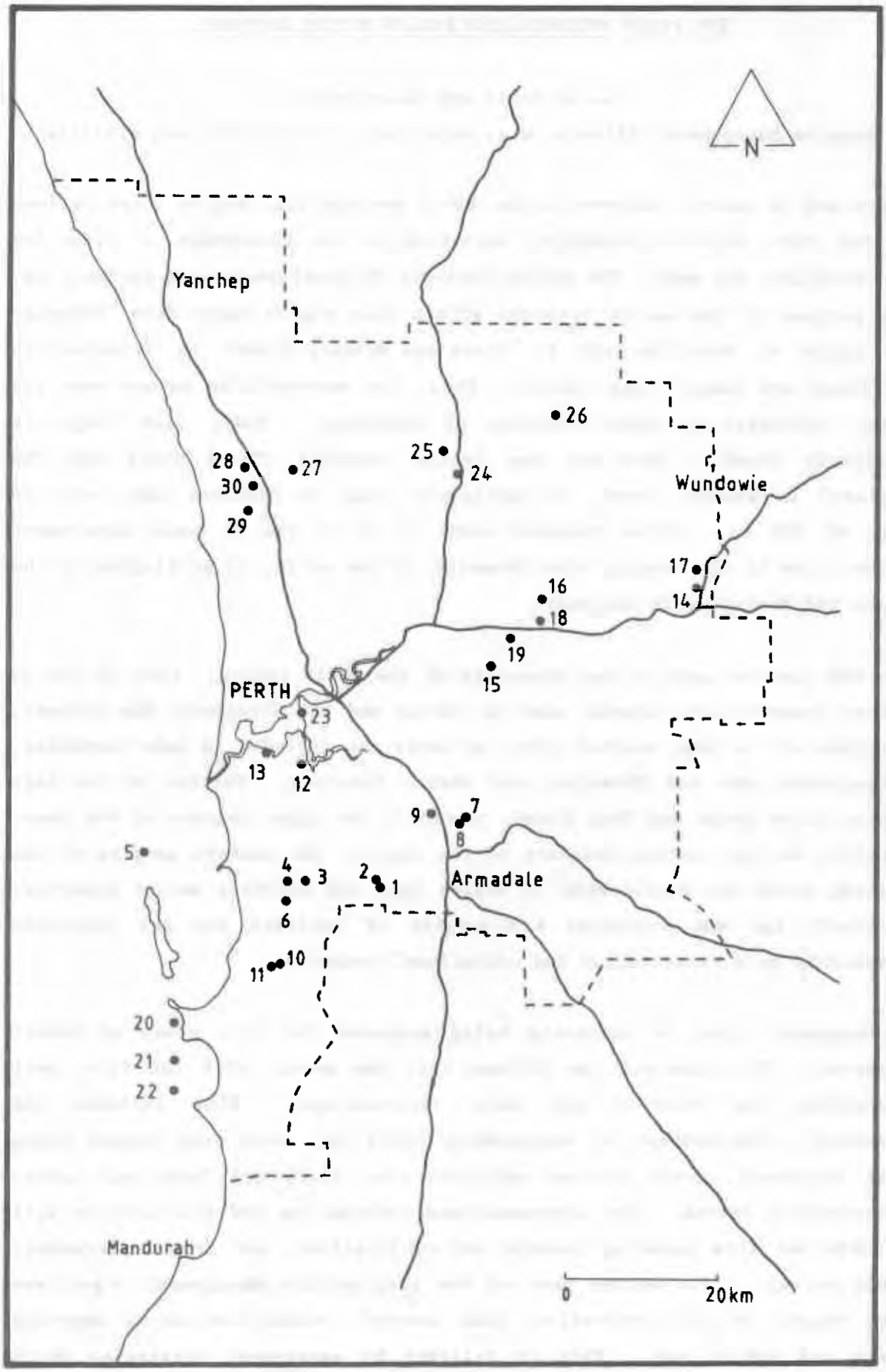
THE PERTH METROPOLITAN REGION NATURE RESERVES

Jim Goodsell and Susan Moore
Reserve Management Officers, W.A. Department of Fisheries and Wildlife

There are 30 nature reserves in the Perth Metropolitan Region (here defined as the Perth Wildlife district, according to the Department of Fisheries and Wildlife; see map). The region includes 28 Local Government Authorities. The purpose of the nature reserves within this region range from 'Drainage and Fauna' to 'Wildlife Park' to 'Flora and Nursery School' to 'Conservation of Flora and Fauna' (see table). Thus, the Metropolitan nature reserves (MNR) encompass a broad spectrum of purposes. Their size range is similarly broad - from the two island reserves (Third Rocks and The Sisters) in Warnbro Sound, of negligible size, to Thomsons Lake, with an area of 509 ha. These reserves occur in 10 of the 28 Local Government Authorities in the region; from Wanneroo in the north, to Rockingham in the south and Mundaring in the east.

The MNR capture much of the diversity of the Perth region. Five of the 30 nature reserves are islands, such as Carnac and the Shoalwater Bay Islands. Examples of the Swan coastal plain wetlands are included in Lake Joondalup, Forrestdale Lake and Thomsons Lake Nature Reserves. Further to the east again, Ellen Brook and Twin Swamps represent the upper reaches of the Swan. Finally, on the eastern boundary of the region, the western margins of the Darling Scarp are represented in Copley Dale and Beechina Nature Reserves. Obviously the MNR encompass a diversity of habitats and are therefore invaluable as a conservation and educational resource.

A management plan is currently being prepared for this group of nature reserves. The plan will be divided into two parts, with the first part describing the reserves and their surroundings. This includes the reserves' relationships to surrounding lands (eg. what road passes along what boundary), their history and past use, flora and fauna and nature conservation values. The aforementioned information and descriptions will be obtained from existing records and publications, and from Departmental field surveys. The second part of the plan details management objectives with regard to fire protection, pest control, rehabilitation of degraded areas and public use. This is followed by management strategies which detail how the objectives are to be achieved, based on the information



THE PERTH METROPOLITAN REGION NATURE RESERVES
(see following table for reserve identification)

NATURE RESERVES OF THE PERTH METROPOLITAN REGION

Reserve No.	Name	Area (ha)	Purpose	Vesting	Map Ref. Number
ARMADALE KELMSCOTT SHIRE					
A24781	Forrestdale Lake	244	Flora & Fauna & Recreation	WAWA	1
37016	-	2	Flora & Fauna & Recreation	WAWA	2
TOWN OF COCKBURN					
7756	-	33	Drainage & Fauna	-	3
A15556	Thomsons Lake	509	Drainage & Fauna Research	WAWA	4
A26646	Carnac Island	19	Fauna & Recreation	WAWA	5
29241	Marsupial Research Station	254	Min. for Fish. & Fauna	WAWA	6
CITY OF GOSNELLS					
32064	-	5	Wildlife Sanctuary	LA	7
24504	Cohunu	16	Wildlife Park	LA with power to to lease.	8
31993	Mary Carroll Park	9	Bird Sanctuary and Park	LA	9

KWINANA SHIRE

A23961	Ridley Green	2	Flora & Nursery School	LA	10
A23958	Ridley Green	1	Flora & Childrens Playground	LA	11

CITY OF MELVILLE

A25562	Blue Gum Swamp	8	Recreation & Fauna	LA	12
35066	Alfred Cove	7	Cons. of Flora & Fauna	WAWA	13

MUNDARING SHIRE

30667	Beechina	56	Flora & Fauna	WAWA	14
20765	-	4	Recreation & Bird Sanctuary	LA	15
11140	-	4	Flora	-	16
30681	-	4	Flora	-	17
10233	-	4	Flora	-	18
36428	-	9	-	LA	19

ROCKINGHAM SHIRE

24204	Shoalwater Bay Islands	3	Fauna	WAWA	20

31893	Third Rocks	Neg.	Fauna	WAWA	21
31894	The Sisters	Neg.	Fauna	WAWA	22
CITY OF SOUTH PERTH					
33803	Kwinana Freeway	4	Fauna	WAWA	23
SWAN SHIRE					
A27620	Ellen Brook	67	Fauna	WAWA	24
A27621	Twin Swamps	155	Fauna	WAWA	25
25919	Copley Dale	5	Flora & Fauna	WAWA	26
WANNEROO SHIRE					
7349	Jandabup Lake	308	Fauna	Min. for Fish. & Fauna	27
A21708	Malup Island	4	Flora & Fauna	-	28
30809	Wanneroo Research Station Site	39	Research of Flora & Fauna	Min. for Fish. & Fauna	29
A31048	Lake Joondalup	465	Recreation & Flora & Fauna	LA & WAWA	30

WAWA - Western Australian Wildlife Authority
LA - Local Authority

given in the first part of the plan.

The plan will be based on a recognition of the value of this reserve system for both conservation and education.

REGENERATION OF SMALL BUSH AREAS

Joanna Seabrook
Eastern Hills Branch of the W.A. Wildflower Society

Early in 1979 the Eastern Hills Branch of the W.A. Wildflower Soceity conceived the idea of growing a Seed Orchard for the Mundaring Shire. Members of the Branch were becoming increasingly conscious of the degradation occurring on road verges, particularly in new housing developments, where all the vegetation was removed during road construction and utility installation. Gravel pits, rather erroneously termed "borrow pits" were also obviously in need of some form of restoration. The Shire of Mundaring was approached regarding possible sites for the venture and a gravel pit in Ryecroft Road was chosen. The presence of numerous soil dumps on the area was believed to be advantageous as it would provide more soil than is usually left in a borrow pit. The Shire were very co-operative and prepared the site by ripping and distributing the old soil dumps.

Eighteen species of shrubs were chosen using the following criteria:

1. The species used should be local to the Mundaring Shire.

2. The fully grown shrubs should not be too tall, so as not to exclude line of sight on road verges.

3. Seed should not be too difficult to harvest.

4. They should be attractive flowering shrubs.

5. The plants should be hardy.

Seed was collected and on 7 May 1979 eight members went to the site and seed was scattered along the ground in rows. By the end of June all seeds had germinated prolifically.

With the help of a machine, this project was completed by eight fairly elderly ladies in less than three hours. Maintenance has been minimal. No water was ever used. The plants survived the following and succeeding summers without any trouble. By the summer of 1982-83 (the third summer),

the Branch was able to supply the Shire with more than $300.00 worth of wildflower seed.

The whole project was experimental and less than a quarter hectare of ground was used. The soil dumps were a great problem because they were full of every imaginable weed seed, and as we had sowed the rows too close together the weeds could not be mechanically removed.

The lessons learned were:

1. Rows of plants should be 2-2.5 m apart to allow for poisoning of weeds and free movement between rows during harvesting of seed.

2. Seed should be sown fairly thinly, or thinning should be carried out after germination.

3. Any area used should be weed free, or weed eradication should be carried out prior to planting.

4. Rabbits can be a problem attacking young plants towards the end of the first summer.

This and other experiments made by members of our Branch have proved that any area may be regenerated quite easily provided seed is available and that the area used is treated for weeds prior to sowing.

Weed eradication or control is another matter and should be dealt with as a separate subject.

This seed orchard originated as, and still is, an experiment to show our Shire, other Shires and interested groups the potential of such projects.

If the difficulties involved in direct sowing of Eucalypt seed can be overcome these could be included in the sowing. This would create endless and hitherto-unthought-of possibilities for regeneration.

Recently there has been so much emphasis on growing trees that the need for growing other plants has been overlooked and neglected.

THE MANAGEMENT OF A SMALL BUSH BLOCK IN DARLINGTON

P.R.E. Day
Eastern Hills Branch of the W.A. Wildflower Society

This paper deals briefly with some practical experience gained during about 10 years management of approximately 3/4 acre of Jarrah/Marri/Wandoo bush on laterite, just east of the top of the escarpment at Darlington. The land concerned is residential and comprises about half my house block plus the adjacent vacant 1/2 acre lot. The experience I have gained is, I believe, relevant to the management of many small bush reserves and public open space areas set aside during subdivison in the hills.

One obvious point that needs to be made is that in no way is such a small piece of bush ecologically self-sustaining in its hostile surroundings. Intensive management is essential. My objective has been to conserve the bush, as measured by general observation of the health, vigour and diversity of the flora. I hope that this has also worked out reasonably well for the fauna, but I must admit to a much more limited knowledge of this aspect.

There are four main factors which have determined my management regime. They are access, fire control, weed invasion and disease. All are interrelated.

Access. This is important if one is to be able, without trampling on plants, to get right into the bush and enjoy it, see what is going on, carry out well controlled burning, and weed effectively.

Fire control. In the urban situation we are required to have firebreaks, and it is sensible to keep fuel down to reasonable levels. Fuel reduction burning is very important for fire safety. Periodic burning of most of the bush must be carried out.

Weed invasion. Probably the most important, and certainly the most insidious factor. For a small bush reserve in a residential setting, where the average resident seems to be hardly aware of the difference between weeds and bush and is not inclined to bend over and pull weeds out (and certainly not until after they have seeded each year) the invasive pressure

is immense.

While bush left undisturbed appears to be reasonably (but not totally) resistent to weed invasion, the two previously mentioned factors of access and fire make additional human intervention to control weeds absolutely essential.

Disease. Although I have not had a positive diagnosis carried out, the signs strongly suggest the presence of Phytophthora cinnamomi possibly with limited viability, on this site. A spate of autumn and spring deaths of Blackboys and young Jarrah some 5 or 6 years ago was cause for concern.

These four factors were all taken into account in the following management plan, which now seems to have reached a stage of practical stability.

1. Winding paths, between 0.5 and 3 m wide have been formed, dividing the area into about 15 irregular shaped and different sized segments. The paths wind around trees, large Blackboys (Xanthorrhoea preissii) and Zamia Palms (Macrozamia riedlii). Prickly Moses (A. pulchella) and Honey Bush (H. lissocarpha) are removed from the edge of the paths for comfort. A thick layer of sawdust/buzzer chips is spread after removal of rootstocks. This soon compacts to form a visually attractive and pleasant-to-walk on surface which strongly resists weed germination, does not erode in heavy rain, and only requires topping up about every 3 years. The paths serve as the required 3 m firebreaks in places (although they do not run in straight lines on the boundaries), and as additional breaks and access ways elsewhere.

2. Using the 15 segments created by the paths, a burning cycle of between 5 and 8 years, depending on fuel level, is established. Between 2 and 4 segments are burnt each year. This is recorded by colour shading on a plan of the area. Burning is always carried out in late autumn after some rain has fallen, and is arranged to be fairly hot to give good legume germination for dieback resistence. Following the burn all remaining shrub skeletons are pruned off at ground level and either chopped into small sticks and scattered, or removed. This process lengthens the time period between fuel reduction burns. A light application of blood and bone is then given (based on the suggestion of forestry officers), to assist the rapid growth of acacia, and to raise

the general health of the vegetation to help resist any dieback which may be present.

3. By late winter-early spring a massive seed germination and regeneration from rootstocks is evident on the burnt segments. At this stage these segments are intensively weeded. Because the native growth is still small, and the background black, weeds are highly visible. The soil is damp and weeds are readily pulled with no significant disturbance to germinating native species. Each square metre is then thoroughly weeded. When complete, a less intensive follow-up weeding is done on the segments burnt the previous year, and perhaps the ones burnt 2 years previously. Very few weeds germinate in these "2 year old" segments, but occasionally thistles or wild oats occur, and these are removed before they can set seed. Particular attention is paid to boundaries where weed seeds from adjacent properties attempt to colonise each year.

4. Although the burning cycle is reasonably long, a couple of small segments are being left unburnt indefinitely for comparison.

5. Due to the importance of the block boundaries in weed incursion from adjacent lots, a dense screen of species such as Hakea trifurcata, is encouraged to minimize wind borne penetration. Weed growth on boundary road verges is well controlled by spreading bark on any bare areas.

The results so far have been very satisfying. The bush looks attractive, it appears to be very healthy, and possible dieback deaths have almost ceased. Over 70 species have been recorded on the 3/4 acre, without intensive searching. Weeds are not generally noticeable and appear to be down to an irreducible minimum. The variety of growth stages of the different segments is visually and scientifically interesting.

While this bush has, if anything, improved over the last 10 years, that on most adjacent lots is rapidly deteriorating. Weeds of every description (there seems to be a new one every year) are displacing native flora. From my observations, a life of between 5 and 10 years is the average life span for most bush species once a house is built and the typical combination of annual spring burning and weed invasion occurs. All that remains are trees and maybe a few blackboys.

I say this not to be critical of others, or to boast, but to point out that for bush lovers all is not lost; that it is possible to successfully conserve the bush in residential areas. The effort required probably sounds excessive from the above description, but it is not. For most of the year there is nothing to do. There are only two periods of intensive activity: one at burning time in autumn, and the other at weeding time in early spring. Together, these involve a total of about 2-3 man weeks of labour for the 3/4 acre (and I am, as you have probably gathered, rather more fussy about that last weed than is really necessary).

I see no reason why some or all of these management techniques could not be successfully applied to small public bush reserves (adaptation would be necessary for other than hills areas). There is nothing that local council gardeners, suitably re-instructed in these new gardening methods, could not do. And I am sure there are bush lovers who, not having natural bush of their own, would love to help.

Finally, a request to the wildlife authorities - a simple manual for weed identification, giving details of habit, propagation, flowering times, seed travel and so on - all regularly updated, would be of immense value.

THE ROLE OF LANDSCAPE PLANNING AND DESIGN IN RESERVE MANAGEMENT

Marion Blackwell
Landscape Consultant, Blackwell and Cala

You must be well aware that we, as a nation, as well as the majority of us individually, still appear to retain an antipathy to "that scruffy old bush", holding it in little regard - clearing without survey, firing, cutting and running it over, often needlessly and without thought or reason. Perhaps this is due to our European ancestry; a result of our forebears coming from softer climes and having to wrestle with the relentless heat, poor soils and the prickly sclerophyllous scrub in this land of alternate drought, flood and fire, in order to grow crops for food.

We still continue, unthinkingly, a nation of despoilers and exploiters; awakening, even now most reluctantly to the desecration we have wreaked, the menace of erosion, deforestation and pollution and the most telling of all, the irrevocable loss of the asset which is our natural heritage - our environment.

There is never-the-less current evidence that the concentration of populations in urban areas, together with the pressures incurred from living in a technological society, are producing in man the urge and need to get away from it all. This syndrome is known as "the green hunger" - the desire to get out into the bush and away from the noisy oppression of "city hustle-bustle" and "people pressures".

There is currently a realisation of the recreational value, as well as the sense of inspiration, to be gained from nature, i.e. the remedial effect of quiet contemplation of the natural environment, with all its joys of familiarity and of unexpected detail. Who hasn't felt the joy and refreshment of a day in the bush? - an outlet for frustrations and a soother for taut nerves.

In an undisturbed environment, plants more than any other factor present the identity of a place. On any particular site, nature, left alone, by means of selection over many thousands of years, has succeeded in establishing vegetation of a type which is suited to that site. Thus the existing plants which are growing on that site are adapted to its

conditions and are self-maintaining; they are therefore the most likely to succeed in that particular habitat. Not only this, but they present in a very definite way the character of that place which is individual and specific.

Parks or public reserves in times gone by, were developed "to provide a stroll", with grass (together with "keep off the grass" signs) and formal displays of high-maintenance horticulture, such as seasonally bedded annuals - often in monoculture. Today people's expectations demand a much less formal approach, with low maintenance being a prerequisite, and the provision of a much wider range of passive activities. Much more interest in native plant species, and in particular in endemics, is currently being shown. There is also a realisation that bush areas are aesthetically valuable, for both their recreation potential and as a teaching resource.

Landscape planning and design are tools which can play an important role in the function and management of such bush areas, and thus give best results if applied from the start. This particularly applies to the assessment of the potential zoning and optimal development for such areas.

Before setting aside a reserve it should be looked at from aesthetic, functional and economic points of view, i.e. what is there, what is its status, what is its potential and its durability, what are the pressures and where are they likely to tell. Then, having determined the above, how does one best instigate and then manage the desired functions of the user requirements, both current and envisaged, within the design budget. Also, what modifications to the existing status quo would be beneficial to those functions, and to the maintenance of ongoing viability; such as paths to prevent trampling; barriers to prevent vehicular access where undesirable; landscaping to integrate an amenities block, etc.

This planning process can be applied to any project, be it a man-made or natural environment (or the integration of the two), in order to zone and set aside specific areas; such as wilderness areas, active or passive recreational areas, or high (people) activity areas. The use of good design in the implementation of these planning decisions can achieve both visual quality and amenity. An example of the procedure in carrying this out involves the following:

1. INITIAL SITE ASSESSMENT

This should analyse:

A. THE SITE ELEMENTS

Vegetation	- constitution (i.e. structure and species) - evaluation - conservation assessment - fragility - education value
Topography	- existing - necessary modifications to facilitate the envisaged functions - fragility
Soils	- existing - problems - conservation measures (resulting from use pressures and other disturbances - salinity problems
Water	- drainage patterns - water bodies (existing and potential)

B. CLIMATE AND MICROCLIMATES

Rainfall
Temperature
Aspect
Wind
Evaporation

C. SURROUNDS AND LOCATIONAL INFLUENCES

- natural and man-made
- advantageous and disadvantageous
- assessed at a continental, regional and local level (as

required).

Considerations include:

Exposure - to coastal conditions, cyclonic influences, snow, flood etc.
Aural intrusions
Odours
Salt fallout
Shelter
Views to frame
Eyesores to screen
Outlooks to preserve
Borrowed landscape(s)
Pollutants
Access - vehicular, public transport, foot
Availability of services

D. INTANGIBLE INFLUENCES

Regional and local significance
Conservation status
Preservation merit
Social appeal - community pride
Sense of place
Genius Loci - spirit of the place
Future planning - proposals for the area

2. IMPACT OF THE PROPOSAL should be evaluated, so as to prevent degradation of the existing site. Impact on the site relates to the constituent site elements, the user requirements, the effect of the design implementation and the feasibility of ongoing management.

Impacts to be evaluated include the following:

A. VISUAL IMPACTS

- both internal and external, including:

Details of siting, orientation, materials, colour, texture and form, and the integration of any developmental structures

Avoidance of swathes and any unnecessary or unsympathetic clearing

B. PHYSICAL IMPACTS

- incorporation of functional design elements including services, structures, signposting etc.

Involves:

Alteration of surface and groundwater systems
Alteration of microclimate
Spillages e.g. petrol, oils, chemicals (including herbicides, pesticides and paints)
Provision of storage areas including temporary amenities, plant and construction materials
Provisions for temporary access and vehicular parking facilities during construction
The establishment of a propagation and/or holding nursery during large jobs
Fencing - type and siting

3. USER REQUIREMENTS must be examined. These usually include a combination of the client's expectations, the public's needs and visions, and a consideration of future socio-economic developments.

The methods of assessing these requirements are many fold and generally involve meetings with councils, local residents and planning authorities. Further to this surveys or polls may be conducted.

4. ECONOMICS OF ACHIEVEMENTS

Involves a consideration of:

Funding sources

Assessments of possible alternatives, such as community participation

or other voluntary labour
Planning of staging to suit funds
Ongoing maintenance requirements including the consideration of automated versus manual systems (i.e. capital versus maintenance costs, for example the reticulation of built up areas)
Vandalism (which relates to design, especially materials).

5. THE PLANNING PHASE. The need for total planning is emphasised. This should be based upon the reserve's purpose and the information gained from the foregoing analyses and assessments. Not only should the development be examined from an aesthetic, functional and economic point of view but it should also be based on an awareness that bush areas add diversity to the urban scene and are an important educational resource, especially for the young.

To be cost effective, carefully considered staging should be used as a design tool in the efficient implementation of the project. Where finances are initially restricted this will also enable sequential development to proceed rationally as funds become available.

6. DETAILED DESIGN PHASE. Good design is the ultimate tool by means of which visual integration of man-made elements can be gracefully achieved, in sympathy with the existing land form and vegetation. Good design should enhance and develop the potential of the existing site, and should retain or protect where desirable, rather than to develop.

Detailed design involves the use of hard landscaping elements, such as paving materials. Great care should be taken in the choice of such elements, particularly in regard to texture, colour, form and positioning. Signposting, for example, should be attractive, as well as positive in content, so as to engender co-operation. In order to retain the character and individuality of a particular piece of bushland, soft landscaping choices should be based on a palette of suitable local species. Good design concentrates on special treatment for specific areas, such as entrances and exits. It also ensures suitably planned management, both in the short and long term.

In summary, the retention of small pockets of bush in suburban areas provides multiple benefits, particularly for passive recreational and

educational purposes. Landscape planning and design are essential tools in the conservation and maintenance of such areas. More importantly, they offer the means of realising optimum development potential for each individual area and the assessment and incorporation of the functional requirements. Without proper design considerations it is inevitable that such small suburban bush areas will become unacceptably down-graded through everyday population pressures.

THE ECOLOGY OF SMALL MAMMALS IN PATCHES OF BANKSIA WOODLAND, WITH PARTICULAR REFERENCE TO FIRE.

M.J. Bamford and J.N. Dunlop
W.A. Institute of Technology

The effect of fire on small mammals is a subject which has only recently begun to receive attention in Mediterranean-type ecosystems, including the Banksia Woodland of the Swan Coastal Plain. The purpose of this paper is to describe a study which is currently in progress in this area and, with reference to the little data available, comment on problems of fire in management of small bush areas for the conservation of mammal species.

The study under consideration is being carried out on private property near Gingin, in Banksia Woodland similar to that once found through most of the metropolitan area. It is particularly suitable for a study on the effect of fire on small mammals because it has a comparatively full small mammal fauna of five native and one introduced species, and there are several areas of Woodland from which fire has been excluded for a long period. This fire exclusion has resulted from patchy clearing for agriculture which left small (75 to 150 ha) areas of woodland surrounded by unimproved pasture. Bush fire policy in the metropolitan region leads to burning at least every seven years nearer Perth.

The study is being carried out using pitfall traps and mark-release-recapture with the same effort, five nights per month, at each site. The post-fire periods of the four sites in the study at April, 1983 (when work began) were 0, 3, 11 and 20 years. Vegetation at the most recently burnt site was only just beginning to regenerate in August, so floristic comparisons can only be carried out between the three other sites. All sites have a similarly developed tree stratum dominated by Slender Banksia (Banksia attenuata), but they differ in the characteristics of their understorey strata. The three year post-fire areas have a low (under half a metre for the most part), dense understorey containing a wide range of species, while the twenty year post-fire area has a very dense, much taller understorey, up to two metres high in places, and this is dominated by Rough Honey Myrtle (Melaleuca scabra). The eleven year post-fire area is intermediate.

Trapping over the past five months has revealed that most of the small

mammal species are present in the three older areas, with no strong preferences as yet apparent (Table 1). However, Ash-Grey Mouse (Pseudomys albocinereus) seems to favour the floristically rich three year post-fire area and, to a lesser extent, the floristically poor twenty year post-fire area. Further work may shed some light on this aparent bimodality and may reveal habitat preferences in some of the other small mammal species.

Table 1. Numbers of small mammals caught at each of the Gingin sites from April to August, 1983.

Species	Site and Number of Trap-nights			
	20 Year (1250)	11 Year (1250)	3 Year (1250)	0 Year (1250)
Western Pygmy-possum (Cercatetus concinnus)	1	1	-	-
Honey Possum (Tarsipes rostratus)	3	3	4	-
Ash-grey Mouse (Pseudomys albocinereus)	4	1	7	-
Grey-bellied Dunnart Sminthopsis grisioventer	12	10	12	-
White-bellied Dunnart S. dolichura	-	-	-	1
House Mouse (Mus musculus)	2	2	1	1
No. of Species	5	5	4	2
Total Individuals	22	17	24	2

Mammal species richness and abundance between the Gingin sites and an area near Jandakot, where work was carried out some years ago by Davidge (1979), are compared in Table 2. The Jandakot site has lost its native rodents and Dasyurids, while the introduced House Mouse (Mus musculus) has greatly increased.

Table 2. Comparison of richness and diversity of small mammal species at Gingin and Jandakot.

Species	Capture per 1 000 Trap-night	
	Jandakot	Gingin
Western Pygmy-possum (*Cercatetus concinnus*)	-	0.47
Honey Possum (*Tarsipes rostratus*)	0.27	2.35
Ash-grey Mouse (*Pseudomys albocinereus*)	-	2.80
Grey-bellied Dunnart *Sminthopsis grisioventer*	-	8.00
White-bellied Dunnart *S. dolichura*	-	0.23
House Mouse (*Mus musculus*)	5.20	1.40
Total	5.47	15.29

The vegetation at the Jandakot site differs in some ways from that in the Gingin locality. Although it is diverse and relatively undisturbed, with little invasion by exotics, it has been subject to more frequent fires, having been burnt about six years before the study and subject to burns of that frequency for some time. Land surrounding the Jandakot study site had been subject to a similar fire regime, and most has been burnt in the last six years. Possibly, the periodicity of fires in the Jandakot area, while allowing for regeneration of vegetation, has been too frequent for mammal recovery, even with the existence of a mosaic of different aged vegetation.

In summary, the Gingin work shows the potential for small bush areas to support native small mammals, but the earlier Jandakot study suggests a problem with the use of fire in the management of such areas. It may not be sufficient just to maintain a mosaic of burn ages; it may be necessary to have mature or even (by examination of the vegetation) senescent areas to act as reservoirs from which recruitment can occur. It would seem that while mammals are able quickly to recolonize an area after fire, doing so

in under three years, their populations will be depleted and ultimately become extinct under fire regimes which advocate frequent burning.

BIRDS AND MAMMALS IN THE MANAGEMENT OF SMALL BUSHLAND RESERVES

Dr Ray Hart

R.P. and R.M. Hart, Consulting Biologists

The mammal fauna of Perth (i.e. the more or less continuous suburban area on the coastal plain) is very poor - only the Brush-tailed Possum and some bats are now common in the suburbs, and the Short-nosed Bandicoot survives in places. The other species have been eliminated and it is now doubtful that any practical scheme of management could return these lost species to the suburbs.

Aquatic birds are still abundant within the suburbs and the presence of many species can be related almost entirely to the survival of suitable habitat. This is a well illustrated by a survey (one day in early September) of Shenton Park Lake (4 species), Perry Lakes (8 species), Lake Claremont (13 species) and Floreat Waters (16 species). Shenton Park Lake has little vegetation and poor diversity of habitats, Perry Lakes has some vegetation, Lake Claremont has a reasonable diversity of habitats, while Floreat Waters has been artificially developed to provide a good variety of habitats. These results show that suitable management can encourage a large number of species.

In relation to bushland birds I sought to answer two questions - "do small reserves have a significant bird fauna?" and "how should the reserves be managed?" All species seen or heard over 90 minutes were recorded, and all individuals were counted over this time in a 25 m transect. The 90 minute interval was spread over several mornings (7-10 am) in August or September. This was done for a variety of reserves with Neerabup National Park as a control. In all cases areas of Banksia eucalypt woodland were selected.

For analysis the birds were considered in four groups:

Group 1. Species which have adapted well to the strictly suburban area.

Group 2. Species which enter the suburban areas commonly but are as much associated with suburban bushland or open spaces.

Group 3. Species which occur within the suburbs only in areas of bushland.

Group 4. Species which do not normally enter the suburbs. Highly mobile or erratic species (such as raptors and cockatoos), aerial species and non-native species were excluded.

In Figures 1 and 2 the reserves have been arranged by their similarity in bird fauna to Neerabup. In Table 1 this order is compared with environmental parameters of relevance to management. From Figure 2 it can be seen that many species survive in these reserve, even in quite small areas.

RESERVE	AREA	VEGETATION	ISOLATION	TREES	BIRDS	
Neerabup	1 000	2	L	M	58	21
Kings Park	300	2	H	H	55	17
Gwelup	40	2	M	H	72	15
Bold Park	250	3	M	M	86	16
Star Swamp	40	2/3	M	M	50	13
Wireless Hill	45	3	L	L	58	15
Dianella	10	3/4	L	L	23	12
Attadale	3.5	2	M	H	90	11
Karrinyup	22	2/3	M	M	38	12
Hollywood	6	4	H	L	82	11

Table 1. The area (ha), the state of the vegetation (on a ranking scale from 1 = pristine to 5 = destroyed), the degree of isolation (low, medium or high), the density of trees (low, medium or high) and the number of individual birds counted (first column) and the number of species recorded (second column), for the various reserves.

In Figure 1 the reserves most similar to Neerabup have Group 1 as a small proportion and Group 3 as a large proportion, and vice versa for the reserves least resembling Neerabup. From Figure 2 it can be seen that this trend parallels the progressive loss of Group 3 and 4 species. Group 2 is relatively constant in all cases. It should be noted from Table 1 that there is no correlation between the number of individuals and the order of

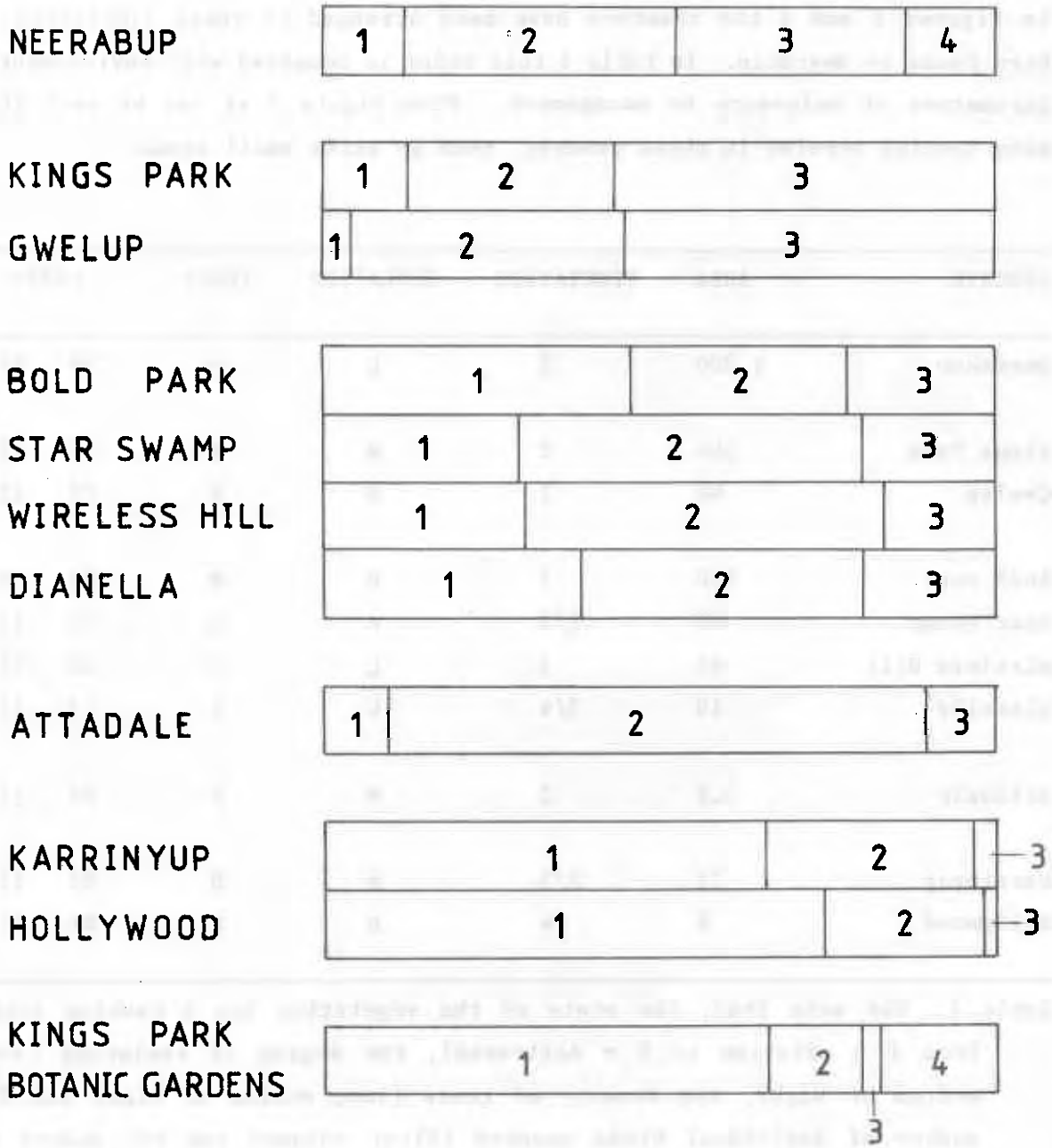


Figure 1. The proportion (%) of each species group counted by the number of individuals, for the various reserves

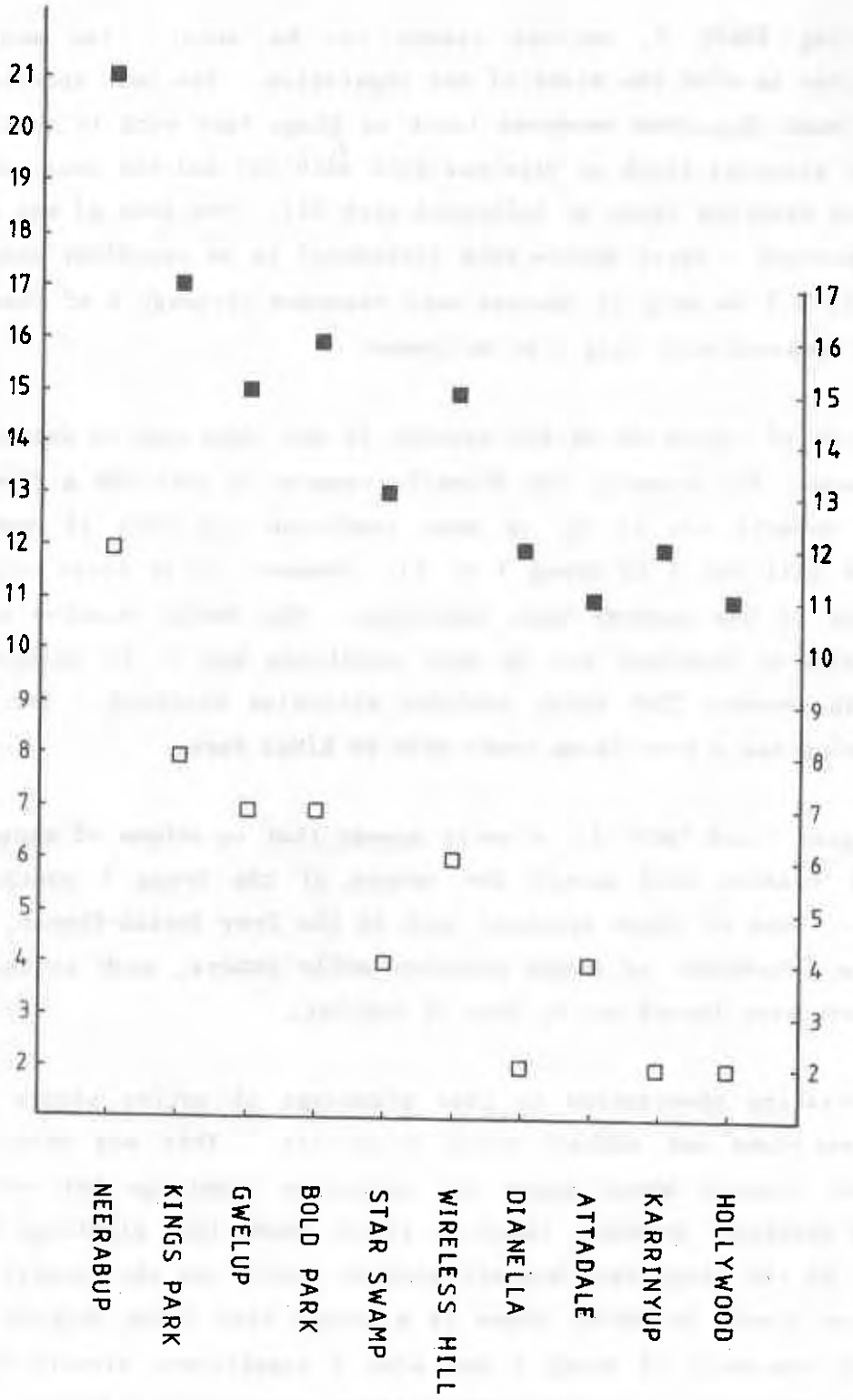


Figure 2. The total number of species (closed squares) and Group 3 and 4 species (open squares), for the various reserves

the reserves.

Considering Table 1, various trends can be seen. The most obvious correlation is with the state of the vegetation. The most species are seen in the least disturbed reserves (such as Kings Park with 17 species), less in other reserves (such as Wireless Hill with 15) and the least in the very disturbed reserves (such as Hollywood with 11). The area of the reserve is also important - Harry Sandan Park (Attadale) is in excellent condition but with only 3.5 ha only 11 species were recorded although 4 of these were in Group 3 compared with only 2 at Hollywood.

The degree of isolation of the reserve is not important in determining the bird fauna. For example, the Dianella reserve is only 500 m from the edge of the suburbs but it is in poor condition and only 12 species were recorded (all but 2 in Group 1 or 2). However in at least one case the surrounds of the reserve were important. The Gwelup reserve has only a small area of bushland and in poor condition but it is adjacent to the Karrinyup Country Club which includes extensive bushland. The result is that Gwelup has a bird fauna comparable to Kings Park.

From Figure 1 and Table 1, it would appear that no scheme of management for a small reserve will permit the return of the Group 4 species to the suburbs. Some of these species, such as the Grey Shrike-Thrush, appear to be quite intolerant of human presence while others, such as the Splendid Wren, have been forced out by loss of habitat.

An interesting observation is that plantings of native plants in garden situations does not attract Group 3 species. This was obvious in the Hollywood reserve where there are extensive plantings but virtually no Group 3 species. However, there is little doubt that plantings do attract birds. In the Kings Park botanic gardens (which are the largest plantings of native plants in Perth) there is a unique bird fauna (Figure 1) with a complete dominance of Group 1 but also a significant element of Group 4 (essentially honeyeaters attracted to the enormous food supply).

In this discussion management has been viewed as solely directed at preserving the native bird fauna. However, reserves within the suburbs have another and possibly larger function, which is to encourage birds of any sort as part of the human environment. Birds are typically very mobile

and many species appear within the suburbs at times (such as Black-shouldered Kites along the coast). There seems little doubt that small areas of bushland are important to these birds. In addition many species (such as the Spotted Pardalote) make regular north-south movements and small reserves may be important to these species as they pass through the suburban area.

HABITAT ACTION IN THE METROPOLITAN AREA

Peter McMillan
Biologist

My approach has always been at the grass roots level of biological and ecological interest - training teachers at the primary level and relying on them to pass on the gospel to their classes.

I first became involved in saving patches of bush in the Metropolitan area through encouraging local resident awareness of their value. Once they became interested I would encourage them to form local "Habitat Action Committees", and in this way they became involved. The more involvement from local residents the better.

At this stage the Claremont Teachers College "crew" would be brought into action. This would involve visiting the site and plotting quadrats and transects to find out what was there. We were concerned specifically with compiling species lists of plants and animals. All this information was compiled into a book and this was then handed over to the "Habitat Action Committee". This was the end of the work by the "Claremont College Crew". It was then the responsibility of the "Habitat Action Committee" to take the data to the Local Authority, and armed with this information request that the said area be retained as a Flora and Fauna Reserve. In most cases the local authorities were very agreeable to these requests.

Our successes have included Bell Swamp, Star Swamp, Bold Park, White Lake, Thornlie, Coogee Strip and the Dianella Sump.

To do this job you have to be "hooked". The Claremont "crew" were very enthusiastic and enjoyed themselves. Now, the young teachers who were at the Claremont Teachers College with me are scattered around the country and are setting up their own little action groups doing what they did with me in the Metropolitan area.

In conclusion, it is important to realise that for these projects to be successful there must be some dedicated people who will continue to look after the reserve and ensure its continued management. There is no point in establishing a reserve if no one is willing to look after it.

HOLLYWOOD RESERVE - A COMMUNITY AFFAIR

G.S. Cannon

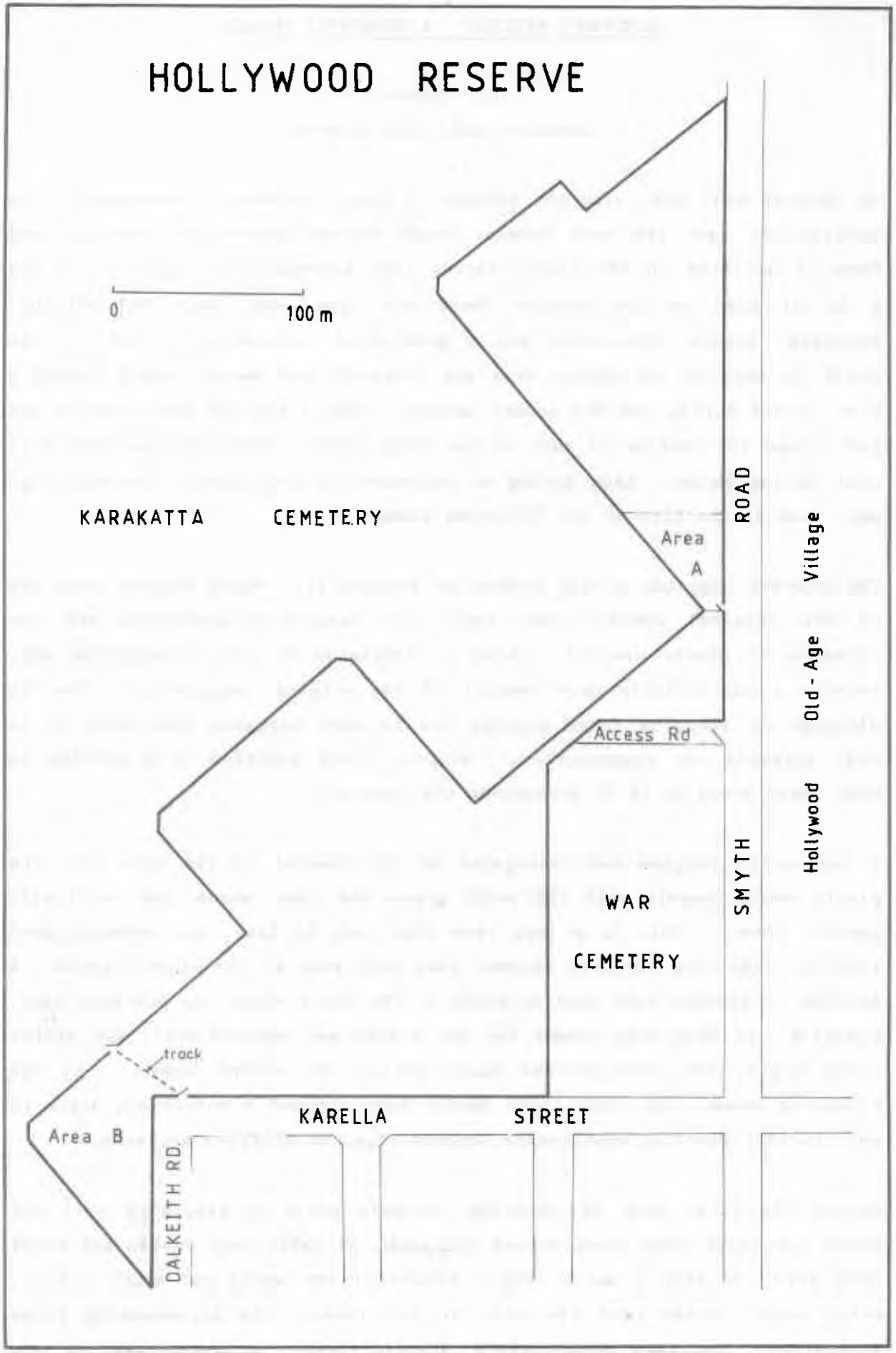
Gardener, Hollywood Reserve

In 1976 Mr Bill Day, with the support of local residents, succeeded in his petition to save the bush between Smyth Rd and Karrakatta Cemetery, and have it declared an "A" class reserve (see accompanying figure). In the 6 ha of bush on the reserve there are some very large old Jarrahs, Banksias, Tuarts, Casuarinas and a good shrub understorey. Little else could be seen as the entire area was infested with weeds, which became a fire hazard during the dry summer months. Many fires had been through and had burned the centres of many of the large trees. These hollow trees fell over during gales. Each spring as regeneration took place, the seedlings were lost in the fire of the following summer.

The reserve contains a high number of species (71) which suggest that few of the original species have been lost despite disturbances and the invasion of exotic species. Area A, indicated on the accompanying map, retains a particularly good remnant of the original vegetation. Area B, although it contains fewer species and is more degraded than Area A, is also suitable for preservation. However, weed invasion is a problem in both these areas as it is throughout the reserve.

A replanting program was instigated on the reserve in the hope that the plants would compete with the veldt grass and other weeds, and eventually smother them. This is a long term plan and, to date, has produced good results. The weed regrowth becomes less each year as the plants spread. A section is planted each year adjacent to the one planted the previous year. Planting is done over summer and the plants are watered until the winter rains begin, and then watered again during the second summer. By the following summer the plant roots should have reached a sufficient depth to make further watering unnecessary, unless signs of distress are seen.

During the first year of planting, vandals would occasionally pull out trees and leave them lying across the path, or cycle over bushes and break them down, or drop a match into a bundle of dry weeds and start a fire, which would spread into the tops of the trees. On apprehending these youngsters, for they were mainly schoolchildren, I would explain the


HOLLYWOOD RESERVE
0
100 m
KARAKATTA CEMETERY
Area A
ROAD
Village
Old - Age
Hollywood
Access Rd
SMYTH
WAR
CEMETERY
track
KARELLA STREET
Area B
DALKEITH RD.

enormity of what they had done and ask for their cooperation in guarding "their" park. Thus a network of "wardens" was set up and the vandalism eventually stopped. Parental approval was asked for and given. The wardens enjoy belonging to a club and in the school holidays, especially in May and August, would pull weeds and burn them. This prevents the weeds turning their roots back into the ground after a shower of rain, which the veldt grass is very prone to do.

During winter it is quite safe to pull veldt grass as all the seed which is going to germinate will have done so. However in summer, after the seed has ripened and fallen, it is better not to disturb the soil surface as germination the following winter will be heavier. In summer, it is better to mow the weeds and when the regrowth reappears in a couple of weeks, the regrowth should be dabbed with Roundup - never sprayed. There are several methods, all cheap and easy to use; .....plastic detergent bottles with a sponge rubber wick in the end.....paint rollers on a long handle, or some other home made invention. Spraying is not recommended as even on the calmest day, there is an undesired drift and many plants can be unintentionally killed.

Roundup should not be used after mid-July when the native bulbs begin to sprout. From mid-July, until the weeds set seed, manual pulling, hoeing or a gardener's knife may be used - whatever causes the least soil disturbance. After that, the heads of seed should be cut off and burned and the remainder of the plant dabbed with Roundup.

During the May and August holidays, the wardens pull lupins, by hand, at the rate of one lolly per 100 lupins. This soon solved the lupin problem. Lupins are a problem as they enrich the soil and multiply very quickly unless eradicated. To encourage the wardens further their names are written each year on a board attached to a tree. At the end of the school holidays, a warden's picnic is held and good fun is had by wardens and parents alike.

The park is used by other members of the local community such as dog walkers who are encouraged to keep their dogs on leads or on the paths. If the dogs are allowed to run wild, they can kill plants by urinating on them. If this is explained to the owners they are very cooperative. Also old people from the Salvation Army Village come over looking for orchids

and are delighted to find them. Orchids which haven't been seen for years, because they were hidden by the weeds, can now been seen in many areas and seem to thrive in weed free environs. The Tuart Club visit the reserve each spring. Overseas visitors are brought in by local residents who enjoy showing them a bush area in the middle of Nedlands. Children from both primary and secondary school walk and cycle through. Visitors to the cemetery walk through. The residents of Karella St have become involved as fire spotters; this involves a phone call to the Fire Brigade if a fire is seen on the reserve at night, on week-ends or public holidays.

REPLANTING

The best results are achieved, particularly in terms of retaining the local character of an area, by planting indigenous species. If a native garden effect is desired a variety of colourful W.A. native plants can be used.

DISPOSING OF WEEDS

If practicable, weeds should be removed from the area. If this is not feasible, weeds should be burned on a clear piece of land according to fire permit rules. The local fire officer or Fire Brigade will furnish all information about safe burning. No matter what precautions are taken, by the end of September, certain areas will become a fire hazrd. These areas are best treated by mowing them with rotary mowers, or by using a weed eater to clean around the plants. Then, in the unfortunate event of a fire occurring, it should not become an uncontrollable wildfire, burning through the tree crowns.

If a bundle of weeds is left in wet weather to be picked up by a rubbish truck, the weeds continue to grow and set seed. In dry weather, a bundle is a temptation to a fire bug. Either way it looks unsightly to leave bundles and the possibility of smothering native plants, which have not shown themselves above ground, is always present. It is better to dispose of the weed bundles as they occur. In Hollywood Reserve, there are established burning areas each season and by the following year they have disappeared and there is no unsightly burnt patch left as small understorey plants take over after the winter rain.

During mowing, an occasional plant is cut off at ground level. Plants with

underground root stock come back the following year (in a similar manner to roses which have been pruned severely). I am not advocating mowing an area flat, for obvious reasons, but an accidental cutting does little harm.

PLANTING AND NAMING

A small hole is dug so that the plant will be about 2 cm below the ground surface when planted. A handful of Osmocote is tossed into the bottom of the hole. The hole is filled with water. The plant is planted, watered and firmed in. It is kept watered during its first two summers by which time it should have developed a strong root system, and should be tapping its own underground water. It is surprising how quickly the area begins to look like natural bush again; usually two years or less. Nameplates should be put in to identify the planted species.

REGENERATION

In Hollywood Reserve, regeneration of naturally occuring species is taking place at a great rate. Grannys' Bonnets (Isotropis cuneatus), Dune Moses (Acacia lasiocarpa), Jarrah (Eucalyptus marginata), Red and Green Kangaroo Paw (Anigozanthus manglesii), Donkey Orchid (Diuris longifolia) and Forest Sheoak (Allocasuarina fraseriana) are now in their fourth year from seedlings (self sown). These have regenerated since fire has been excluded from the area.

FAUNA

The bird life has become more prolific, and so bird watchers are adding to the number of park users. I have never seen a snake of any description, but I have seen almost every other animal and bird described by Alan and Susan Tingay in their book 'Common Animals in Kings Park and Perth Gardens', obtainable from the Kings Park Board and published in 1982.

SPREADING THE WORD

Get the local paper to write an article, accompanied by a photo. Spell out the problems and ask for weed pullers, fire wardens, and "Friends of the Park". You may have to work quite hard at this, but as the park improves, more people appear. The publicity has to be kept up from year to year,

well ahead of the flowering season. Planning ahead is necessary to ensure that an article is published when the flowers are at their best (this should also coincide with mowing of paths to make walking through the park as easy as possible). A photographic record should also be kept to show improvement. A photographer could be appointed from the local community, possibly a retired person with an interest in photography.

These are some of the ways in which the local residents of Hollywood have been involved in making it a "Community Affair".

COTTESLOE ROAD VERGE RESERVE

Mary Edwards and John Gardner
Association for Cottesloe Reserve

The development of a flora reserve was stimulated in 1982 by a request, in the Cottesloe Council Monthly Civic Centre News, for suggested areas of improvement in the district. The suggested location for the reserve was along Broome St (from the Kindergarten to Forrest St) bordering Seaview Golf Links. The Council responded favourably to the suggestion, with the proviso that development was based on community effort. The area involved has always been admired for its stands of Black Boys and autumn flowering yellow Leschenaultia (Leschenaultia linarioides).

The area was surveyed by Robert Powell (Department of Fisheries and Wildlife) who recorded 37 species of native plant. A public meeting followed, and at this it was suggested that the Hollywood Reserve Plan be used as a model. Advice was given at an ensuing working bee by Robert Powell and Goldie Cannon (Gardener, Hollywood Reserve). It was finally decided to follow the Hollywood Plan, although only local plants would be grown.

The lower or kindergarten area was selected as a site for planting as it was poorly vegetated. The higher limestone area with its cover of native plants, was to be weeded and left to regenerate. This limestone area contains some attractive Grevilleas and Acacias, and Templetonia (Templetonia retusa).

One of the main weeds found on the reserve is lupins, which are hand-pulled. In winter more lupins appear, and these are hand pulled along with the veldt grass - before any of them can set seed.

Busy bees are held on the third Sunday of every month and have been responsible for clearing 3 truckloads of rubbish from 3 gullies, as well as the aforementioned weed control work. Windbreaks of Rottnest Tea Tree (Melaleuca lanceolata) and Pine (Callitris preissii), Peppermint (Agonis flexuosa) and Tuart (Eucalyptus gomphocephala), have been planted, as well as Banksias, Hardenbergia, Hibbertia and Grevillea and other species of the area. The Council has erected a log fence along the edge of the reserve

and provided $200 for plants and materials.

A notebook and photos are being kept to record activities, to show progress and to enable comparisons to be made in the future.

It is hoped to have seats strategically set for people to enjoy the reserve and the view. The reserve will be available for school children to enjoy nature study, and to enable Cottesloe residents to enjoy the plants and flowers of the area.

MANAGEMENT OF STAR SWAMP

W.A. Loneragan

Department of Botany, University of Western Australia

Star Swamp Reserve encompasses a freshwater lake, 4 ha in area, surrounded by approximately 96 ha of bushland. The reserve is located in the suburb of North Beach (31°51'S; 115°45'E) and is bounded by North Beach Road, Marmion Avenue, Beach Road and Hope Street. This isolated remnant of vegetation is one of the few remaining wetland swamps which, together with its associated communities, once formed part of a broad wetland system on the Spearwood Dune soils of the Swan Coastal Plain (Seddon 1972).

With the population of Perth and its environs commonly predicted to double by the year 2000, wetland remnants such as the Star Swamp Reserve are increasingly being viewed as important sites for recreation, the conservation of wetland-dependent plant and animal species, and as centres of interest in the landscape (System 6 Study Report, 1981).

As a result of representations by the Trigg North Beach Waterman Community Association to the Australian Heritage Commission, the Reserve has been listed on the Register of the National Estate (Commonwealth of Australia Gazette, 1983). Following further submissions to the Federal Government, by the same group of concerned citizens, a grant of $3 000 has been made to develop a management plan for the Reserve.

A study group, comprising the author (as co-ordinator), Mr R.P. McMillan (zoologist), Dr. L. Townley (hydrologist) and Ms L. Watson (botanist), has been appointed to undertake the proposed investigation. The objectives which the study group is required to address include:

1. A survey of the Reserve to: update and extend previous descriptions of the vegetation by Bell *et al.* (1979), Watson and Bell (1981); list the fauna; and define the hydrological characteristics.

2. Identification of areas of special interest and application, for example for school projects, tertiary level courses and access by handicapped groups.

3. A management plan with special emphasis upon control of weeds and the use of fire.

4. Ways of implementing the management plan so as to involve local government, local community groups and specific user groups such as schools, tertiary institutions, etc.

At this time the study group has just commenced its investigations; therefore only general comments on the management requirements can be made.

It is clear from the terms of reference that use of the Reserve is to be multi-purpose including activities of scientific, educational and of passive recreational nature. Given the size of the Reserve (about 100 ha) and this multiplicity of uses, management should be intensive with considerable involvement of user groups.

A number of potential problems which will impinge upon a successful management plan can be readily identified, these include:

1. Control of access. At present the Reserve is subject to illegal trail-bike and horse riding. While those engaging in these activities largely confine themselves to existing tracks, they are a source of weed invasion and a general nuisance to legitimate users. Even if the area can be fenced, entry points will be required for fire-control, wheelchair access and general public access. It is unlikely that unauthorized access to the Reserve and vandalism can be satisfactorily controlled unless a warden is appointed.

2. Weed and insect control. The Reserve is already known to contain some 209 species of plants representing some 157 genera in 55 families, of these, 75% are species native to Western Australia. While the remaining 25% of species represent introduced or 'weed' species, their proportion amongst the main vegetation types ranges from 23% (in Banksia dominated woodland) to 48% (Melaleuca woodland fringing the lake). The Reserve is therefore already considerably invaded by weeds.

   It is also known (Watson and Bell, 1981) that within the Eucalyptus gomphocephala (Tuart) woodland little recruitment of trees, killed

either through old age or defoliation by insect attacks, is occurring. Unless this problem is halted further substantial weed invasion can be expected. Attempts by the local Community Association to control lupins, using hand-weeding techniques, appear to have some probability of success, especially if this approach can be integrated with replanting and selective use of weedicides.

Evidence from elsewhere (Baird, 1977) indicates that some weed species such as veldt grass (Ehrharta calycina) can be controlled provided the structure of the natural vegetation, especially of the tree canopy, is maintained.

3. Fire control. Elsewhere in this publicaton Dr P. Wycherley has shown for Kings Park that most of fires which occur in the Park are deliberately lit, and that these fires account for the greater area burnt. It might be anticipated that fires in other Reserves within the Metropolitan region follow a similar pattern. If this assumption is correct the use of fire as a management tool within Star Swamp Reserve is made more difficult. There is, however, much evidence (largely unpublished) that suggests that native vegetation benefits from occasional firing through accelerated nutrient recycling, destruction of insect and fungal infestations, regeneration from seed, rejuvenation of moribund plants and increased flowering. The problem is that research also indicates natural firing cycles may be of the order of 10 years or more (van der Moezel, 1981). Fire more frequent than this interval may ultimately reduce or eliminate fire sensitive species while favouring weed species (Baird, 1977). Some use of fire will be necessary in Star Swamp Reserve, if only to reduce the potential hazard to adjoining properties that accumulated litter would produce. However, this use must take cognizance of the biology of the species involved.

4. Water control. Two aspects of the waters of the lake body invite concern. The first relates to changes in the water table level, which has increased since 1951 (Watson and Bell, 1981). It is possible that local changes resulting from increased urbanization have been responsible for this increase but it is also possible, given the continuity of the hydrological system that underlies much of metropolitan Perth, that the changes originate from more distant sources. The

second point of concern is the likelihood of eutrophication occurring. The water body receives run-off from adjoining streets and while at the moment water quality appears satisfactory (Bell et al. 1979), most lakes close to Perth, compared with the more distant Loch McNess at Yanchep (within the same wetland system), contain greater levels of nutrients.

Whatever the specifics of the initial management plan one point is certain. Its successful implementation will require a programme of monitoring, for without such a programme it will be impossible to obtain the data necessary to modify the management procedures as experience dictates.

Perhaps the most exciting aspect about the Star Swamp Reserve has been its method of creation. The action of a local community group in coordinating the activities of interested individuals, educationalists and scientists, successfully seeking to register the area as part of the National Estate, then obtaining some initial funding from the Federal Government is a new development. The intention is that implementation of the management plan will involve local government, the local community and user groups, and if successful, this approach may well become a blue-print for the future.

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BUNGENDORE PARK

Kim Sarti

Armadale-Kelmscott Branch of the W.A. Wildflower Society

1. Introduction

Bungendore Park (Place of Gum Blossom) is an "A" Class Reserve vested in May 1965 in the then Shire of Armadale-Kelmscott.

The reserve is located some 3 km south-east of Armadale and occupies an area of 450 ha (1 114 acres). The main entrance to the Park is from Admiral Road, which leads to the Wungong Dam. There is also an entrance off Albany Highway. The western boundary is formed by the Darling escarpment - an area recognised as being floristically important. The southern boundary adjoins predominantly freehold land and in places overlooks the Wungong Gorge.

The Park was included in the System 6 Report as part of an area including Reserve A4561 (Bungendore proper), Gravel Reserve C10433, land controlled by the Metropolitan Regional Planning Authority (MRPA) and vacant Crown land (VCL). In the Green Book, it was recommended that the VCL adjacent to Bungendore be included. However, approval was granted to use part of this land as a private school site. The open woodland area lost contained the greatest species concentration of terrestrial orchids in the Armadale-Kelmscott area.

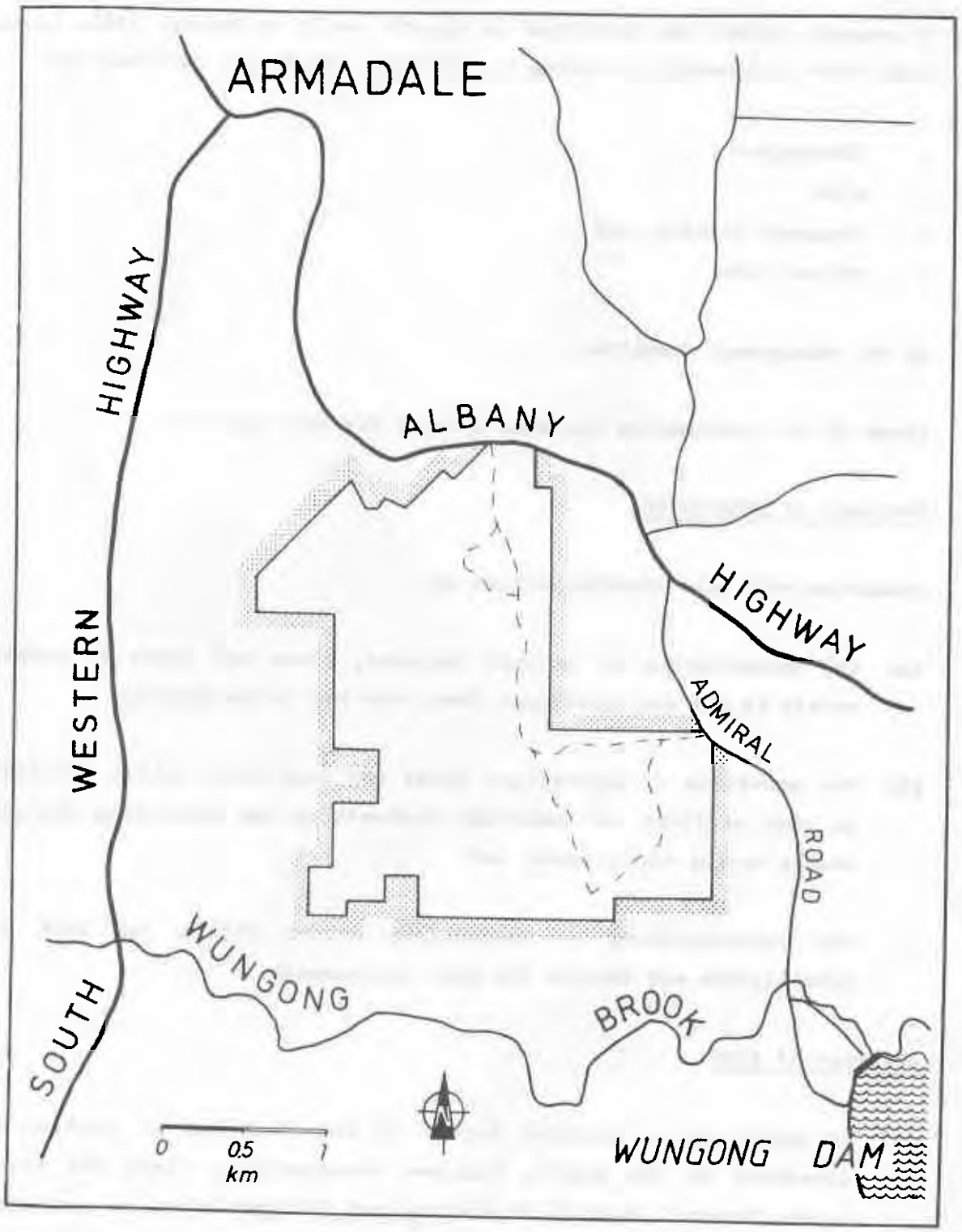
2. General

Following numerous letters from various organisations regarding rubbish dumping in the area, the Bugendore Park Management Committee was established by the Armadale Town Council in June 1981, the aims being the improvement and preservation of this "A" Class Reserve.

Committee membership is from the following organisations:

- Lions Club of Armadale-Kelmscott
- W.A. Wildflower Society, Armadale-Kelmscott Branch
- Forests Department

BUNGENDORE PARK



. Bedfordale Residents Association

The committee is chaired by a councillor from the Armadale Town Council.

A progress report was submitted to Council early in October 1982. Along with other information relating to the Park, the Report outlined the:

. Strategies
. Aims
. Progress to date, and
. Future plans

of the Management Committee.

(Some of the information has been updated for this paper.)

3. Abstract of STRATEGIES

Committee will make recommendations on:

(a) the preservation of natural features, flora and fauna to enable people to see and appreciate them, now and in the future;

(b) the provision of appropriate areas and facilities within the Park so that visitors can undertake bushwalking and picnicking without damage to the environment; and

(c) the implementation of appropriate action within the Park to rehabilitate and improve the park environment.

4. Abstract of AIMS

(a) to carry out a detailed survey of the park and to produce an inventory of the Park's features incorporating flora and fauna types, natural physical highlights and dieback infection patterns; and

(b) based on the information above, determine road closures necessary

to help control the spread of dieback fungus and to protect the bushland; identify areas of special interest; identify areas requiring rehabilitation work and develop areas for picnicking, bushwalking and nature study groups.

5. Abstract of PROGRESS TO DATE

(a) Park survey -

(i) Detailed maps (1:5 000) have been produced with the assistance of the Forests Department. These maps have proved invaluable in determining suitable courses of action in the management and conservation of the Park. A reduced simplified map is included for reference.

(ii) The Wildflower Society has commenced a detailed study of the Park flora - a project expected to take 4 years.

(b) Rehabilitation -

Approximately 3 400 seedlings were planted in June 1982 and 3 720 seedlings in June 1983 in and around disused gravel pits. Local species were used - the trees were donated by Alcoa and the understorey shrubs by the Armadale-Kelmscott Wildflower Society.

A seeding trial was conducted in 1983 using broadcast sowing. The Forests Department "recipe", which consists of seed, fertilizer and sawdust as a bulking medium, was used.

(c) Rubbish Control -

Several busy bees have been organised by the Lions Club. Large volumes of rubbish have been removed, including car bodies.

6. Abstract of FUTURE PLANS

(a) Provision of picnic facilities and rubbish collection arrangements;

(b) 4 000 seedlings to be planted in 1984 following contour ripping

and bank battering of gravel pits. Data will be collected to determine the best seed broadcasting techniques. Broadcasting will reduce the need for a high manpower (and womanpower) input into seedling propagation and planting.

(c) all unnecessary tracks to be closed off and permanent tracks to be named and identified with road signs.

7. Abstact of Appendix A

An Appendix to the Report outlined the need to preserve local environments and describes the biological value, and value to the landscape, of rehabilitating using indigenous plant species. Thus, all the understorey plants have been propagated from seed collected within Bungendore, thereby ensuring full genetic variability and preservation of local forms.

8. Publicity

A number of recommendations were made in the Report, one being that the Town Council undertakes to publicise the Park and the work being carried out at present, with the aim of attracting interest and assistance from the general community.

This is being done by:

(a) articles in the local newspaper;

(b) a static display of text, maps and montage of pictures. Used to date at a Community Fair and a smaller version at a wildflower exhibition;

(c) a promotional brochure is being designed to encourage particular service groups to assist in the physical work, under the guidance of the Committee;

(d) naming the Park and access roads with signs to give the Park an "identity". At the risk of being accused of bias, the road names have a flower theme. The bushwalking trails will be named after

birds or mammals. A provisional nomenclature map is included for reference; and

(e) organised bushwalks through sections of the Park. (First walk planned for 9 October 1983.)

9. Problems

(a) Rehabilitation -

(i) Understorey plants for 1982 rehabilitation were grown in tubes. This resulted in a higher than normal loss, as planting was carried out with the assistance of people not familiar with the correct techniques for removing the seedlings with minimum disturbance. The use of peat pots in 1983 overcame this problem, particularly as a number of children were involved in the planting programme. (We used $6cm^2$ pots, size no. 522)

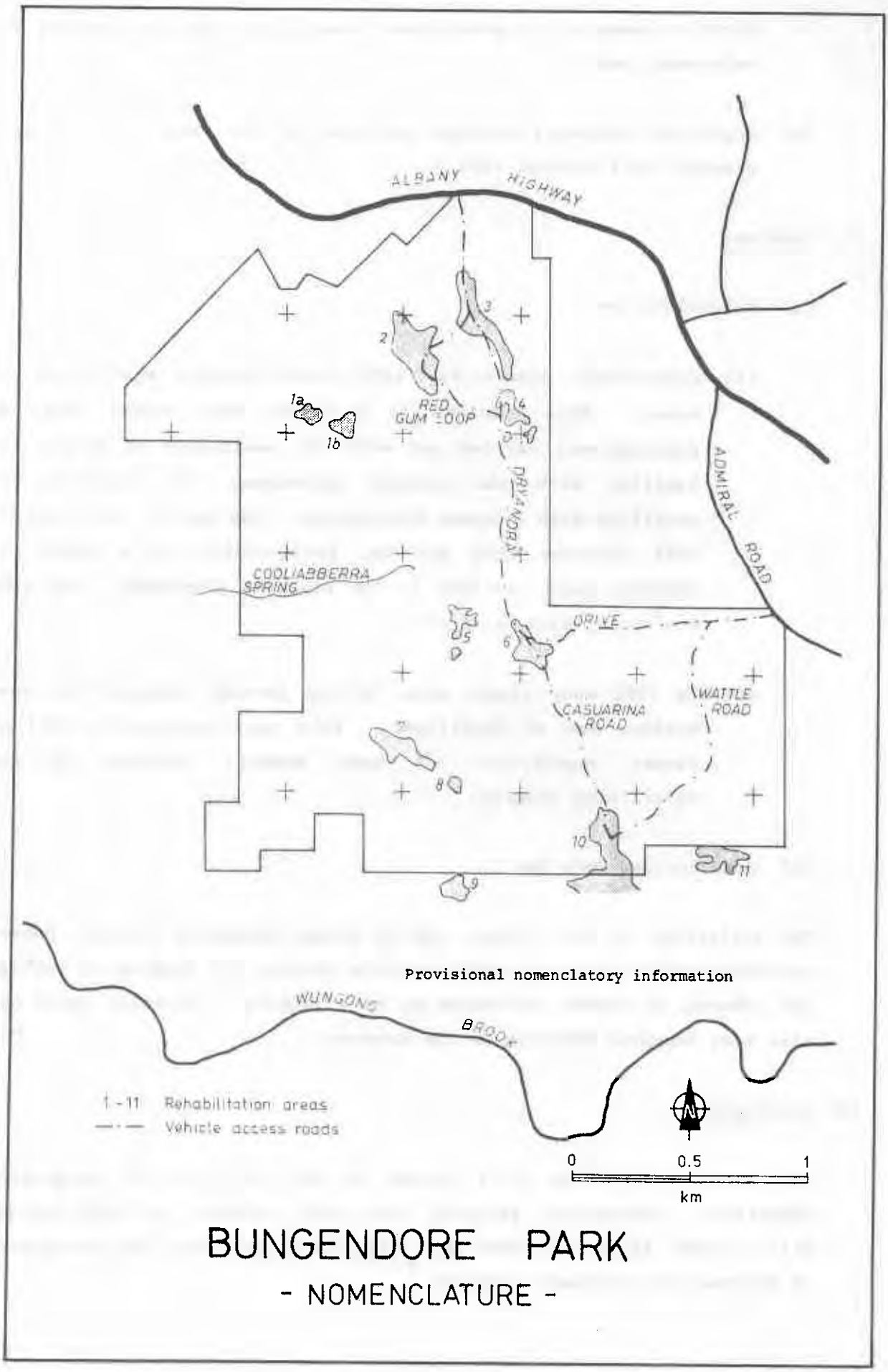
(ii) In 1982 many plants were "killed through kindness" by over zealous use of fertiliser. This was overcome in 1983 by closer supervision of fewer numbers involved in the fertilising program.

(b) Unauthorised Park Use -

The activities of trail bikes, and of horses spreading dieback, horses spreading other fungi and weeds in their manure, the dumping of rubbish and removal of timber continues to be a problem. Recently there has also been kangaroo shooting in the Reserve.

10. Conclusion

The above information is a resumé of the work of the Bungendore Committee. Information gathered from other speakers at this Seminar will provide different ideas and suggestions regarding the management of Metropolitan bushland reserves.



BUNGENDORE PARK

- NOMENCLATURE -

ST RONAN'S WELL RESERVE

Eric McCrum and Mary Madden
W.A. National Parks & Reserves Association Inc (WANPARA)

St Ronan's Well Reserve, with an area of 19 ha, was vested in the York Shire as a "Camping Reserve" prior to its vesting in WANPARA as an "Historic Site". Recently the association has requested that Lands & Surveys adds "Conservation of Flora and Fauna" to the vesting order.

St. Ronan's Well Reserve is located on the north side of the York Road, some 15 km west of York. Its southern boundary fronts the York Road, and it is fenced on all four sides with access from York Road.

There are two wells some 5 m apart. The larger is a "Mary" well, lined with local granite, and it was used to water horses and camel teams travelling to and from York. The second well is lined with convict-made bricks, and was used by people as a water source. The "Mary" well was probably constructed within 18 months of the first settlement at Fremantle in 1829; the second well was probably constructed when the convict road depot was still in use. Two wells were necessary to separate drinking facilities; at the time of construction of the second well the Afghans had just arrived in the colony with camel teams.

In 1830 an area of 5.12 km^2 was reserved around the well for a townsite. The town of St. Ronan's never came into existence, but the wells remained the last watering place before York for travellers and teamsters for more than 50 years. To assist with the road construction from Perth to York, a convict road party was stationed at the well in 1850. Even Moondyne Joe - the notorious bushranger - was once held at the St. Ronan's Well gaol before being taken to York. Remnants of some of the foundations of these old buildings are still evident.

By the 1960s a farmer whose property adjoined the reserve obtained permission from the York Shire to graze sheep on the reserve. Partial clearing and supering of the reserve eventually made it indistinguishable from the surrounding farmland. One side of the main well was pushed in and clearing levelled what was left of the buildings.

WANPARA undertook to revegetate and restore the reserve as part of their activities. This is being carried out in a series of yearly projects.

The Well Restoration

The smaller well has been cleaned out and now has a warning fence around it, with planking over its opening to help prevent pollution of its water, and possible vandalism. Fresh water suitable for drinking can still be drawn from it.

Because the wells hold water throughout the year, late summer was chosen as the time to pump the main well dry to allow removal of the granite stones bulldozed into the well and to rebuild the lining, using these original stones. Daily working bees on this well over the last two years have been hampered by the amount of water in the well. Pumping time has been lengthened in an attempt to solve this problem.

Consultation with other towns that have "Mary" wells has assisted WANPARA in restoring St. Ronan's Well.

Additional soil is being used to refill areas immediately east of the well. Two reasons have been given for bulldozing the wall of the well - one was to give sheep easier access to water, whatever the level, and the other - to extricate a horse which managed to fall in the well.

Picnic Facilities

A series of 10 m wide horseshoe-shaped picnic areas were designed, and in 1980 were planted with trees and shrubs. Each "nook" has its opening facing the wells. Native trees and shrubs were alternated in each horseshoe perimeter to create a wall to give privacy to each picnic area. Tables and benches, made from rough hewn natural timbers, were later installed in three of the bays.

Generous donations of trees have allowed intensive plantings. Additional trees and shrubs have been planted in many of the bay's perimeters to establish even denser walls; to give each picnic "nook" greater shelter and privacy. These bays were established on the east, north-east and west sides of the main well. As the water feeding the wells drains from the

north, and in the winter overflows to the south, those two sides were avoided as picnic areas.

Each year, since the original planting, replacements have been made where damage by sheep and farm machinery has occurred. Initially WANPARA had to place wire guards and posts about each plant to prevent damage by the sheep on the reserve. Sheep were finally barred from the reserve and the guards could be removed.

Revegetation

In the initial planting operation undertaken by WANPARA in 1979, native trees donated by Bold Venture Nursery and members, together with plants purchased by WANPARA funds, were used. Several planting areas were chosen.

In addition to the picnic area itself three other areas were selected for planting: the first between the well and the York Road; the second about 40 m east of the well; and a third 50 m north of the well. These were replanted respectively with Flooded Gums and Casuarinas; a mixture of gums and wattles; and gums, Melaleucas and small shrubs. These three areas were fenced with ringlock and barbed wire to keep the sheep out. All three areas were mowed to establish firebreaks along the fences and clear grass from between the young plants. In 1983 the areas are thriving.

In 1981 a donation of some 1200 trees from George Lullfitz and from WANPARA members allowed a massive planting to revegetate open areas in the north-west, and on the eastern boundary, of the reserve. This project has been successful as the 30 cms seedlings are now over a metre tall. Native plant seeds were also scattered in a variety of areas throughout the reserve. Only moderate germination is evident. However, it may be some seasons before the seedlings emerge through the grass. Melaleuca and Flooded Gum seedlings were planted along the creek areas with some success.

Birds have always been present in varying numbers, particularly in the mature trees around the wells, and now it appears that kangaroos are using the replanted areas for shelter and feeding.

Salt Areas

Two areas under heavy grazing had become seriously salt affected. Between the well and the road saline pools with salt-caked edges were numerous. Most of the surrounding vegetation was sparce, with large expanses of open ground.

The pools were gutter drained to the east-west flowing stream near the road. Fencing was erected around the area, and Flooded Gums, Casuarinas and Old Man Saltbush were planted. Progress has been encouraging. Many trees have thrived, with salt resistant samphire re-covering much of the bare ground, and both Flooded Gums and paperbarks are regenerating naturally.

The other salt problem was some 250 m west of the well and was a 1 ha area of bare, salt encrusted damp country. A fenced area of about 20 m^2 on the north-eastern side of the salt pan was planted with Tamarisk, Casuarinas and Eucalyptus sargentii. In later plantings, saltbushes, Casuarinas, Tamarisks and local Paperbarks were planted over much of the area. Already the salt reclamation area shows improvement. In the future it may be necessary to remove the Tamarisk.

Fire Control

On one occasion the total area was control burned by WANPARA members. In the subsequent years less grass has been evident, and some native shrubs are regenerating. Fire breaks are now established about the picnic facilities and on the inner boundaries of the reserve.

Weed Control

Several years of mowing and hand pulling of Cape Tulip have been carried out and much of the picnic area is now free of this weed. The hand pulled bulbs and foliage were burned. Much still needs to be done to eradicate the remaining hectares of this weed, which previously spread freely.

Stinkweed pulls have eliminated most of this weed. Truckloads were carried to an open area on the reserve and burnt. With the absence of sheep, much of the animal distribution of this weed's seed will be eliminated. Paddy

melons increased dramatically and a special working bee was used to collect and destroy the fruits.

Access Activity

As the roadway into the reserve crosses the westward flowing creek close to the road, WANPARA has approached Main Roads and a civil engineer for suggestions to improve the present ford. Large cement pipes have been stored near the site, and moves are underway to place these in the stream bed and seal the upstream approach to reduce erosion. Main Roads and the Police Department will be asked to consider the siting of the entry.

Management Plans

Management plans have been discussed with the Department of Conservation and Environment.

Historical Site

Approaches have been made to various institutions to see whether any graduate would be interested in researching the history of the buildings on the reserve, with the purpose of some eventual restoration being undertaken.

Subsequently applications for funds have been made, the aim being to encourage a postgraduate student to research the buildings, outline the foundations, and supply plans and specifications. Information in the Battye Library would assist this research.

SUMMARY

WANPARA is proud to have begun revegetating the reserve and to have achieved such success; restored the well to near original condition; begun Cape Tulip and Stinkweed eradication; begun a successful desalination revegetation scheme; and produced the "St. Ronan's Well" historical pamphlet - written by John Rogers (a WANPARA member from York).

Our future planning includes establishment of a shrub understorey, and with advice from the Wildflower Society, we will re-introduce indigenous wildflowers.

An additional unexpected workload has been caused by the recent clearing of a narrow strip between the eastern boundary of the reserve and a granite outcrop on privately owned land. This has caused an immediate erosion and silting problem which has jeopardised our new plantings.

Consistent with its committed use since 1830, this reserve still offers an inviting picnic stop to casual visitors.

MANAGMENT OF PINNAROO VALLEY MEMORIAL PARK

L.J. English
Superintendent, Pinnaroo Valley Memorial Park
(An Additional Paper)

1. INTRODUCTION

Pinnaroo Valley Memorial Park is an area of bush situated in the northern Metropolitan corridor, bounded by Whitfords Avenue to the north, the proposed Freeway extension to the east, Padbury housing to the west, and bushland to the south (presently vested with the M.R.P.A.). It consists of 111 ha, within which 11 ha have been developed as a Memorial Park, more commonly known as a "cemetery".

Pinnaroo is classified as an "A" Class Reserve and is vested in the control of a Board of Trustees, appointed by the Minister for Local Government.

2. AIMS AND FUNCTIONS

2.1 Primary

To provide a Memorial Park in a bushland setting which will create an atmosphere of tranquility for a resting place of the deceased.

2.2 Secondary Function

To create an area where passive recreation such as walking, small picnics or the quiet enjoyment of nature may take place.

To preserve the natural flora and fauna and to provide areas for research and for nature appreciation by the general public.

3. POLICIES IN RELATION TO THE FLORA AND FAUNA

3.1 Flora

The Trustees resolved in 1979 that all flora planted at Pinnaroo would

be of Western Australian origin. This has been followed (with the knowledge available), with any species not indigenous to the area being restricted to introduced garden beds in lawn areas or some extremely damaged bush areas close to developed areas.

The remaining natural bush areas have been left to regenerate at their own accord except for weed and fire control. Two areas of white sand coastal dunes, where damage has been caused by housing development on the boundary, have been replanted with Carpobotus aqualaterus (Pig Face) to stop wind erosion, and then over-planted with plants from the local environment. The results have been excellent.

3.2 Fauna

Not having any basic training in this field it is difficult to comment but observations indicate that with the preservation of the natural bush the wild life is multiplying.

Recently sighted were birds such as the Scarlet Robin, Splendid Wrens, Western Rosellas and numerous others. Kangaroos and Western Brush are quite common within the Park.

Two artificial lake complexes have been developed; one with a natural environment. At this stage only a few ducks have appeared, however, it is hoped that swans will eventually use the lake.

4. WEEDS PRESENT AND POLICY ON REMOVAL

Pinnaroo is located on an old stock route, and cattle rested here until they were taken into the auction yards or meat works. This was an ideal place for this purpose, with Lake Goollelal to the east, and Lake Mawson to the west.

The constant movement of stock through the area, and the continual disturbance by grazing, has led to the introduction of many weed species, including lupins, clovers, fine leaved grasses and Cape Tulip. In recent years veldt grass, Doublegees and wild Gladioli have become prominent, probably as a result of frequent fires and the intrusion of roads into the area. This has resulted in damaged areas of bush which

are easily invaded by weeds.

In 1978 it was decided that these weeds should be removed and the following management techniques were introduced.

4.1 Lupins

In 1978 there were approximately 30 ha of lupins, with some areas so thick it was difficult to penetrate on foot. Other areas only had scattered plants. To eradicate this weed we used a "brush cutter" on the thicker areas and hand pulled the scattered ones; a two man operation alternating to get maximum use from the brush cutter. Obviously timing is essential and flowering time was selected to ensure that regeneration did not take place. The operation in 1978 took approximately three weeks. Now in 1983 there are only 3 ha of scattered lupins, and these took only two days to remove, using the same equipment.

4.2. Clover and Narrow Leaved Grasses

No manual approach has been instigated but I believe that winter burning (i.e. late July early August), to reduce the fire hazard, is an important part of control. To support this theory I suggest the following.

(a) A late winter fire will not destroy the canopy and will leave some litter on the ground.

(b) Where there is a build-up of grasses these will carry a fire, destroying any of the previous year's dead grasses and also the present year's germination, thus preventing seed set in spring.

(c) Understorey plants that are affected by the fire have the spring to regenerate, and have time to establish themselves before autumn so they can successfully compete with the grasses.

I have tried this technique over the past two years with encouraging results.

4.3 Veldt Grass

In 1981 it became obvious from observations in other areas that if positive steps were not taken towards keeping the bush free of this weed, and the occurrence of several major fires in quick succession being a real possibility, the end result could be 111 ha of veldt grass. The eradication of lupins left some bare areas and the veldt grass has occupied these. The approach taken has been to pull and burn the older plants, and spray the younger ones. It is too early to gauge the effect of these actions; possibly it will take a fire to get a true indication. However, the immediate results are encouraging.

I believe that until all authorities and land owners take, or are forced to take positive measures, the problem will never decrease because of the nature and manoeuvrability of the seed.

4.4 Doublegees

Fortunately we have only a small area infested at this stage. However, because of the long term viability of the seed, the removal of this weed presents long term problems. Our approach at this stage has been manual pulling, spraying, and complete restriction of traffic.

4.5 Cape Tulip and Wild Gladioli

If the bush regenerates through protection from fire, and from other weeds, Cape Tulip and Wild Gladioli will eventually disappear as neither like competition, particularly the former.

5. SUMMARY

I feel that if any area of bush is left to its own devices it will, over a period of time, regenerate to its natural state; however in an urban setting management problems appear. To solve these problems vehicle and foot movement must be restricted. Fire control and fire hazard reduction burning must be selective both in period between burning and the time of the year in which it is undertaken.

The removal and control of weeds is a slow and tedious task, particularly

when one's neighbours leave their weeds. To control this there must be two lines of approach.

(a) Some form of legislation must be introduced to force various bodies to control troublesome weeds.

(b) Where eradication programmes are introduced, it must be a 100% commitment every year, even if it means attacking only small areas at any one time.

TOWN PLANNING IMPEDIMENTS TO WILDLIFE CONSERVATION

Max Hipkins
Town Planning Consultant, Max Hipkins and Associates

Most of the previous papers have demonstrated the good job that is being done in the preservation of small bush areas. I could do the same but rather (because I think it would be more productive) I have chosen to focus on the bad job town planners are doing, largely through no fault of their own.

Within the Perth metropolitan area, the Metropolitan Region Planning Authority and local councils exercise control over development via powers granted by Western Australia's Town Planning and Development Act. This Act does not recognise wildlife conservation as a legitimate land use in its own right, which creates severe impediments for the preservation and management of bush areas, both large and small.

The First Schedule to the Act specifies matters which may be dealt with by Town Planning Schemes. The closest references to wildlife conservation are as follows:

s.2. "Parks and open spaces generally; and particularly public reserves, gardens, playgrounds, sports and recreation grounds, public and private camping grounds and reserves, drill grounds, aviation grounds, public squares and other open public spaces, and fences, railings, monuments, statues, buildings, and other erections or works on parks, open spaces, public squares, and other public places."

S.11."Conservation of the natural beauties of the area, including lakes and other inland waters, banks of rivers, foreshores of harbours, and other parts of the sea, hill slopes and summits, and valleys."

S.12."The preservation of historic buildings and objects of historical or scientific interest."

Note that there is no direct reference to wildlife, flora, fauna or fisheries, although it can be argued that these items are indirectly

covered by broad interpretation of the words "park", "conservation of natural beauty" and "objects of scientific interest".

Town Planning Regulations made under the Act specify Scheme Report subject matter, notations and symbols for maps and a model Scheme Text, which are to be followed whenever a Planning Scheme is prepared. Admittedly the regulations are advisory only and are often varied, but once again there is no direct reference to wildlife conservation, flora, fauna or the natural environment generally.

The closest references are as follows:

In the Scheme Report subject matter: Part I, which specifies the Planning Data on which the Planning Scheme is based, reference is made only to "Crown Land and Reserves".

In the standard specifications for maps and symbols: there is a land use notation for "Swamp or Waterlogged Land", immediately followed by a notation for "Area to be reclaimed". Other notations specified are "Park and Recreation Area", "Special Reserves for State Forest and Water catchment" and "Undeveloped Land" (uncoloured). All wildlife areas are, by the Town Planning definition, either "Parks and Recreation Area" or undeveloped, and by implication are only waiting to be used for some purpose or other, and be given colours on the map.

In the model Scheme Text: Part II deals with Reservation of Land and Development thereof; Part III deals with zones and includes within the Table of Permitted Uses, which is based on a list of 50 use classes, "Public Recreation", "Rural Use" and "Zoological Garden" - these are the closest references to wildlife conservation.

The result is a confusion of definitions and terminology. By its omission, wildlife conservation is discounted in importance by most people associated with town planning and the development process.

There are exceptions of course - some Town Planning Schemes have included development controls in areas of significance to wildlife; some have even included tree preservation. However, these subjects are not specifically mentioned in the legislation and regulations and

consequently there is legal doubt as to their validity.

Generally, it is uncommon for Town Planning Scheme Reports to comprehensively discuss the natural environment or for Scheme Maps to identify valuable wildlife habitats, let alone the Text contain provisions for the protection of such areas.

Usually, wildlife reserves are included in the general category of "Park and Recreation Reserve". Unless the lands are vested in a State Government agency, such as Fisheries and Wildlife, there can be pressure on Local Councils to use the land for grazing or gravel extraction or to up-grade their sporting and recreation facilities within the "Park and Recreation Reserve" category, all at the expense of bush areas. Even if parks are limited to "passive recreation", this does not prevent the removal of native species and other destructive forms of use. In addition, any wildlife areas not reserved (that is, areas intended to remain in private ownership), are usually zoned for uses which would necessitate some degree of clearing.

The present procedure invites conflict as the Town Planning Scheme completely ignores wildlife conservation as a valid land use, and as a result confrontation between conservationists and developers is inevitable. In conflict situations the outcome is usually a compromise; for example, a small part of a lake is kept as a wildlife refuge, while the remainder is developed for recreation. Thus, the environment suffers, as the eco-system is reduced in area and degraded to such an extent that it is no longer self-sustainable.

If the issue is important enough to involve State Government agencies such as Fisheries and Wildlife or Conservation and Environment, or a habitat action group, the conservationists may win. But for how long - Councils change, concerned residents move on, people forget. With small bush areas, it is considerably harder to win. More often than not the bush occurs on private property and does not justify the allocation of scarce government resources. Individuals are often powerless to do anything even if they feel strongly. However, there is scope here to harness the energies of community minded professionals, enthusiastic landowners and voluntary conservation organisations. Difficulties occur as present legislation does not clearly accept a

simple conservation strategy such as tree preservation on private property, and thus there is little likelihood of private interests assuming greater responsibility for the protection and management of small bush areas.

Notwithstanding the successes we have heard about today, I would guess that most would probably readily admit, that small bush areas will inevitably continue to decline in both in quantity and quality, as the metropolitan region continues to grow.

Can anything be done to protect these bush areas? The recently adopted National Conservation Strategy for Australia (NCSA) identified insufficient knowledge and understanding of issues, and inadequate planning for integration of conservation and development, as presenting major obstacles to achieving NCSA objectives - 22(g),22(m). The following were listed as priority national actions for improving the capacity to manage.

S. 28(c)"Integrate land use planning and environmental assessment by encouraging a multidisciplinary approach (including socio-economic effects) to ensure that conservation and development issues are not addressed in isolation."

S. 28(g)"Review, and where appropriate revise, the charters of single purpose government authorities to enable them to take account of both conservation and development objectives."

With the current review of Western Australia's Environmental Protection Act, combined Town Planning and Environmental legislation is being considered for this State but is unlikely to become a reality in the short term. For the present, it is probably more productive to concentrate on correcting the imbalance of the existing Town Planning legislation and regulations, by incorporating reference to wildlife conservation.

The Parks and Reserve Act and the Town Planning Act should be amended to clearly specify that wildlife conservation, including tree preservation, is a matter which may be dealt with under these Acts. Whether or not this is done, the Town Planning Regulations should be changed to require an examination of the Physical and Natural Environment to be included within

the Planning Data of the Scheme Report Subject Matter (Appendix C) and there should be a further change to include a standard map notation for Wildlife Conservation (Appendix B).

A change of the regulations would be very much easier to achieve than a change of legislation. In fact, the regulations are currently being reviewed and the time is opportune to press for change. I suggest that this gathering seriously consider making a resolution at the end of the day, to support the changes that I have outlined.

The changes would be beneficial to both development and conservation interests as presumably the more each knows of the other's concern, the greater the likelihood that energies currently being directed to confrontation can be re-orientated, so that private interests accept greater responsibility for conserving small bush areas.

A PERSPECTIVE ON SMALL RESERVE MANAGEMENT

Ian Briggs
Environmental Officer, Department of Conservation and Environment

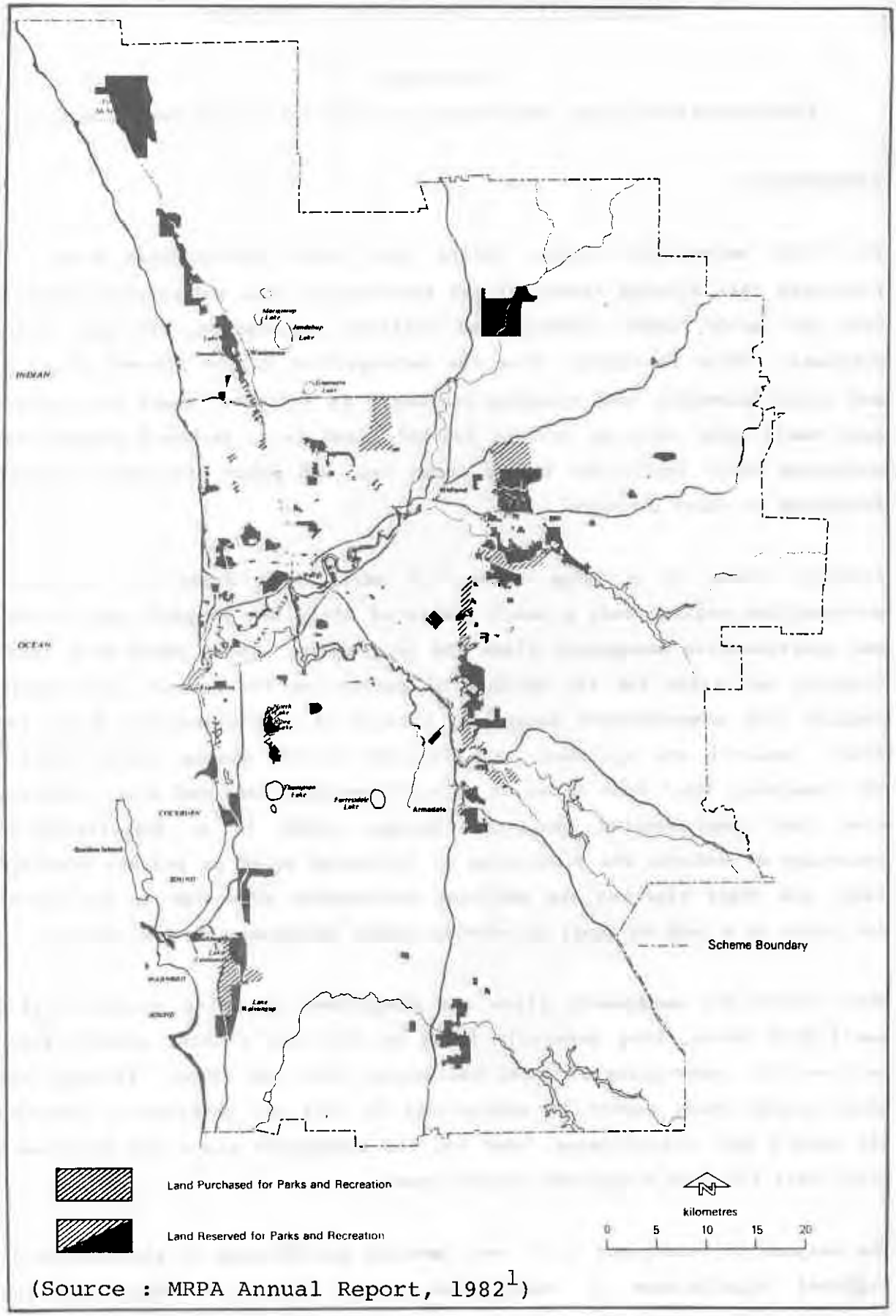
INTRODUCTION

The Perth metropolitan area, unlike many other metropolitan areas, is fortunate that a large extent of the residential area and countryside have been set aside, under planning and wildlife legislation, for open space purposes. This is evident from the Metropolitan Region Scheme[1] (Fig. 1) and Local Authority town planning schemes. In addition, there are a great many small bush areas on private freehold land (e.g. backyard gardens and uncleared rural land), and vacant Crown land and other uncleared reserves dedicated to other purposes.

Although there is a large number of small bush areas in the Perth metropolitan region, only a small number of these are managed under formal and comprehensive management plans and programmes. Those small bush areas formally set aside for the purpose of protecting the natural environment usually lack comprehensive management because of a deficiency in funds for staff, research and equipment, as discussed in the System 6 Green Book.[2] The remaining small bush areas on private freehold land and other reserves also lack comprehensive management because there is no legislation to encourage or enforce the protection of uncleared areas on private freehold land, and other reserves are awaiting development some time in the future and there is a lack of funds to provide proper management in the interim.

Where there are management plans and programmes providing protection for small bush areas, they generally focus on the area's local significance, such as the conservation of local indigenous flora and fauna. Although the local significance aspect is appropriate it does not necessarily describe the area's full significance, that is, the management plans and programmes often omit the area's regional significance.

The purpose of this paper is to very briefly outline some of the aspects of regional significance of small bush areas, so as to highlight the importance of managing the existing remnants of the natural environment in the Perth metropolitan region.



(Source : MRPA Annual Report, 1982[1])

FIGURE 1 The Metropolitan Region Scheme reserves for Parks and Recreation.

REGIONAL SIGNIFICANCE OF SMALL BUSH AREAS

There are many individual characteristics which give a small bush area regional significance. These characteristics can be broadly classified into three functions :

- habitat availability
- linkage
- scientific reference

Not all functions always apply equally to each area and in many instances only one or two of these functions may apply.

These functions have become increasingly important to the natural environment's well-being, especially since European settlement, because much of the Perth metropolitan region has been cleared to various degrees, as shown in Figure 2. The only extensive bush areas are those in the northern portion of the Swan Coastal Plain, and the central and southern portions of the Darling Plateau. The small bush areas in the remainder of the Plain and Plateau are the only remnants of the natural environment and their existence is under increasing pressure from direct and indirect impacts associated with both human activities and natural events. Thus, the management for the protection of the regional characteristics and functions of small bush areas is important and is discussed in more detail in the following sections.

HABITAT AVAILABILITY FUNCTION

This function is best explained using birds as an example. The presence of many bird species in the Perth metropolitan region is dependent on the continued availability of sufficient suitable habitats. Both nomadic and sedentary birds rely on the presence of good habitat for feeding, breeding and refuge. When sites are disturbed, either by man's activities or by natural events, birds utilizing the area are forced to find alternative habitats or perish.

Examples highlighting the importance of this regional function are the foreshore areas of Melville Water, the Fremantle group of islands and the

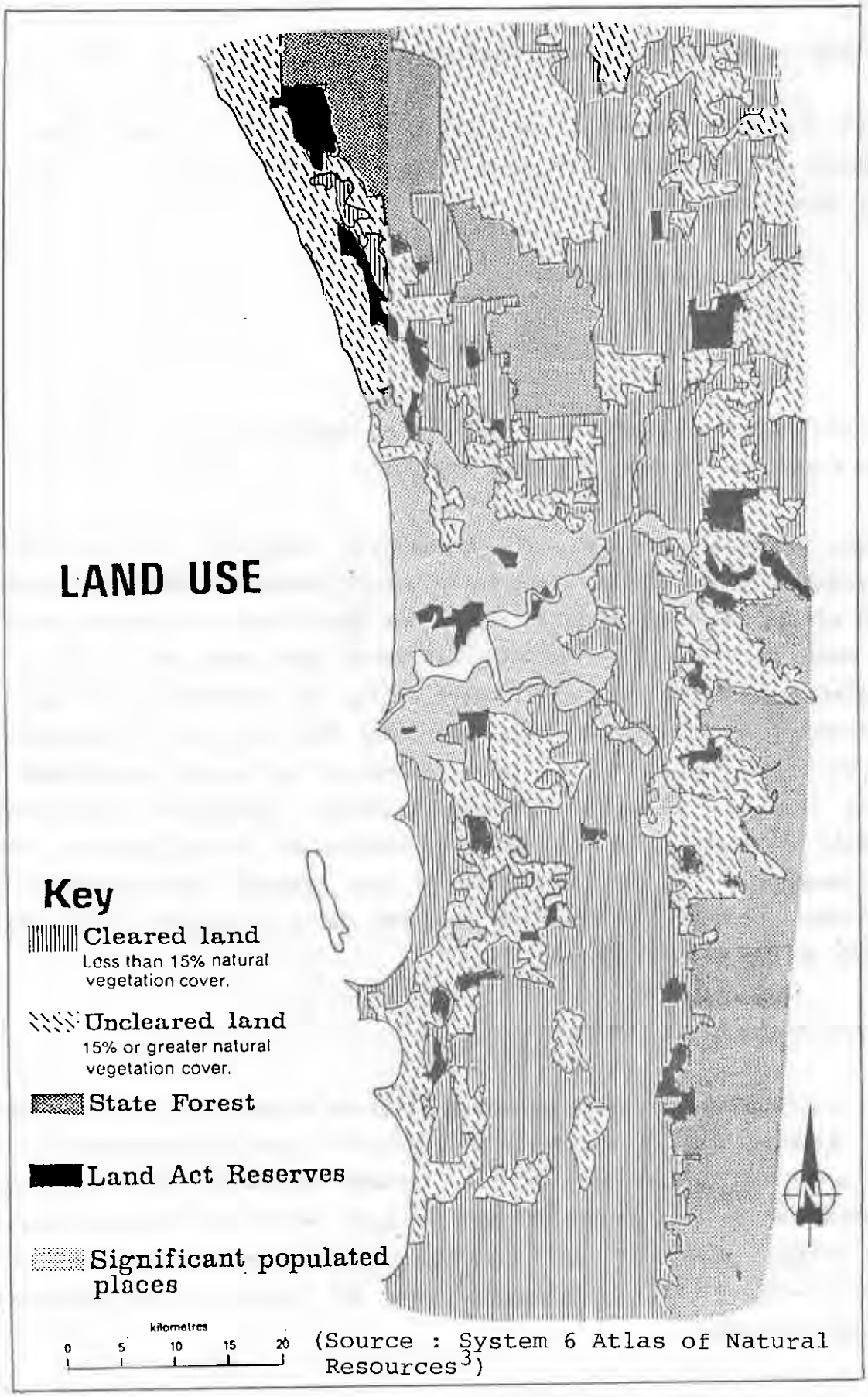


FIGURE 2 Degrees of Clearing on Swan Coastal Plain in the Perth Metropolitan Region.

wetlands of the Perth metropolitan region.

Firstly, the foreshore sites of Melville Water, namely Pelican Point, Alfred Cove and the South Perth foreshore (off Kwinana Freeway) provide good feeding areas for migratory waders as well as feeding and nesting areas for nomadic and sedentary birds. If any of these foreshore areas are adversely affected and the habitat degraded, then the other two areas provide suitable alternative habitats. Also, this and many of the other wetlands, together with the coastal fringe and islands, provide habitat for trans-equatorial migratory birds. These areas act as stop-over points, mainly because of their reliable food supply. Thus, a portion of the Perth metropolitan region is of international significance as recognised by both the Japanese and Australian Governments under the Japan-Australia Agreement[4]. This Agreement proclaims the need for the protection of certain trans-equatorial birds, with emphasis placed on the enhancement of habitat. Table 1 lists those trans-equatorial migratory bird species which regularly visit the Perth metropolitan region.

TABLE 1

Birds, included in the Japan-Australia Agreement, which regularly visit the Perth metropolitan region:

Wedge-tailed Shearwater	Wilson's Storm-petrel
Red-necked Stint	Sharp-tailed Sandpiper
Common Sandpiper	Curlew Sandpiper
Bar-tailed Godwit	White-winged Black Tern
Crested Tern	Bridled Tern

Secondly, in the Fremantle group of islands, for example, those in Shoalwater Bay, some bird species are colonial and may shift sites from one island to the next in successive seasons or within one season. For example, there are frequent site changes by the Caspian, Crested, Roseate and Fairy Terns due to predation, interference or repeated human disturbance at a previous site. Also, the breeding activities of the Pied Cormorant colonies result in the destruction of the nesting habitat (woody bushes) by the birds each breeding season. This necessitates the selection of a new site the following breeding season. If these species are to continue breeding successfully in the Perth region, sufficient habitat must be

available to permit this movement. Another regional significance aspect of the Fremantle group of islands, in terms of breeding, is that this group of islands is separated from the nearest nesting area by 100 km.

Thirdly, many wetlands in the Perth metropolitan region provide habitat for water fowl during drought periods, both in the region itself and in low rainfall areas, particularly to the north and east.

The small bush areas of the Perth metropolitan region have an important regional function in providing habitats for breeding, feeding and refuge. For habitat availability the small bush areas must be of a suitable quality, as this quality determines the habitat value. The habitat value of the small bush areas having this regional function is, in most cases, under increasing threat from man's activities, such as site disturbance from noise, air and water pollution, changes in ground water tables, recreation, indiscriminant and too frequent fires, vandalism, and the introduction of exotics - all of which contribute to the habitat degradation. There are also natural stresses from drought, disease, fire, flooding and seasonal variations in climate. Thus, to ensure maximum habitat availability, such disturbances, especially those derived from man's activities, should be considered in regional management plans and programmes for small bush areas in the Perth metropolitan area.

LINKAGE FUNCTION

An important requirement for nomadic birds is frequently occurring sites which provide refuge and food. For these birds it is necessary to have a "stepping-stone" or linkage system connecting feeding areas. The decline or absence of certain bird species in the Perth metropolitan region has been attributed to the absence of such suitable linkages. Thus the presence of bird species in the Perth area is dependent to some degree on the quality of the linkage system provided by small bush areas. This quality is determined by the distance between sites, the size and type of the site (e.g. large or small water body, dense understorey, or open woodland) and the quality of the site's environment (e.g. degree of human disturbance, amount of food, and number of feral cats). Many of the inner Perth small bush areas have become unsuitable as linkage sites for several bird species because of intrusion and disturbance by the urban population, and general degradation of the habitat.

The linkage function is also important for the movement of birds through the Perth metropolitan region, especially between major breeding and feeding sites. For water birds and waders linkages include offshore islands, (including Rottnest Island), coastal beaches and wetlands (such as the Cockburn and Wanneroo wetlands, which chain together with those dispersed throughout the coastal plain). For nomadic birds (e.g. honeyeaters and insectivorous species) mainland woodlands and forests, such as Warwick Woodland, Marangaroo, Kings Park and Bold Park are important. These are only a few examples of small bush areas ranging from backyard gardens to larger areas such as National Parks.

Another important aspect of the linkage function is the maintainence of floral genetic diversity to ensure succession of floral species. Many of the small bush areas are too small to ensure the survival of certain floral species. Some small bush areas may not contain large enough populations of certain species for them to be self sustaining, and thus must rely on the importing of seeds and pollen from more productive surrounding areas. Pollen is transported by birds, especially the nectar and pollen eaters (e.g. honeyeaters), and by insects and wind. Seed-eating birds are responsible for the movement of seed.

To ensure the presence of as many bird species as possible in the Perth metropolitan region and also to help maintain genetic diversity of floral species, it is necessary to provide a suitable "stepping-stone" or linkage system throughout the region. A good linkage system, that is, one of frequently occurring sites with high habitat values, assists in encouraging the movement of birds and other animals throughout the Perth metropolitan region. Thus, the regional function of linkage should be considered as an integral consideration in the production of management plans and programmes for small bush areas in the Perth metropolitan region.

SCIENTIFIC REFERENCE FUNCTION

Although most of the small bush areas in the Perth metropolitan region are not in a pristine state, they do indicate aspects of the natural environment, especially flora and landscape, prior to European settlement. At a regional scale the distribution of vegetation complexes on the Swan Coastal Plain is closely related to soil and topography and furthermore, is represented by a fairly simple pattern as shown in Figure 3.

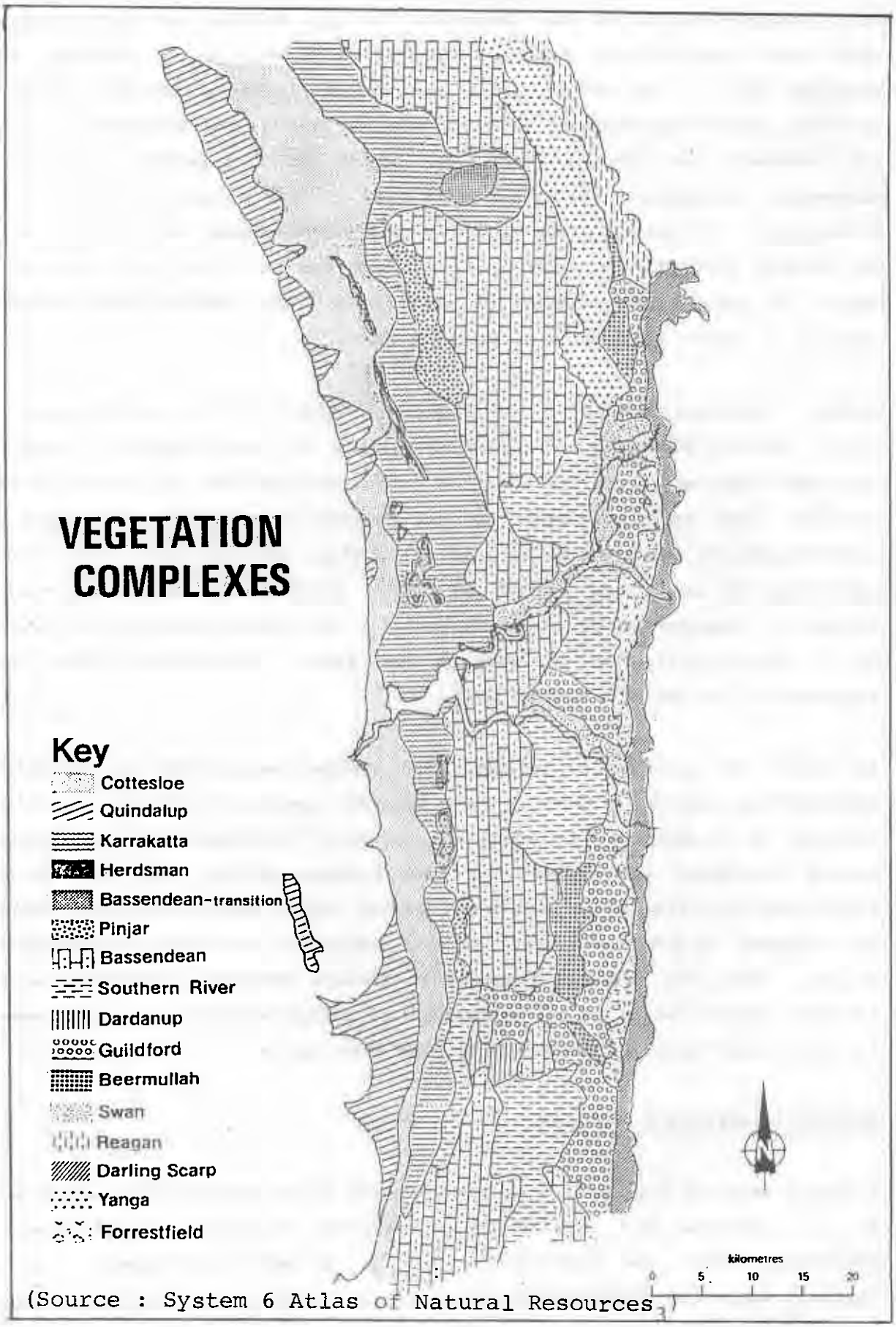


FIGURE 3 Vegetation Complexes on the Swan Coastal Plain in the Perth Metropolitan Region.

The relatively simple distribution pattern and the north-south orientation of the vegetation complexes enables a comparison of environments both longitudinally and laterally. For example, a comparison of wetland flora and fauna can be made both within a vegetation complex, say, at the northern and southern extremities of Cottesloe or Bassendean vegetation complexes, as well as between vegetation complexes, such as along an east-west transect from the Quindalup to the Guildford vegetation complex. This simple distribution over such a large area of the Perth metropolitan region permits the relatively accurate measurement of environmental changes in any one vegetation complex. For example, the affect of urbanisation on small bush areas located on elevated topography, lowlands or wetlands can be measured by using undisturbed sites as controls found in the same vegetation complex outside the urban area.

A more moderate aspect of this reference function is the provision of varying types of bush land in the urban and rural areas for educational purposes as well as for aesthetic reasons. In terms of aesthetics, the existing distribution of small bush areas provides examples of different landscapes between the coastal plain and the Darling Scarp, and at the same time breaks the monotony of the urban and industrialised environment.

DISCUSSION

The three functions of available habitat, linkage and scientific reference are very important: to the well-being of animal and floral species; for scientific measurement of the environment; and in providing natural bush settings in urban and rural areas. Thus, small bush areas, whether on reserves having conservation or open space purposes, on other reserves awaiting future development, or on private freehold land, play an integral role in the quality of community life in the Perth metropolitan region.

At present there is little formal management of reserves set aside for open space or conservation purposes, or for other uncleared reserves awaiting future development; nor is there any legislation which encourages or enforces the protection of bush areas on private freehold land. This deficiency is recognised in the System 6 Study[2] and one of the main thrusts of the Study is to promote the setting aside of "larger" (i.e. over 20 ha) small bush areas for conservation purposes (see Figure 4). It also recognises the regional significance of small bush areas in the Perth

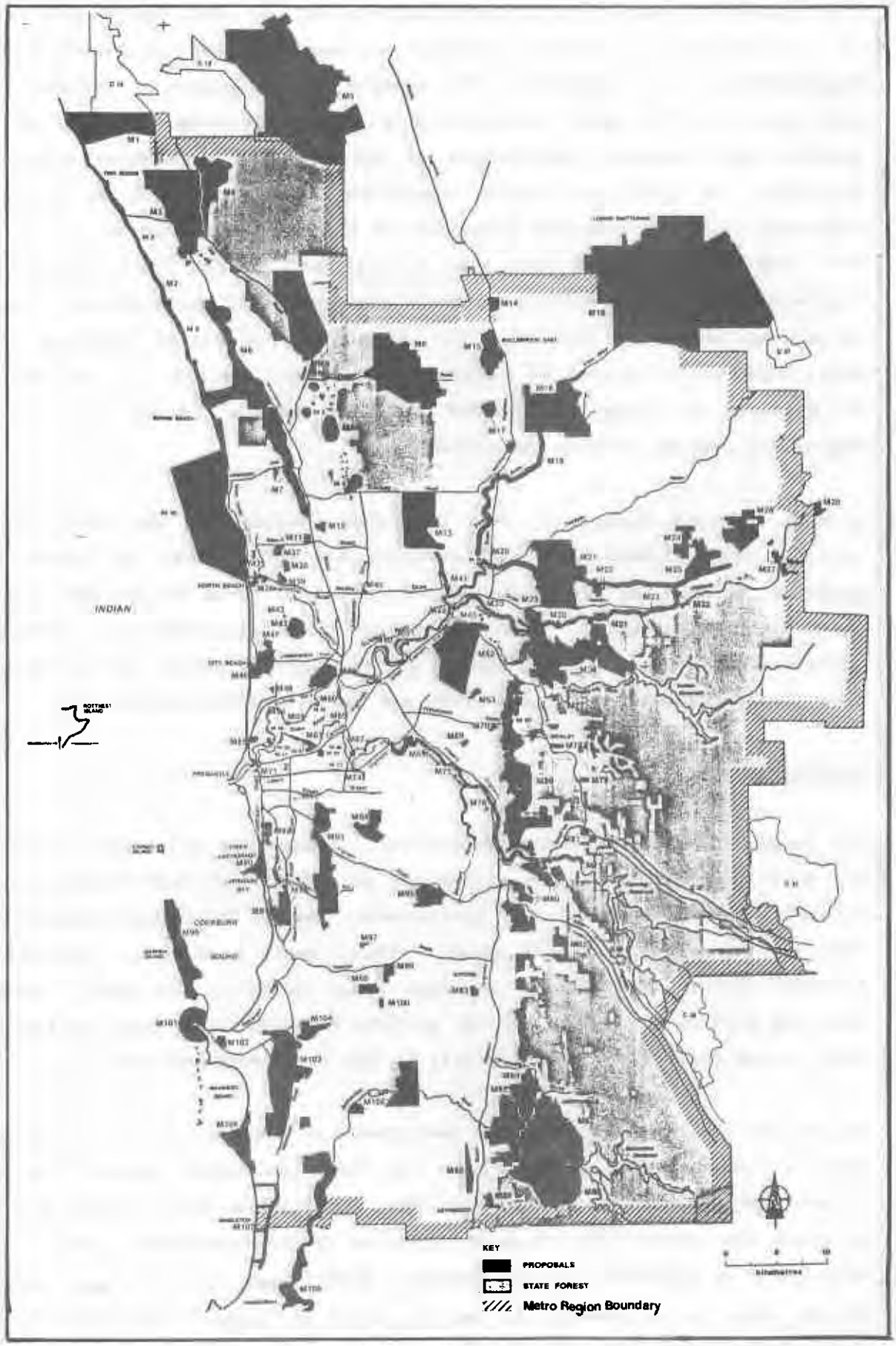


FIGURE 4 Recommendation Areas in the Metropolitan Region in the System 6 Green Book[2].

metropolitan area and has recommended the creation of regional parks to ensure a co-ordinated regional approach to the planning and management of habitats and linkage systems including Land Act reserves, and government and private freehold land.

In conclusion, the small bush areas in the Perth metropoliton region are remnants of the pre-European environment and thus represent the only "natural" habitats available. Without proper management of these areas their habitat value is degraded, reducing their ability to support populations of indigenous flora and fauna and resulting in a relatively poor opportunity for the movement of animals, especially birds, throughout the region, as well as threatening the succession of flora species. This could lead to a decline in the bird species present and a loss of vegetation species. Thus, the small bush areas require management plans and programmes which take into account their value in the regional context.

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[1] Metropolitan Region Scheme : Metropolitan Region Planning Authority Annual Report, MRPA, Perth, 1982.

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[3] Department of Conservation and Environment : Atlas of Natural Resources, Darling System, Western Australia, 1980.

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MANAGEMENT PLANNING FOR METROPOLITAN BUSH AREAS

Robert Powell
W.A. Department of Fisheries and Wildlife

THE NEED FOR MANAGEMENT PLANNING

Once we have decided to preserve an area of bush we must then consider how best to manage it. The two main aims of management are (1) to maintain the area's natural features (or, if it is degraded, bring it closer to its natural condition), and (2) to encourage the public to enjoy it and learn from it.

In the preceding papers we have read about the varied factors that affect bush areas; many of these are strongly inter-related, for example natural vegetation, weeds, fire and people. On the one hand, virtually all the management problems - repeated fires, weeds, erosion, rubbish dumping - are caused directly or indirectly by people. On the other hand, people can gain much pleasure and knowledge from bush areas, and, moreover, can develop an interest in helping to manage them (e.g. by weeding).

So the value of a bush area will depend very much on how well it is managed. Good management requires a management plan, so that principles and procedures can be thought out in advance and followed through. Without public support a plan is unlikely to succeed; the preparation of a management plan must therefore involve the public.

THE PROCESS OF MANAGEMENT PLANNING

I believe there are four important steps in management planning:

1. Study of Reserve

   We need to know the plant species and their distributions in the reserve. It is also helpful to know which ones are less likely to continue to survive in the reserve, and which ones are of special interest - for example, those with a restricted occurrence in general. We should also find out as much as we can about the various groups of animal species that inhabit or use the reserve. The reserve's history

(including fire history) and present management problems should also be noted.

2. Draft Plan

The draft plan should be widely circulated so it reaches most people likely to use the bush area. This can be done by publishing an article in the local newspaper summarizing the draft plan and stating where copies may be obtained. In cases where the area is of regional rather than local significance (e.g. Bold Park, which contains Reabold Hill, the highest hill on the coastal plain in the metropolitan area), draft plans should be publicised more widely, by an article or advertisement in one of the main newspapers.

Comments on the draft plan should be invited. The case for preserving the bush should be carefully argued in the draft plan, to ensure that people understand and support the plan. It is especially important to gain the support of persons living next to or very near to the reserve, and it is a good idea to have special discussions with them.

3. Public Response

Summarizing the public submissions and making this summary available indicates to the public that their comments have been seriously considered, and that they are actively involved in the planning process.

4. Final Plan

This should acknowledge the public submissions received and where possible should include suggestions made in these submissions.

It should be circulated widely.

Preparing a management plan in this way will do much to increase public interest and support.

PROVIDING THE DETAILS

The two Model Management Plans that follow are preliminary attempts to provide guidelines for writing management plans. The first is for an area of good quality bush, as may be found in an outer suburb; the second is for a small area of bush that has been modified by various pressures. Both of them contain provisions for: public use; fire control; weeding; removal of rubbish; erection of barriers where necessary; and taking of photographs for monitoring.

The second Model Management Plan includes additional measures aimed at bringing the vegetation closer to its natural state. These are: the removal of any non-local plants that have been planted; the planting of local species; watering; and the avoidance of pruning. These require more understanding of our bush and its ecology than most of the measures that are listed in both Models. They are explained under Management Measures 2, 4, 5 and 9 of the second Model, and I wish here, too, to expand on these:

Removal of non-local Plants

Since the aim is to promote bush (i.e., a natural association of species), all non-local species - those that are not natural to the site - should be removed.

Planting of Local Species

Planting tends to destroy the natural character of the vegetation, and therefore should not be carried out unless absolutely necessary. One should not be in a hurry to plant: natural regeneration (as is encouraged by weeding) should be tried for the first few seasons.

Planting must of course be confined to local species. Furthermore, since most plant species vary a lot genetically, the propagating material should be collected at or near the site.

Finally, planting must be in sympathy with the type (or types) of vegetation present. We must take care to avoid changing its composition and structure (e.g. the massed planting of jarrah seedlings might turn

a jarrah-banksia woodland into a jarrah forest). If the vegetation is not uniform throughout the reserve, the plantings of individual species must be within the zones in which they already occur.

Watering

The purpose of watering is merely to help newly planted seedlings through their first summer; watering is otherwise generally harmful to bush. Watering must therefore be specific and be done by hand. A bush reserve is no place for installing reticulation.

Avoidance of Pruning

The lopping of trees and pruning of shrubs are widespread practices in Perth. In bush areas, with their emphasis on the natural, such pruning is clearly inappropriate. Unpruned trees and shrubs offer an immense variety of forms. Dead branches are very informative, because in attempting to determine why they are dead we can learn about ecology. They contribute to the overall structure of the plant. They are also important biologically, providing hollows for birds, bats and reptiles.

I should be pleased to receive any comments you have on the Model Management Plans.

MODEL 1

MODEL MANAGEMENT PLAN FOR AN AREA OF GOOD BUSH IN AN OUTER SUBURB OF PERTH

PART ONE : GENERAL

The purpose of this management plan is to retain the area of bush located at _ _ _ _ _ _ _ _ _ (see attached plan) for the wildlife it contains and for people's enjoyment. Bush areas support not only many species of local plants but also a great diversity of associated animals, especially invertebrates (insects, spiders, etc.). By retaining areas of bush we can become familiar with local flora and fauna. Such areas are most appropriate and convenient sites on which schools (both primary and secondary) could conduct field studies as part of their biology courses. Even for those persons uninterested in learning about local flora and fauna, bush areas can provide a restful change from the many developed parks, and an historical insight into the past state of their local environment.

It should be remembered that there will not always be bush around the suburb of _ _ _ _ _ _ _ _ _. Only fifty years ago there was extensive areas of bush in and around such suburbs as Nedlands, Attadale and Mosman Park, but very little remains today: it has been replaced by roads and houses and largely artificial parks and gardens. In some of these older suburbs, residents are taking an increased interest in small remnants of bush, both in planning for their retention and management, and in carrying out weeding and other management practices.

The System 6 Study Report recognised the value of retaining areas of bush, and recommends that in the Metropolitan Region 'the growth and regeneration of local indigenous flora should be encouraged' or words to that effect.

This particular area contains a large number of plant species: _ _ _ _ _ _ (number) (see attached list). Most of these species are typical of the soil-type of this site: _ _ _ _ _ _ _ _ _ _ (soil-type). Some of them, for example _ _ _ _ _ _ _ _ _ (species), are virtually confined to these soils, while others, for example, _ _ _ _ _ _ _ _ _ _ (species), are of more widespread occurrence and are also found growing on _ _ _ _ _ _ _ _ _ (soil-types). A particularly interesting feature is that the species are by no means uniformly distributed _ _ _ _ _ _ _ _ _ (species), for example,

grow mostly at _____(part of area), whereas _____ (species) are largely confined to _____ (part of area). This is probably because _____.

Since this plan involves the retention of the area as bush (i.e., a natural association of species), no planting will be undertaken. The planting of species that do not grow here would only detract from the total effect, and serve as a perpetual reminder of human interference. Even the planting of species that do grow here could easily interfere with the natural patterns of the distribution of the various species (see above). In the management of degraded areas of bush it is sometimes necessary to plant where there are bare patches to speed the process of recovery (taking great care to plant only local species propagated from seed or cuttings taken from naturally occurring plants on or near the site), but this is quite unnecessary in this area, with its good cover of vegetation.

Term of Plan

The term of this management plan is 10 years. After 10 years the Management Measures (below) will be reviewed to determine their effectiveness, and a new management plan produced, either with the same or with modified Management Measures. The Management Aims of the new plan will remain unaltered.

PART TWO : PLAN FOR MANAGEMENT

Management Aims

1. To protect the local vegetation and maintain it in a state as close as possible to its natural one.

2. To encourage the use of the area by school children and others in such a way as to help them develop a familiarity with local vegetation and an understanding of its ecology.

Management Measures

1. Public Use

(i) The careful design of pathways around or through the area to encourage people to keep to them and thus not trample the vegetation.

(ii) The use of signs, labels, etc., to help people to learn about local vegetation.

2. Weeding when and where necessary - for the purpose of reducing competition from introduced plants, and thus encouraging the growth and regeneration of naturally occurring plants. It will be adequately supervised to ensure that disturbance to naturally occurring plants is minimal. If necessary, advice will be sought from the Department of Fisheries and Wildlife.

3. Any rubbish that has been dumped will be promptly removed. Rubbish has several harmful effects. It looks unsightly and encourages further dumping. By acting as a fertilizer it harms local plants and at the same time encourages weeds. It may create a fire hazard and may harbour vermin.

4. Meaures to Control Fire

(i) Weeding (No. 2) will help reduce the incidence and impact of fire.

(ii) The ploughing or mowing of minor firebreaks around the borders of the area if necessary. Internal paths will act as further firebreaks, and will help confine any fires that occur, preventing them from burning the entire area.

(iii) Using residents near the area to volunteer as fire informers, to notify the _____ (body) of outbreaks of fire.

Frequent fires cause extensive damage, by injuring and thinning the natural vegetation and reducing the leaf litter on the ground, and by encouraging weed growth. Vegetation that has been recently burnt is more accessible to people, and is thus vulnerable to trampling and soil disturbance. In this Plan the aim will be to maintain an interval of <u>at least</u> 15 years between fires. Vegetation that remains

unburnt for longer still is of scientific interest because it provides information on plant longevity and reproduction in the absence of fire.

5. The erection of barriers, where necessary, to encourage people to keep off fragile areas (e.g. steep slopes); and the erection of temporary fences if necessary, to protect, from trampling, areas that have been accidentally burnt.

6. The taking of photographs from fixed points every two years, and their careful examination. If they indicate any deterioration in the plant cover, the causes of the deterioration and appropriate remedial action can be carefully considered. If necessary, advice will be sought from the Department of Fisheries and Wildlife.

MODEL 2

MODEL MANAGEMENT PLAN FOR A SMALL AREA OF SEMI-NATURAL BUSH IN AN INNER METROPOLITAN SUBURB

PART ONE : GENERAL

The purpose of this management plan is to retain the area of bush located at _ _ _ _ _ _ _ _ _ _ (see attached plan) for the wildlife it contains and for people's enjoyment. Even small areas of bush support not only many species of local plants but also a great diversity of associated animals, especially invertebrates (insects, spiders, etc.). By retaining areas of bush we can become familiar with some of the local flora and fauna. Such areas are most appropriate and convenient sites where schools (both primary and secondary) can conduct field studies as part of their biology courses. Even for those persons uninterested in learning about local flora and fauna, bush areas can provide a restful change from the many developed parks, and a historical insight into the past state of their local environment.

Areas of bush in the Metropolitan Region are fast disappearing as the city continues to expand. Moreover, remnants that do survive rarely stay in a natural or near-natural state. The reasons for this are twofold. Firstly, they are subjected to heavy pressures, such as rubbish dumping, trampling and frequent burning. Secondly, non-local plants are often planted within them, which detracts from their natural character. However, if well managed, bush areas can not only retain, but also improve, their natural condition. Management techniques employed in recent years have increased the cover and even the diversity of the local vegetation of a reserve in Hollywood. In Fremantle, the vegetation cover in a small bush area has increased simply as a result of less frequent burning.

The System 6 Study Report recognised the value of retaining areas of bush, and recommends that in the Metropolitan Region 'the growth and regeneration of local indigenous flora should be encouraged' or words to that effect.

This particular area has in the past been subjected to many of the pressures mentioned above, which have caused changes in its appearance. Trees have been damaged and the understorey has become sparse and

fragmented. Introduced plants, especially _____ (species), have become abundant. Nevertheless, _____ (number) of the original species survive on the reserve (see attached list). Most of these species are typical of the soil-type of this site: _____ (soil-type). Some of them for example _____ (species), are virtually confined to these soils, while others, for example, _____ (species), are of more widespread occurrence and are also found growing on _____ (soil-types). An especially interesting feature is that the species here are by no means uniformly distributed _____ (species), for example, grow mostly at _____ (part of area), whereas _____ (species) are largely confined to _____ (part of area). This is probably because _____.

Since this plan involves the retention of the area as bush (i.e., a natural association of species), any planting that is undertaken should be strictly of local species (i.e. those species that are natural to this particular site) and will be done in such a way as to preserve the natural character of the area (see Part 2 - Plan for Management. 4. Planting). Increasing the cover of natural vegetation should be achieved, as far as possible, by natural regeneration rather than planting.

Term of Plan

The term of this management plan is 10 years. After 10 years the Management Measures (below) will be reviewed to determine their effectiveness, and a new management plan will be produced, either with the same or with modified Management Measures. The Management Aims of the new plan will remain unaltered.

PART TWO : PLAN FOR MANAGEMENT

Management Aims

1. To protect the local vegetation and maintain it in a state as close as possible to its natural one.

2. To encourage the use of the area by school children and others in such a way as to help them develop a familiarity with local vegetation and an understanding of its ecology.

Management Measures

1. Public Use

   (i) The careful design of pathways around or through the area to encourage people to keep to them and thus not trample the vegetation.

   (ii) The use of signs, labels, etc., to help people to learn about local vegetation.

2. The removal of the non-local trees and shrubs that have been planted in the area. This should be done:

   (i) in winter, so the local plants do not suffer from the sudden removal of shade during summer

   (ii) with as little disturbance as possible to the soil and the local vegetation.

   Although it is always sad to remove plants, the removal of the non local plants is necessary to enable the area to develop a natural plant association, suitable for biological field studies and as a harmonious reminder of the past state of this part of _ _ _ _ _ _ _ _ (suburb).

3. Weeding will be carried out to reduce competition from introduced plants, and thus encourage the growth and regeneration of local plants. It will be adequately supervised to ensure that disturbance to naturally occurring plants is minimal. If necessary, advice will be sought from the Department of Fisheries and Wildlife.

4. Plantings should only be necessary in bare areas and only species occurring naturally on the site† (i.e. the species in the attached list) should be used. They will be propagated from seeds or cuttings collected from the site itself or nearby sites with a similar soil-type. Seeds and cuttings so collected may be given to a nursery for propagation on the understanding that no substitutes will be accepted. No nursery plants should be used.

Wherever natural regeneration can be utilized to revegetate bare areas, this is preferable to planting, and planting should be regarded as a preliminary measure, to be discontinued once plant cover has increased.

5. Plants experiencing their first summer after planting should be watered. Such watering will be no more than once a week, and to be done individually by hand. No general watering will be undertaken, because it is liable to harm some species and upset the natural balance.

6. Any rubbish that has been dumped will be promptly removed. Rubbish has several harmful effects. Not only does it looks unsightly and encourage further dumping, it also acts as a fertilizer, harming local plants and encouraging weeds. It may also create a fire hazard, and harbour vermin.

7. Measures to Control Fire

(i) Weeding (No. 3) will help reduce the incidence and impact of fire.

(ii) The mowing or ploughing of minor firebreaks around the borders of the area if necessary. Internal paths will act as further firebreaks, and will help confine any fires that occur, preventing them from burning through the entire area.

(iii) The asking of residents near the area to volunteer as fire informers, to notify the _ _ _ _ _ _ _ _ _ (body) of outbreaks of fire.

Frequent fires cause extensive damage, by injuring and thinning the natural vegetation and reducing the leaf litter on the ground, and by encouraging weed growth. Vegetation that has been recently burnt is more accessible to people, and is thus vulnerable to trampling and soil disturbance. In this Plan the aim will be to maintain an interval of at least 15 years between fires. Vegetation that remains unburnt for longer still is of scientific interest because it provides information on plant longevity and reproduction in the absence of fire.

8. The erection of barriers where necessary, to encourage people to keep off fragile areas (e.g. steep slopes); and the erection of temporary fences if necessary to protect, from trampling, areas that have been accidentally burnt.

9. The avoidance of any sort of pruning of local plants except where absolutely necessary. The natural structure of a plant is an important aspect of its beauty; it is also very informative, since different plants grow in different ways for different reasons. Dead branches are as informative as living branches. If a branch must be pruned, for example to make a path passable, it should be cut completely off, leaving no stump.

10. The taking of photographs from fixed points every two years, and their careful examination. If they indicate any deterioration in the plant cover, the causes of the deterioraiton and appropriate remedial action can be carefully considered. If necessary, advice will be sought from the Department of Fisheries and Wildlife.

†Note: If the number of remaining local species is very small indeed it may be desirable to plant other species that are almost certain to have originally grown on the site. Advice should be sought from the Department of Fisheries and Wildlife.

CAPABILITY ASSESSMENT AS A PREREQUISITE TO DECISION MAKING

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The decision to develop a parcel of land for urban use has been based, in the majority of cases, on the land "being there", rather than the attributes of the land being suitable for a particular use. Historically, a decision to develop a parcel of land has simply been made on the premise that the land adjacent to the last development was available. No capability assessment of these parcels of land was undertaken.

With the development of environmental awareness in the late 1960s, developers were forced to look more closely at their land prior to approval for development, and to preserve areas within the development as "open space". The minimum percentage of open space was laid down by law but could include drainage lines, small unusually shaped areas, and natural features, such as swamps.

In addition, there was little co-operation between developers of adjoining land areas. Consequently, developments could take place without the incorporation of large areas of open space, unless the planners were able to have an input into the decision making process. Thus, remnants of areas developed were small areas unsuitable for retention as natural areas.

G. Tyler Miller, Jr., in his book "Living in the Environment" has identified a number of goals that aim at preserving a rich diversity of spaces that match the diversity of human needs. These include:

- Aesthetics - preservation of visually pleasant and beautiful places
- Establishment of recreation areas
- Preservation of unique historic or cultural sites
- Provision of physical and ecological buffer zones between and within urban areas
- Provision of habitats for birds and other forms of wildlife that can live in or near urban areas.

To achieve the goals, the areas suitable for preservation must be identified as the first step. To achieve the identification of these

areas, an assessment of the physical attributes of the total area (on a regional basis) must be undertaken. This is capability assessment.

Capability Assessment

Capability assessment is the identification of the physical attributes of an area and the assessment of the effect each attribute, either individually or in combination, will have on the development of a particular parcel of land.

Various methods are available for capability assessment. Aerial photographic interpretation with field checking may be used to produce reconnaissance level assessments. More detailed surveys can then be undertaken on the areas that appear suitable for development. The detailed surveys, undertaken at mapping scales between 1:5 000 to 1:25 000 usually involve intensive field surveys.

Attributes which require identification include:

- Geology, landform, soils
- Contemporary geomorphic processes
- Fauna and flora
- Surface and groundwater hydrology
- Historic sites
- Archaeological and ethnographic sites
- Current regional land use

With the collection of this base data, an assessment can be made of the capability of that land parcel. Areas that are not suitable for urban development are, therefore, available for uses such as open space or bushland.

The capability assessment can involve the use of map overlay systems such as expounded by McHarg (1969), a matrix system as used in Canada, computer mapping techniques, or simply subjective personal assessment.

McHarg (1969) mapped all the individual attributes using pastel mapping colours for suitable areas and graded to dark colours for those unsuitable. By overlaying the maps, the lighter coloured suitable areas are clearly distinguished among the dark colours. Even within this system, subjective

decision must be made of the relevant value of each attribute in deciding what colour tone should be used. This system, with modification, has been most useful at the regional scale of mapping.

Matrix systems are usually computer programmes that are complicated and require "weighting" of attributes. These systems are not perceived to be suitable at the local scale for use by councils or developers. Computer mapping is also generally beyond the scope of council capability. Subjective personal assessment is the most widely accepted and used method. An individual's assessment should always be followed up by round table discussion to achieve a balance between the ideas and requirements of both planners and users.

The capability assessment procedures therefore identify those areas suitable for conservation, active and passive recreation, residential, and commercial or industrial uses. It is the areas which are identified as being suitable for conservation and passive recreation in which we are interested.

The assessment of land capability on the broad scale is advantageous to local councils which administer these small bush areas. The principal attributes of the areas have been identified and councils are then able to carry out more detailed surveys according to their requirements. The capability assessment is able to place each bush area in the regional setting such that pressures that may not be identified at the local level can be identified at the regional scale.

Conclusion

For too long, small bush areas simply have been formed from the "leftovers" of urban development. The identification and assessment of capability of land for use as small bush areas must take priority over ad hoc development strategies.

References

McHarg, I.L. (1969). Design with Nature. (Falcon Press : Philadelphia).

Miller, G.T. Jnr. (1975). Living in the Environment. Concepts, Problems, and Alternatives. (Wadsworth: Belmont, Calif.)