LANDNOTE

CONSERVATION AND LAND MANAGEMENT
Number 1 1994

REVEGETATION AND RECOLONIZATION BY VERTEBRATES OF FITZGERALD RIVER NATIONAL PARK, WESTERN AUSTRALIA FOLLOWING 1985 WILDFIRE

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ABSTRACT

Vegetation regeneration and recolonization by vertebrate fauna were examined over a 3 year period following a large (17 500 ha) summer wildfire in the Fitzgerald River National Park. Many species of reptile survived in the burnt area, particularly in disused nests of the ant Iridomyrmex conifer. Small pockets of unburnt vegetation appeared to play an important role in the survival of small passerine birds. Pitfall capture rates of small vertebrates were low, both in the burnt area and in adjacent unburnt stands. Vegetation regeneration was predominantly by means of woody root stocks and from seed. A considerable number of annuals were recorded following the fire, including a number of species rarely seen in long unburnt vegetation. Species of short lived ephemerals contributed substantially to the foliage cover in the immediate post-fire years, but had begun to decline within 3 years.

INTRODUCTION

The Fitzgerald River National Park (FRNP), located on the south coast of Western Australia between the coastal towns of Hopetoun and Bremer Bay, see Fig. 1, covers an area of 328 000 hectares. The park has an exceptionally rich biodiversity and several species of mammals and birds, including most of the rare ones,are dependent upon long unburnt vegetation for their survival (Chapman and Newbey 1987).

On 31 January 1985 a lightning strike on Woolbernup Hill started a fire which burnt for 21 days and covered an area of 17 500 hectares or 6.5% of the park. This paper describes the recovery of flora and fauna over a period of three consecutive years.

Although the fire completely burnt out the vegetation in some areas, unburnt patches remainded amounting to approximately 5% of the area covered by the fire. Most of the study area was an almost flat marine plain with deep sands and clayey sands the most frequent soil type. Sands supported *Eucalyptus decipiens* very open shrub mallee (Muir 1977) with small areas of *Banksia baxteri* scrub. The clayey sands were occupied by structurally similar vegetation dominated by *Eucalyptus uncinata*. Occasional swamps occurred in the area and supported *Eucalyptus occidentalis* woodland. Also in the area were hills of quartzite and phyllitic schist which supported mixed open scrub vegetation. Detailed site descriptions of these vegetation / soil complexes are in Chapman and Newbey 1987.

METHODS

Observations were carried out at 9, 23 and 35 months following the fire. The wettest winter in FRNP since 1972 occurred between the first and second recording periods.

VEGETATION

Vegetation and flora were recorded at each quadrat. Structure and floristics were recorded at the two unburnt sites in an area of 50 x 60 metres and 5 x 1 metres at burnt sites. At the latter a) all individuals of all taxa and b) average height of each taxon were recorded. Recording periods are in Table 1. Data from site 4 are excluded from analysis in Table 2 because site markers were removed, however a replacement quadrat was marked out. Taxa in flower, or having recently flowered, were recorded in the burn and their flowering frequency and cover/abundance assessed in Table 3. A single patch of *Eucalyptus occidentalis* woodland of approximately 40 hectares was about three quarters burnt. Two plotless sites of 0.5 hectares were selected within burnt and unburnt sections of the woodland. These data are in Appendix 1.

FAUNA

Each trapping quadrat consisted of 6 x 60 cm long PVC cylinders with an external diameter of 14 cm sited in a 10 x 20 metre rectangular grid. Pit traps were unfenced and unbaited. Two quadrats were established in unburnt vegetation at the edge of the burn, 5 in burnt vegetation, including 2 at the burnt edge of the burn, see Fig. 1. The total number of pit trap nights was 630.

All mammals were temporarily marked on the tail with 'texta' pen to identify recaptures, weighed, identified and released. In the first recording period 20 Elliott traps were run for five consecutive nights on Woolbernup Hill. For the second and third periods 20 Elliott traps were run for five consecutive nights in a burnt out creek-line. This site was outside all pit trap grids. During all recording periods bird and reptile data were recorded opportunistically.

Most data on reptile survival were obtained by actively searching out cryptic species. For birds particular attention was paid to small pockets of unburnt vegetation.

TABLE 1
SAMPLING PERIODS ON BURNT SITES

MPF = Numbers of months post-fire

Year	MPF	Period (Vertebrate)	Vegetation & Flora
1	9	13-26/11/1985	20-25/11/1985
2	23	29/12/1986 - 4/1/1987	20-24/12/1986
3	35	27/12/1987 - 1/1/1988	22-26/11/1987

RESULTS AND DISCUSSION

VEGETATION

The vegetation structure at 9 months generally consisted of suckers 10-40 cm high with canopy cover of 2-4 per cent, seedlings

4-10 cm high with canopy cover of 1-4 per cent, and sedges 15-30cm high and 5-15 per cent canopy cover.

At 35 months, the largest changes in regenerating biomass comprised the suckers of eucalypts, some of which had reached 80 cm in height. Others to show substantial gains were suckering Melaleuca species and Hibbertia andrewsiana. Many seedlings had increased less than 20 per cent in height between 23 and 35 months. With the exception of sedges most regeneration in the first year following the fire was by seedlings (Table 2).

Species lists with 343 taxa from which Tables 2 and 3 were derived are available from the senior author.

TABLE 2

REGENERATION OF PLANTS FOLLOWING FIRE IN FITZGERALD RIVER NATIONAL PARK

(Plant numbers in 1 x 5 metre quadrats)
A = suckers, B = seedlings

Life form	Period since fire and type of regeneration					
	9 months		23 months		35 months	
	A	B	A	B	A	B
ANNUALS	NIL	53	NIL	12	NIL	143
GEOPHYTES	9	NIL	5	NIL	5	2
PERENNIAL GRASSES	61	234	62	NIL	63	1
SEDGES	167	NIL	211	77	224	68
WOODY PERENNIALS	184	196	177	287	292	451
UNIDENTIFIED	6	832	NIL	276	NIL	NIL
TOTALS	427	1315	455	652	584	665

One hundred and thirty seven taxa had flowered by 9 months increasing to 245 at 23 months (Table 3). Forty two taxa were recorded only in 1985 recording period and 131 only in 1986 recording period, 71 taxa flowered both years. At 35 months, 263 taxa had flowered or were in flower; 92 of these being new records. The first flowering of a suckering Eucalyptus species was recorded: a few flowers on E. falcata.

TABLE 3
FLOWERING RECORDS FOLLOWING FIRE

Lifeform, and period since fire	Number of species by site type: Sand	Clayey sand	Quartzite/ schist	Swamp
ANNUALS				
9 months	16	5	NIL	35
23 months	13	3	1	35
35 months	9	3	NIL	20
GEOPHYTES				
9 months	13	NIL	5	10
23 months	11	1	3	1
35 months	15	2	5	6
PERENNIAL GRASSES				
9 months	1	NIL	NIL	1
23 months	5	1	2	3
35 months	5	2	NIL	6
SEDGES				
9 months	5	NIL	1	2
23 months	27	4	7	6
35 months	19	9	3	11
WOODY PERENNIALS				
9 months	23	5	7	8
23 months	66	13	24	17
35 months	75	38	11	23

At 9 months, five flowering species that are rarely present other than following a fire were present; four were annuals (Asteridea asteroides, Lobelia rhombifolia, Macarthuria apetala and Trachymene glaucifolia). The fifth species (Cypselocarpus haloragoides) lives for only a few years after germination. Heavier than normal flowering occurred on Dasypogon bromeliifolius. Lyperanthus nigricans and Nuytsia floribunda. Rarely does Lyperanthus nigricans flower for more than two seasons after fire. Substantially higher than normal populations were present of Alyogyne huegelii, Bulbine semibarbata, Lobelia heterophylla and Stipa macalpinei. The latter species was very common on sandy soils. In mature vegetation this species is rare.

At 9 months 99 taxa in the burnt area were regenerating (Table 2) 36 from woody root stocks, 18 from rhizomes and 4 from tubers. Thirty two species germinated from seed, while nine regenerated from both suckering and seed germination. Each suckering plant scored was believed to be an individual plant. However, defining the extent of some sedge species (Cyperaceae and Restionaceae) was sometimes difficult. At 23 months 131 taxa were regenerating; at 35 months 155. The increase in numbers were due mainly to more of the seedlings becoming sufficiently large for identification.

At 9 months, some plants were difficult to define as either a sucker or a seedling. At two quadrats (BP2 and BP5), the combined number of suckers and seedlings do not vary greatly. However, quadrat BP3 had a combined total of 874 at 9 months but only 402 at 23 months. A major cause of the difference lay in Stipa macalpinei (231 and 0). Most of the remainder was due to the death of unidentified seedlings.

A comparison of unburnt and burnt Eucalyptus occidentalis woodland was made (see Appendix 1). In the burnt area most E. occidentalis trees were killed to ground level but had resprouted from just below. Few seedlings of this species were seen. Most shrubs were killed by the fire but suckering was common. An important change in shrub strata was the increase of Alyogyne huegelii canopy cover from 0 to 10 per cent. This species persists for 3 to 4 years after the fire and then progressively dies out. After fire, the number of annual species increased from 8 to 32. Fifteen of these were introduced. This number is abnormally high for FRNP and may have resulted from horse feed used while servicing the nearby abandoned Telegraph Line (1875-1929). Most of the introduced species occur throughout FRNP but rarely so many together.

The taxa that added the largest amount of biomass were Alyogyne huegelii, Acacia ligulata, A. sp. (KRN 2472), Kennedia nigricans and Muehlenbeckia adpressa. During November 1987, Alyogyne huegelii was starting to become senescent.

FAUNA

Mammals

Nine months after the fire only three Mus musculus were trapped in central burnt areas, including on Woolbernup Hill. Tarsipes rostratus and Sminthopsis griseoventer were recorded at the burnt edge of the area. Tachyglossus aculeatus survived in small unburnt pockets. Macropus fuliginosus were present in the burnt area in higher numbers than in unburnt vegetation; we could find no evidence that kangaroos were killed by fire.

At 23 months (second survey session) Sminthopsis griseoventer and Rattus fuscipes were trapped in central burnt areas, and Pseudomys albocinereus on the burnt edge of the area. Mus musculus was not trapped in pit traps, so presumably it had declined since the first period. It was trapped in some Elliott traps set along a burnt-out creek. Numbers of M. fuliginosus had declined since the first sampling period.

At 35 months (third survey session) both Sminthopsis griseoventer and Rattus fuscipes were recorded in central burnt areas; only the latter were more abundant than at 23 months. Additionally R. fuscipes had moved out of dense regenerating creek thickets into open plain habitats. Only one Tarsipes rostratus was recorded (at quadrat BP4). This site is ca 4km from the fire edge. This suggests that Tarsipes is very susceptible to the direct effect of fire This may also indicate re-colonisation rather than fire survival. The nutritional and metabolic requirements of Tarsipes make it extremely unlikely to survive in an immediate post-fire regime.

TABLE 4

PIT-TRAPPING RESULTS FOR MAMMALS, FROGS & REPTILES (CAPTURES PER 100 TRAPNIGHTS,EXCLUDING RECAPTURES EXCEPT FROGS)

	BURNT QUADRATS (450 trap-nights)			**UNBURNT QUADRATS (180 trap-nights)**		
MONTHS POST-FIRE ->	**9**	**23**	**35**	**9**	**23**	**35**
MAMMALS:						
Sminthopsis griseoventer	0.2*	0.9	0.4	0	0.6	0.6
Cercartetus concinnus	0	0	0	0	0.6	0
Tarsipes rostratus	0.2*	0	0.2	1.1	0.6	0.6
Rattus fuscipes	0	0.7	0.9	0.6	0	0
Pseudomys albocinerus	0	0.2*	0.2*	0	0	0
Mus musculus	0.4	0	0.4	0	0	0
FROGS:						
Heleioporus eyrei	0	0.2	0	0	0	0
Limnodynastes dorsalis	0	0.9	0.2	0.6	0	0
Neobatrachus sp.	0	0	0	0	3.9	0
Pseudophryne guentheri	0	0.4	0	0	0	0
Ranidella sp.	0	2.0	0	0	0	0.6
REPTILES:						
Delma australis	0	0	0	0.6	0	0
Ctenotus gemmula	0	0	0.2	0	0	0
Ctenotus impar	0.2	0	0	0.6	0	0
Egernia bos	0.2	0.9	0.4	0	0	0.6
Morethia obscura	0	0	0	1.1	0	0
Hemiergis peronii	0	0	0.2	0	0	0
Total Number spp.	5	8	9	6	4	4

* fire edge re-coloniser only

Reptiles and Frogs

A considerable number of small reptile and frog species survived the fire (both the direct effect and probable subsequent food shortage). The following species were recorded in central burnt areas - many kilometres from unburnt vegetation at 9 months.

Ranidella pseudinsignifera	*
Limnodynastes dorsalis	
Crenadactylus ocellatus	
Diplodactylus spinigerus	
Phyllodactylus marmoratus	
Delma australis	
Delma fraseri	*
Pygopus lepidopodus	
Ctenotus gemmula	*
Ctenotus impar	
Ctenotus labillardierei	
Egernia multiscutata bos	*
Egernia napoleonis	
Hemiergis peronii	
Leiolopisma trilineatum	*
Lerista distinguenda	*
Menetia greyii	*
Morethia obscura	*
Notechis coronatus	*
Ramphotyphlops australis	*

* indicates survival in dis-used Iridomyrmex conifer ant nests.

The following larger species (Varanus rosenbergi, Notechis scutatus and Tiliqua rugosa) survived in pockets of unburnt vegetation. By inference they are vulnerable to wildfires because of their larger size. At twenty-three months both Notechis scutatus and Varanus rosenbergi, as well as the frogs Pseudophryne guentheri, Neobatrachus albipes and Heleioporus eyrei, had appeared in central burn areas.

At 35 months Tiliqua rugosa as well had appeared in central burnt areas. Thus wihin 3 years there is progressive recolonisation of burnt areas from unburnt pockets.

Birds

TABLE 5

BIRDS RECORDED WITHIN THE BURN (EXCLUDING UNBURNT POCKETS)

x = species recorded.

	Months After Fire		
Species	**9**	**23**	**35**
Emu	x	x	x
Square-tailed Kite			x
Collared Sparrowhawk			x
Wedge-tailed Eagle	x		x
Brown Falcon	x	x	
Australian Kestrel	x		x
Australian Bustard		x	
Common Bronzewing	x	x	

	Months After Fire		
Species	**9**	**23**	**35**
Brush Bronzewing			x
Red-capped Parrot		x	
Elegant Parrot		x	x
Tawny Frogmouth	x		
Owlet Nightjar	x	x	
Spotted Nightjar	x		
Laughing Kookaburra	x	x	
Welcome Swallow	x		
Tree Martin			x
Richard's Pipit	x	x	x
Black-faced Cuckoo Shrike	x	x	x
Red-capped Robin	x		x
Hooded Robin	x	x	x
Willie Wagtail		x	
Grey Shrike Thrush	x		
Crested Bellbird			x
Grey Fantail		x	
Restless Flycatcher		x	x
Southern Scrub Robin			x
Weebill	x	x	x
Inland Thornbill		x	x
White-browed Scrub Wren		x	x
Hylacola	x	x	
Field Wren	x	x	x
Emu Wren		x	x
Blue-breasted Fairy Wren			x
Yellow-rumped Pardalote		x	
Spotted Pardalote			x
Grey-breasted White-eye	x	x	x
Brown Honeyeater		x	x
White-naped Honeyeater		x	x
New Holland Honeyeater		x	x
Tawny-crowned Honeyeater	x	x	x
Little Wattlebird		x	x
Red Wattlebird	x	x	x
Yellow-throated Miner	x	x	
Western Spinebill			x
White-fronted Chat	x	x	
Grey Butcherbird	x	x	x
Australian Magpie	x	x	x
Grey Currawong	x	x	x
Australian Raven	x	x	x
Total Number spp.	25	34	36

The following species of birds survived in unburnt pockets and nowwhere else at 9 months. The size range of these pockets was from <1 ha to ca 20 ha.

Southern Scrub Robin	+
Grey Shrike Thrush	+
White-browed Scrub Wren	*
Blue-breasted Fairy Wren	+
Inland Thornbill	*
Willie Wagtail	*
Grey Fantail	*

At 23 months those marked with an asterisk had moved into central burnt areas. Additional inhabitants of unburnt pockets then were: Crested Bell-bird, Purple-gaped Honeyeater, White-browed Babbler and Western Whipbird.

At 35 months those species marked (+) had moved into central burnt areas. There were no additional species in unburnt pockets then. Thus, as for reptiles, these data indicate a progressive recolonisation by birds of large burnt areas from unburnt pockets.

Richard's Pipit and White-fronted Chat were much more abundant at 9 months than at 23 months. White-fronted Chat and Common Bronzewing were nesting in areas burnt 9 months previously. Tawny-crowned Honeyeater and Yellow-rumped Pardalote were nesting in areas burnt 23 months previously.

At 35 months there had been interesting quantitative and qualitative changes to avifauna. Some small passerines which previously were only in unburnt pockets had moved into the central burnt area. The Brush Bronzewing was quite common and had replaced Common Bronzewing. The White-fronted Chat which was very common at 9 months and still present at 23 months, had completely disappeared; Richard's Pipit was scarce. Elegant Parrot was more common. The extensive suckering of regenerating mallees provides a temporary, dense de facto "shrub" layer which provides adequate cover for small passerine species. A seed based food supply must also have been present for the Elegant Parrot and Brush Bronzewing. Tawny-crowned Honeyeater was nesting again at 35 months.

The winter of 1986 was unusually wet and the reduced vegetation within the burn allowed greater run-off to recharge swamps. In December 1986/January 1987 the following waterfowl were present on freshwater swamps and one lake within the burnt area. Black-throated Grebe, Hoary-headed Grebe, Pied Cormorant, Pacific Heron, White-faced Heron, Black Swan, Mountain Duck, Black Duck, Grey Teal, Musk Duck and Coot. Grey Teal and Black-throated Grebe bred in these swamps.

General Conclusions on Fauna

The data on vertebrates indicate a progressive increase in species richness since the fire. Data from another study in FRNP, Chapman (1985), indicated that mammal species richness was highest at 5 years, declined at 15 and rose again at 27 + years. Bird species richness on the other hand was highest at 15 years. Reptiles showed a similar trend to mammals.

The data from the present study do not indicate a substantial invasion or irruption of Mus musculus approximately 12 months post-fire as occurred in Nadgee Nature Reserve N.S.W (Newsome et al 1975). The Nadgee study indicated that Rattus fuscipes only survived the fire in mesic swamp and dune swale vegetation; it became locally extinct in less mesic habitats. This study recorded a similar result with Rattus fuscipes moving from mesic to more arid habitats within only 3 years of the fire.

This study and others in FRNP, Chapman (1985) and Chapman and Newbey (1987), indicate that for small mammals there is a broad spectrum of vegetation fire-age tolerance. There are good data to indicate that those species capable of surviving in vegetation at 5 years include: Sminthopsis griseoventer, Cercartetus concinnus, Pseudomys albocinereus and Rattus fuscipes. Tarsipes rostratus is in the middle of the spectrum; it does not achieve high numbers until approximately 15 years post-fire. The rare small mammals including Parantechinus apicalis, Sminthopsis granulipes, Pseudomys occidentalis and P. shortridgei require vegetation 30 + years to survive.

Reptiles as a group have the greatest capacity to survive the direct effect of wildfires and the subsequent probable food shortage. This is due to their use of burrows or non flammable refugia eg. Iridomyrmex conifer ant nests or small rock piles. Their low metabolic requirements are conducive to surviving the post-fire food shortage.

Small relatively sedentary passerine birds are very susceptible to the direct effect of wildfires. However, some survive even in relatively small unburnt pockets which also are used as staging posts by more mobile species as they recolonise the large burnt area.

ACKNOWLEDGEMENTS

The Western Australian Heritage Committee and the Department of Conservation and Land Management funded years 1, 2 and 3 of this project respectively. Dave Robinson, Brad Maryan, Fredy Mercay and Brenda Newbey all contributed data on reptiles and birds.Richard How, John Dell, Neil Burrows, Per Christensen, David Coates, Michael Ridpath, Lachie Mccaw, Gordon Friend and Peter Kimber all refereed earlier drafts of this paper. Lee-Anne Martin and June Anderson typed the final manuscript.

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APPENDIX 1

COMPARISON OF OF BURNT AND UNBURNT *Eucalyptus occidentalis* LOW WOODLAND

Taxa are listed by stratum and canopy cover (Muir 1977).
U = Unburnt (recorded November 1985), followed by burnt (year - 85, 86 etc.).
Numbers are % canopy cover; + indicates a value less than 0.1% canpoy cover. * indicates introduced taxon.

Taxon	U	85	86	87	..	..	..
STRATUM 1: Trees 10-14 m							
Eucalyptus occidentalis	12	10	10	.	.	.	.
STRATUM 2: Shrubs 2.1-5.0 m							
Acacia leioderma	+	.	.	.	.	.	.
Acacia sp. (KRN 2472)	4	.	.	.	.	.	.
Allocasuarina huegeliana	4	.	.	.	.	.	.
Alyogyne huegelii	.	.	.	0.1	.	.	.
Calothamnus quadrifidus	15	.	.	.	.	.	.
Eucalyptus occidentalis	.	.	.	4	.	.	.
Hakea laurina	0.1	.	.	.	.	.	.
Hakea lissocarpha	+	.	.	.	.	.	.
STRATUM 3: Shrubs 1.6-2.0 m							
Acacia saligna	0.5	.	.	0.1	.	.	.
Alyogyne huegelii	.	.	5	3	.	.	.
Goodia lotifolia	.	.	.	+	.	.	.
Pimelea argentea	.	.	.	+	.	.	.
STRATUM 4: Shrubs 1.1-1.5 m							
Acacia ligulata	.	.	1	3	.	.	.
Acacia saligna	.	.	0.2	.	.	.	.
Alyogyne huegelii	+	.	.	1	.	.	.
Eucalyptus occidentalis	.	.	1	.	.	.	.
Exocarpos sparteus	+	.	.	.	.	.	.
Goodia lotifolia	.	.	0.1	.	.	.	.
Indigofera australis var. *australis*	.	.	.	0.1	.	.	.
Muehlenbeckia adpressa	.	.	.	+	.	.	.
Pimelea argentea	.	.	0.1	0.1	.	.	.
Rhagodia preissii ssp. *preissii*	.	.	.	0.1	.	.	.
Solanum capsiciforme	.	.	+	.	.	.	.
STRATUM 5: Shrubs 0.6-1.0 m							
Acacia cyclops	.	.	.	+	.	.	.
Acacia harveyi	.	.	+	.	.	.	.
Acacia ligulata	.	.	.	0.1	.	.	.
Acacia sp. (KRN 2472)	.	.	.	12	.	.	.
Alyogyne huegelii	.	10	.	.	.	.	.
Dodonaea ceratocarpa	+	.	.	.	.	.	.
Exocarpos sparteus	.	.	.	+	.	.	.
Goodia lotifolia	+	+	.	.	.	.	.
Indigofera australis var. *australis*	.	.	.	.	.	.	.
Muehlenbeckia adpressa	.	.	+	.	.	.	.

Taxon	U	85	86	87	..	..	..
ANNUALS cont.							
*Centaurium erythraea ssp. rumelicum	.	+	3	.	.	.	.
Ceratogyne obionoides	.	.	+	.	.	.	.
*Conyza bonariensis	.	.	.	0.1	.	.	.
Crassula colorata var. colorata	.	.	0.1	.	.	.	.
Crassula exserta	.	0.1	.	.	.	.	.
Crassula pedicellosa	.	.	+	.	.	.	.
Daucus glochidiatus	.	0.1	0.1	.	.	.	.
*Ehrharta longifolia	0.2	+	.	.	.	.	.
Erodium crinitum	.	.	.	+	.	.	.
Gnaphalium gymnocephalum	0.1	0.3	2	0.1	.	.	.
*Gnaphalium calviveps	0.2	0.2	2	0.1	.	.	.
Goodenia filifolia var. filifolia	.	.	+	.	.	.	.
Helichrysum leucopsideum	.	0.1	.	.	.	.	.
Helipterum demissum	.	0.2	1	1	.	.	.
Hydrocotyle callicarpa.	.	0.1	0.1	.	.	.	.
*Hypochaeris glabra	.	.	+	+	.	.	.
Levenhookia stipitata	.	.	+	.	.	.	.
Lobelia gibbosa	.	.	+	+	.	.	.
Nicotiana rotundifolia	.	.	+	.	.	.	.
Pelargonium littorale	.	.	2	.	.	.	.
*Pentaschistis airoides	.	+	.	.	.	.	.
Plantago hispida	0.2	0.2	0.1	+	.	.	.
*Plantago aff. debilis	.	.	.	+	.	.	.
Poranthera microphylla	.	0.1	.	.	.	.	.
*Pseudognaphalium luteo-album	+	0.1	.	+	.	.	.
Senecio hispidulus var. hispidulus	.	.	+	.	.	.	.
Senecio quadridentatus	+	0.1	0.2	0.1	.	.	.
*Sonchus asper var. nymanii	.	.	+	.	.	.	.
*Sonchus oleraceus	.	+	+	+	.	.	.
Trachymene ornata var. ornata	.	0.1	.	.	.	.	.
*Trifolium arvense	.	.	+	.	.	.	.
*Trifolium campestre	.	+	.	.	.	.	.
*Trisetaria cristata	.	0.1	0.1	0.1	.	.	.
*Vellereophyton dealbatum	+	.	+	.	.	.	.
*Vulpia myuros	.	+	.	.	.	.	.
Wahlenbergia gracilenta	.	+	0.2	+	.	.	.
Wahlenbergia multicaulis ssp. multicaulis	.	0.1	.	+	.	.	.
Waitzia acuminata	.	+	+	+	.	.	.
CLIMBERS							
Clematis pubescens	+	.	.	.	.	.	.
Convolvulus erubescens	+	.	+	.	.	.	.
Kennedia nigricans	0.1	+	0.2	+	.	.	.
FERNS							
Cheilanthes austro-tenuifolia	.	0.1	.	.	.	.	.

Taxon	U	85	86	87	..	..	..
STRATUM 5 cont.							
Rhagodia preissii ssp. preissii	0.1	.	.	.	.	.	.
Solanum capsiciforme	.	+	.	.	.	.	.
Thomasia angustifolia	.	.	.	+	.	.	.
STRATUM 6a: Shrubs 0.0-0.5 m							
Acacia ligulata	.	1	.	.	.	.	.
Acacia saligna	.	0.1	.	.	.	.	.
Acacia sp. (KRN 2472)	.	2	3	0.1	.	.	.
Astroloma drummondii	+	.	.	.	.	.	.
Astroloma epacridis	.	.	.	+	.	.	.
Calothamnus quadrifidus	.	+	0.1	+	.	.	.
Cassia nemophila var. nemophila	.	.	.	+	.	.	.
Dichondra repens	1	.	+	.	.	.	.
Enchylaena tomentosa var. tomentosa	0.1	+	.	.	.	.	.
Eucalyptus occidentalis	.	+	.	.	.	.	.
Gompholobium marginatum	.	.	.	+	.	.	.
Goodenia affinis	.	0.1	+	+	.	.	.
Hakea lissocarpha	.	.	.	+	.	.	.
Indigofera australis var. australis	+	.	.	.	.	.	.
Kennedia eximia	.	+	.	.	.	.	.
Maireana enchylaenoides	+	+	+	.	.	.	.
Melaleuca pentagona var. subulifolia	.	.	.	+	.	.	.
Muehlenbeckia adpressa	+	0.1	.	.	.	.	.
Olearia revoluta	.	.	+	.	.	.	.
Phyllanthus calycinus	0.1	+	0.1	+	.	.	.
Phyllanthus scaber	.	.	+	0.1	.	.	.
Pimelea argentea	.	+	.	.	.	.	.
Scaevola cuneiformis	.	+	.	.	.	.	.
Scaevola thesioides var. thesioides	.	.	+	.	.	.	.
Sclerolaena diacantha	+	.	+	+	.	.	.
*Solanum nigrum	.	0.1	.	.	.	.	.
Stackhousia monogyna	.	+	.	.	.	.	.
Styphelia intertexta	.	.	.	+	.	.	.
Thomasia angustifolia	+	+	+	.	.	.	.
Thomasia foliosa	2	.	0.2	+	.	.	.
Vittadinia gracilis	2	3	1	2	.	.	.
ANNUALS							
Actinobole uliginosum	.	0.1	0.2	+	.	.	.
*Aira cupaniana	.	0.4	1	2	.	.	.
*Anagallis arvensis	2	1	1	+	.	.	.
Brachycome ciliaris var. ciliaris	.	.	+	+	.	.	.
*Brassica tournefortii	.	.	+	.	.	.	.
*Briza minor	.	+	+	0.1	.	.	.
Bulbine semibarbata	.	0.2	0.1	.	.	.	.
Calandrinia calyptrata	+	.	.	.	.	.	.
*Carduus pycnocephalus	+	.	.	.	.	.	.
*Centaurea melitensis	4	3	3	0.1	.	.	.

Taxon	U	85	86	87	..	..	..
GEOPHYTES							
Lagenifera huegelii	.	0.1	.	+	.	.	.
Microtis unifolia	.	0.1	.	.	.	.	.
Oxalis corniculata	+	.	.	+	.	.	.
Pterostylis sp. (KRN 9598)	+	.	.	.	.	.	.
Ptilotus spathulatus	.	+	.	.	.	.	.
Thysanotus patersonii	+	.	.	+	.	.	.
PARASITIC CLIMBERS							
Cassytha melantha	0.1	.	.	+	.	.	.
PERENNIAL GRASSES							
Danthonia caespitosa	.	.	.	0.1	.	.	.
Danthonia setacea var. breviseta	.	.	0.1	0.1	.	.	.
Danthonia setacea var. setacea	0.2	.	.	.	.	.	.
Neurachne alopecuroidea	+	.	.	.	.	.	.
Stipa puberula A	0.8	.	.	0.1	.	.	.
Stipa puberula B	.	.	0.1	0.1	.	.	.
Stipa pycnostachya	.	.	.	+	.	.	.
SEDGES							
Gahnia ancistrophylla	0.1	.	5	8	.	.	.
Lepidosperma tenue	.	.	.	+	.	.	.
SEDGE-LIKE							
Lomandra micrantha ssp. micrantha	.	.	.	+	.	.	.

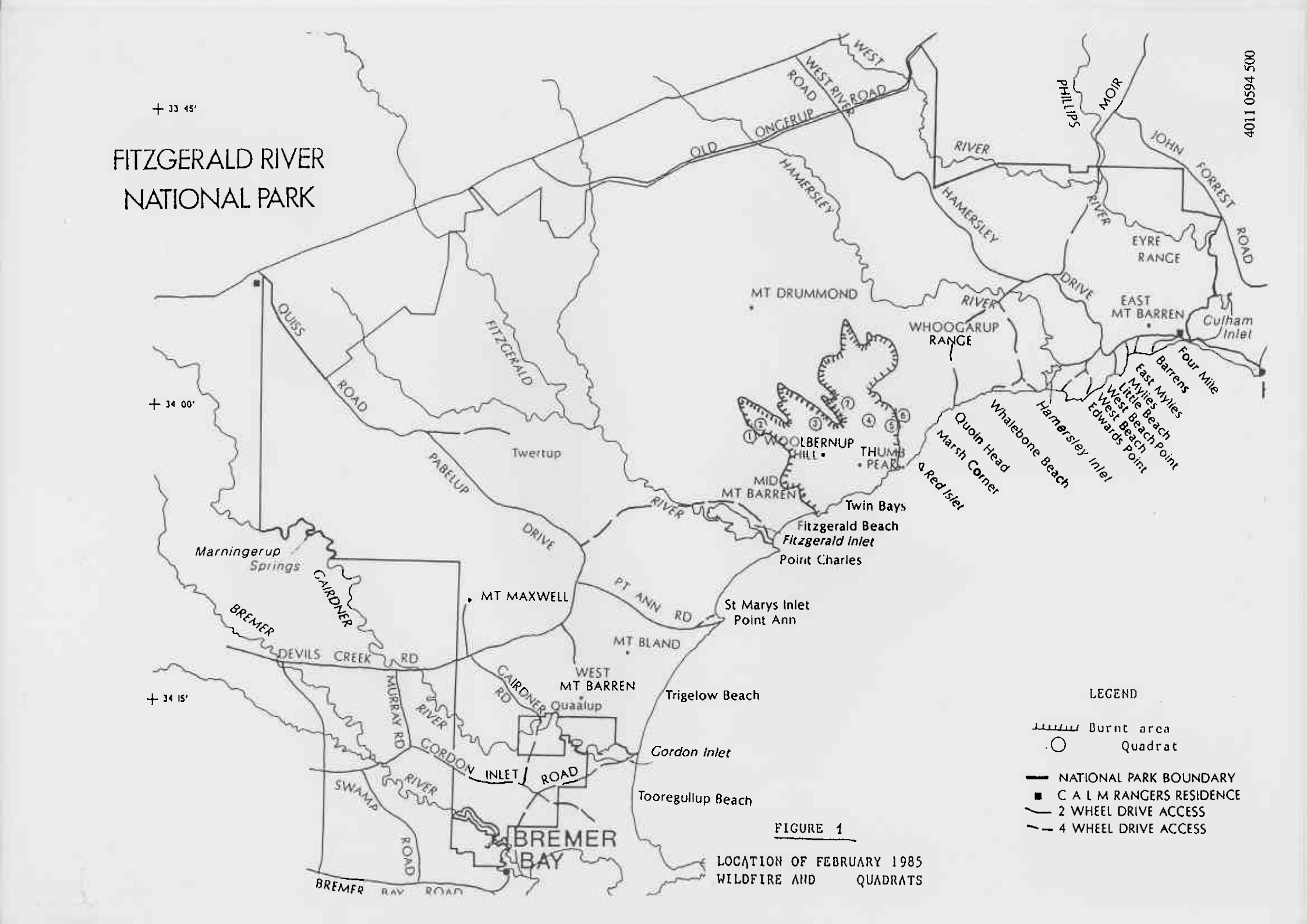

FIGURE 1

LOCATION OF FEBRUARY 1985 WILDFIRE AND QUADRATS