

Response of Montane Wet Sclerophyll Forest Understorey Species to Fire: Evidence from High and Low Intensity Fires

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On the New England Tablelands wet sclerophyll forests typically form the ecotone between rainforest and dry sclerophyll forest. Currently there are few data on the response of wet sclerophyll plant species to fire. We compared the fire-response traits of woody understorey and sub-canopy species in wet sclerophyll forest after high and low intensity fires. The majority of species (>80%) resprouted after fire and the prevalence of resprouting did not differ with fire intensity. Obligate seeders were rare in these communities (<10% of species), and similar numbers of rainforest and sclerophyllous species were killed by fire. Resprouting from basal stems and root suckering were the most common mechanisms of vegetative regeneration; however, these traits may have arisen more in response to canopy disturbance than fire regime. We found that most rainforest taxa resprouted but lacked post-fire seedling recruitment, whereas most resprouting sclerophyllous taxa recruited from seed after fire. This dichotomy in seedling recruitment could reflect the productivity and disturbance gradients across the ecotone. We propose that gap-phase recruitment is favoured towards the rainforest margin and fire-related recruitment is more prevalent at the eucalypt forest edge.

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KEYWORDS: functional groups, obligate seeding, rainforest, resprouting, seedling recruitment, wildfire.

INTRODUCTION

Wet sclerophyll forests typically form an interface between two broad vegetation types, rainforest and dry sclerophyll forest. These tall eucalypt forests have been described as a stage in long-term succession as their structure and composition approaches that of rainforest in the prolonged absence of disturbance. Hence, changes in community properties have been closely linked to the passage of fire and length of fire-free periods (Ashton and Attiwill 1994). Wet sclerophyll forests are not highly flammable most of the time, and as time-since-fire increases the probability of a subsequent fire is reduced as mesophyllous taxa become more dominant in the standing vegetation (Unwin 1989; Adam 1992; Harrington and Sandersen 1994). Generally, one intense crown fire every 100-200 years is thought to be sufficient to maintain the sclerophyllous component and restrict the more mesophyllous taxa of the wet sclerophyll ecotone (Gilbert 1959; Chesterfield et al. 1991).

On the New England Tablelands many areas of

wet sclerophyll forest have been used for hardwood timber production and cattle grazing. These forests have consequently been exposed to a regime of frequent, low-intensity fires that are often associated with grazing (stimulation of green pick). A high fire-frequency is thought to reduce diversity of woody species in the forest understorey by removing mesophyllous taxa and promoting growth of fire-tolerant grasses and forbs (Binns 1991; Henderson and Keith 2002). Currently there are few data on the demographic links between disturbance frequency and changes in understorey composition in the wet sclerophyll ecotone.

The classification of plant species into functional groups based on fire-response traits can be useful in preliminary modelling of how vegetation will change with more frequent or less frequent fires (Whelan 1995; Bond and van Wilgen 1996). Baseline data on the response of plant populations to crown fire are being sought to contrast the effects of seed-based recruitment (persistence of populations) with those of resprouting (persistence of individuals) (Clarke and Knox 2002; Pausas et al. 2004; Vesk and Westoby

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2004). However, generalisations about vegetation change with fire-frequency may be complicated by variable responses of species to fire of different intensities (e.g. Ashton and Martin 1996; Morrison and Renwick 2000). In addition, shade-tolerant rainforest species are not expected to have fire-driven recruitment, and their regeneration syndromes are more likely to be linked to small-scale disturbances such as tree fall that create light gaps.

In spring 2002, areas of wet sclerophyll forest in Washpool National Park were burnt by fire following the severe drought that affected most of eastern Australia. We took advantage of this one in fifty year event to record the response of wet sclerophyll understorey species to crown fire. We focused on the shrub and sub-canopy taxa, as the dominant overstorey eucalypts all resprout after fire and their dynamics have been documented elsewhere (e.g. Ashton and Attiwill 1994; Florence 1996). To test the generality of responses to fire we compared data from the crown fire at Washpool National Park with a lower intensity burn at Mummel Gulf National Park the previous year. We addressed the following questions: 1) Do fire-response traits vary with fire intensity? 2) Do fire-response traits vary between sympatric rainforest and sclerophyllous species? and 3) Are there correlations between environmental variables, fire-response traits and other life-history traits?

METHODS

Study areas

The New England wet sclerophyll forests are restricted to areas of high rainfall along the eastern edge of the escarpment. These forest are characterised by a eucalypt-dominated overstorey, typically exceeding 30 m in height, and a well-developed, layered understorey of mesomorphic and sclerophyllous growth forms (Specht 1970; Ashton and Attiwill 1994). The area selected for study at Washpool National Park (hereafter WPNP) was in the recent western additions that were acquired by the New South Wales National Parks and Wildlife Service (NPWS) in 1998 and had not been burnt for at least 50 years. The fires that occurred in November 2002 were high-intensity fires that burnt all vegetation strata in the sclerophyll forests and the understorey of the warm temperate rainforest. Mummel Gulf National Park (hereafter MGNP) lies approximately 60 km east of Walcha and was also gazetted as National Park in the late 1990s. The fire at MGNP was a back-burn, initiated by the NPWS to contain a

grass fire from a neighbouring property in October of 2001. The fire was of low to moderate intensity and resulted in the complete burning of the understorey and ground layer, but with minimal canopy scorching. All study sites occurred at altitudes greater than 900 m on metasediment-derived soils. Prior to the fires, areas of wet sclerophyll forests within each park were surveyed for full floristic composition using 20 x 20 m quadrats (21 vegetation survey sites in total: WPNP, 12 sites; MGNP, 9 sites). Vegetation in each quadrat was described in terms of the growth form, height and cover of dominant species in the ground storey, understorey and canopy strata. All species were recorded in each quadrat and their abundance estimated using Braun-Blanquet cover-abundance scale. For each survey quadrat geographical position, altitude, slope, local soil characteristics, physiography, evidence of fire and other disturbances were recorded.

Responses of adult plants to fire

Responses of woody plant species to fire were recorded at four sites within burnt forest at WPNP and MGNP. At each of these sites two transects (20 x 2 m) were placed along each of three topographical positions - ridge, slope and gully. Topographical position accounted for differences in vegetation composition prior to fire and differences in fire intensity. Post-fire responses of adult plants were recorded along each transect in four categories: 1) killed by fire, 2) resprouting via root suckers, 3) resprouting via basal stem buds, and 4) resprouting via stem buds. The presence of post-fire seedling recruits was also recorded. In addition to these observations, post-fire responses of other woody species outside of transects (16 species) were recorded to gain a more comprehensive overview of fire-response traits of wet sclerophyll forest understorey species.

Analyses of fire response traits

Plant species were allocated to one of five fire-response syndromes based on categories defined by Gill and Bradstock (1992). Note that because of the low frequency of occurrence, species killed by fire were classified into one group regardless of seed bank type. An additional group was also formed with the combination of regeneration by root suckering (Category IV) and resprouting by basal stem buds (Category V). Fire-response traits of woody species were compared between sites of different fire intensities, i.e. high-intensity fire (WPNP) and low-intensity fire (MGNP), and between topographic positions (ridge, slope and gully) within WPNP and MGNP. The relative frequency of fire-response traits

Table 1. Summary table for life-history attributes of 61 woody taxa occurring in wet sclerophyll forest in Washpool and Mummel Gulf National Parks on the New England Tablelands. Note eucalypts not included. Figures are the No. of species in each category.

Attribute	WPNP	MGNP
Growth form		
Shrub (<3 m)	17	19
Small Tree (3-10 m)	13	9
Tree (>10m)	12	6
Leaf type		
Sclerophyllous	15	15
Coriaceous	6	7
Mesophyllous	21	12
Dispersal syndrome		
Vertebrate	21	21
Invertebrate	9	4
Wind	4	5
Passive	8	4
Seed bank type		
Soil	31	26
Canopy	3	3
Dispersed	8	5
Species richness	42	34

was compared with a G-test for independence (Sokal and Rolf 1981). Fire-response traits of adult plants after crown and understorey fires were reclassified into one of the four plant persistence syndromes based on the hierarchical persistence scheme of Pausas et al. (2004). The relative frequencies of persistence syndromes after crown and understorey fire were compared with a G-test for independence (Sokal and Rolf 1981).

Analyses of persistence syndromes and foliage types

To test for differences in persistence syndromes between rainforest and sclerophyll forest taxa growing in the same habitat, species were divided into three

foliage types; sclerophyllous, coriaceous and mesophyllous. These categories were chosen as preliminary representatives of the different life-history syndromes of plant species in the wet sclerophyll ecotone. Rainforest taxa generally fell into the mesophyllous and coriaceous leaf types, while most sclerophyll forest taxa were classified as sclerophyllous. Note that because of low frequencies of occurrence, taxa with coriaceous leaves were grouped with the mesophyllous taxa for the analysis. The frequencies of persistence syndromes (as described above) were tested between foliage groups with a G-test for independence (Sokal and Rolf 1981).

Life-history traits and environmental variables

To examine the relationship between plant traits and environmental variables, constrained ordinations were derived from the full floristic data set. Patterns of life-history traits and environmental correlates were tested with Canonical Correspondence Analysis (CCA) using CANOCO™ v4.5 (ter Braak and Smilauer 1992). A life-history trait data set was constructed using observations in the field and from other sources. Growth form, leaf type, dispersal syndromes and seed bank classes are shown in Table 1. Plant persistence syndromes were also included in the analysis. An environmental matrix was constructed using the variables recorded in each vegetation survey quadrat and climatic parameters extracted from BIOCLIM™ (Busby 1991). For the purposes of analysis, Australian Map Grid Eastings and Australian Map Grid Northings

were included as covariables. The significance of environmental variables was determined using 499 Monte Carlo Permutations and the forward selection option in CANOCO™ v4.5 (ter Braak and Smilauer 1992).

RESULTS

Fire-response traits, persistence syndromes and fire intensity

Data on the fire-response of 49 woody taxa were collected from transects at WPNP and MGNP. Resprouting was the dominant response to fire (> 80% of taxa, Table 2) and there was no difference in

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Table 2. Summary of contingency-table analysis for fire-response traits of woody understorey species following high intensity and low intensity fires in National Parks on the New England Tablelands. Figures are the No. of species in each category.

	High intensity fire (WPNP)				Low intensity Fire (MGNP)			
	Ridge	Slope	Gully	Total	Ridge	Slope	Gully	Total
Fire Response (II-VI)								
II. Killed, soil-stored seed bank	5	5	4	6	4	1	1	2
IV. Resprouts via root suckers	3	4	4	3	1	2	4	3
V. Resprouts via basal stem	13	14	12	16	10	14	13	18
VI. Resprouts via stem bud bank	1	1	1	1	1	1	1	1
Both IV & V	5	4	5	8	3	4	4	3
Fire Response								
Killed (> 70% killed)	5	5	5	6	3	1	1	2
Resprout (< 30% killed)	21	23	20	27	15	20	21	22
Variable (30 - 70% killed)	1	0	1	1	1	1	1	3

the frequency of fire-response traits between crown fire (WPNP) and understorey fire (MGNP) ($G^2 = 2.68$, $P > 0.05$). The frequency of resprouting traits was also consistent across topographic gradients within parks (WPNP, $G^2 = 0.87$, $P > 0.05$; MGNP $G^2 = 4.19$, $P > 0.05$). Resprouting from basal stems was the most common fire-response, followed by species regenerating from both basal stems and root-suckers and then those regenerating from root-suckers alone (Table 2). Species killed by fire were less common in

the landscape, although a greater number of species killed by fire were recorded at the high-intensity fire sites (WPNP, 17%) than at the low-intensity fire sites (MGNP, 7%) (Table 2).

Additional observations recorded outside transects were included in the persistence syndrome data set, with persistence traits of 54 woody species included in the analysis. Resprouting was the most common persistence syndrome, although resprouting without post-fire seedling recruitment was more frequent than resprouting with post-fire seedling recruitment (Table 3). Species killed by fire were low in frequency at both sites. There was no significant difference in the relative frequencies of any of the persistence syndromes between high-intensity fire sites and low-intensity fire sites ($G^2 = 2.84$, $P > 0.05$).

Table 3. Summary table of contingency analysis for persistence syndromes of woody understorey species after crown and understorey fires and between leaf-type classes. Persistence syndromes defined by Pausas et al. (2004), presence or absence of seedlings refers to post-fire recruitment only. Species killed by fire and lacking post-fire recruitment rely on the dispersal of propagules into a burnt area for recruitment.

	Low intensity (WPNP)	High intensity (MGNP)	Sclerophyllous	Mesophyllous/ Coriaceous
Resprouters				
+ seedlings	9	10	12	1
- seedlings	21	15	2	29
Killed				
+ seedlings	6	2	3	4
- seedlings	1	2	1	2

Persistence syndromes and leaf types

Sclerophyllous (dry forest taxa) species had a higher frequency of resprouting species with post-fire seedling recruitment than mesophyllous and coriaceous

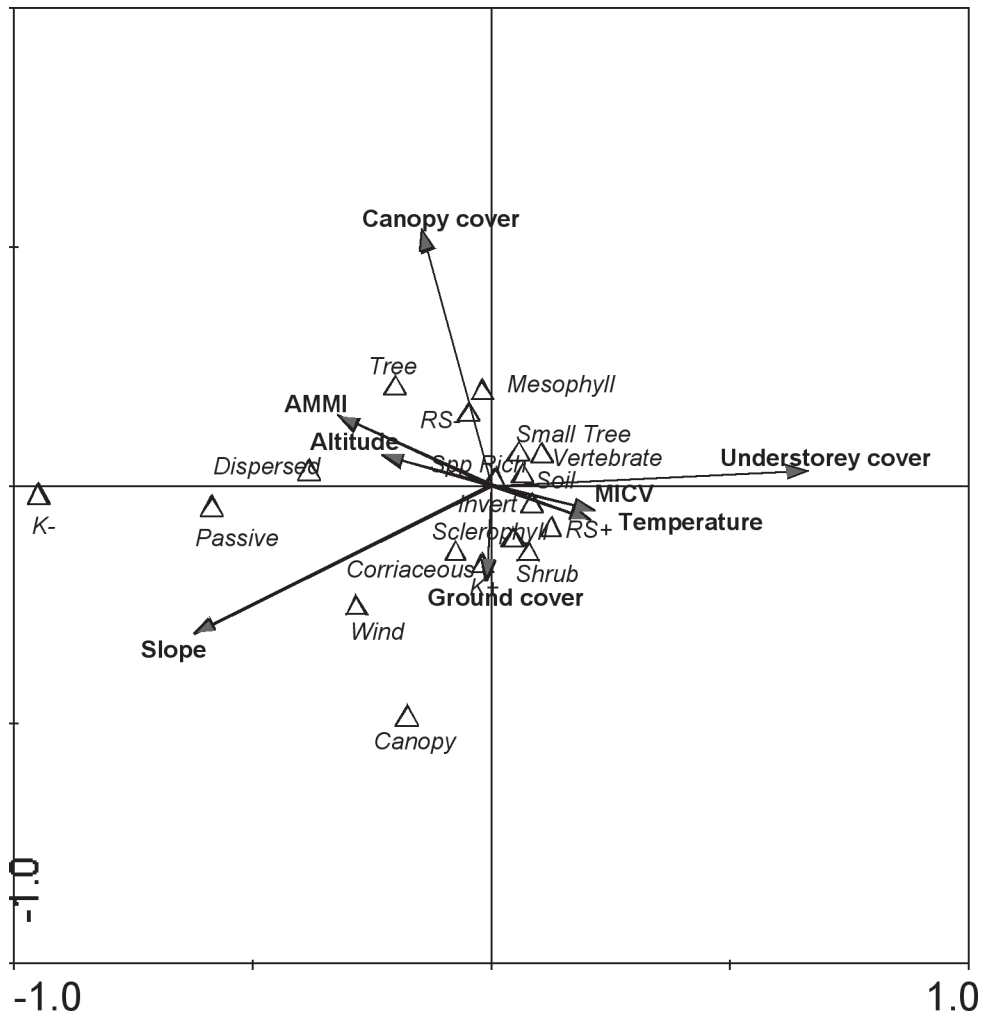


Figure 1. Biplot diagram of CCA ordination for environmental variables and life history traits of 61 woody taxa in wet sclerophyll forest. D= life history traits; solid arrows = significant environmental variables (499 Monte Carlo Permutations, $P < 0.05$). RS-, RS+, K-, K+ = persistence syndromes defined by Pausas et al. (2004); passive, wind, vertebrate, invertebrate = dispersal syndromes; Spp Rich = species richness; AMMI = annual mean moisture index; MICV = moisture index coefficient of variation. Plot axes are 1 by 1 units of ordination.

taxa ($G^2 = 22.66$, $P < 0.0001$) (Table 3). Conversely, rainforest taxa (mesophyllous and coriaceous plants) had significantly greater frequency of species that resprouted and lacked post-fire seedling recruits (Table 3). There was no difference in the frequency of species killed by fire with or without post-fire seedling recruitment between leaf type groups (Table 3).

Plant traits and environmental variables

Shrubs were the most common woody growth forms at both sites, but trees and small trees were

more common at WPNP (Table 1). There were more sclerophyllous and mesophyllous taxa than coriaceous at both sites and most species had vertebrate-dispersed propagules (Table 1). Soil-stored seed banks were the predominant type with less than 20% of species having a canopy-held seed banks or relying on dispersal of seed for regeneration (Table 1). More detailed information on the life-history traits of individual species is given in Appendix 1.

Life-history traits of woody taxa in the wet sclerophyll understorey were significantly correlated with canopy cover, slope and understorey cover

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(Fig. 1). Mesophyllous and tree attributes correlated with increasing canopy cover, as did resprouting species that lack post-fire seedling recruitment (Fig. 1). Species killed by fire and with post-fire seedling recruitment from *in situ* seed banks were negatively associated with increasing canopy cover, but positively correlated with increasing ground cover. Resprouting species with post-fire seedling recruitment were weakly associated with increasing understorey cover, but correlated closely with moisture predictability and temperature (Fig. 1). Species with canopy-stored seed banks and wind-dispersed seeds were positively correlated with landscape slope (Fig. 1). Species with passive dispersal, those lacking *in situ* seed banks, and those killed by fire with seeds dispersed into the post-fire environment, were all negatively correlated with increasing understorey cover (Fig. 1).

DISCUSSION

Do fire response traits vary with fire intensity?

We found that the majority (>80%) of woody understorey species in montane wet forests resprouted after fire irrespective of fire intensity. Whilst fire intensity was not replicated across sites our general observations in wet forests in the region support this finding. This contrasts with observations that high-intensity fires limited vegetative regeneration in Victorian wet sclerophyll forests, where rootstocks and bud banks did not survive high temperatures. Conversely, after lower-intensity fire, the predominant mechanism of regeneration was vegetative with a high density of root-suckers and resprouting adults in the post-fire environment (Ashton and Martin 1996). In our study, less than 10% of species demonstrated a variable response to fire, indicating that the dichotomous classification of species into obligate seeders (< 30% resprout) and resprouters (> 70% resprout) is a useful generalisation for these systems.

The proportion of resprouting species recorded here is high in comparison to wet sclerophyll forests in Victoria (30%) and southwest Western Australia (24%), but comparable to data for coastal wet sclerophyll forest in northern New South Wales (60%) (Ashton 1981). Similarly high proportions of resprouting species have been reported for other highly competitive systems such as wet heaths and grassy woodlands on the New England Tablelands (Clarke and Knox 2002; Clarke et al. 2005). Resprouting may be favoured in productive habitats as vegetative recruits and regeneration are competitively superior to seedlings (Clarke et al. 2005). This may also explain

the low frequency of obligate seeding species and post-fire recruitment in these communities. We also recorded high levels of root-suckering, and roughly one quarter of the species were capable of resprouting from the basal stem and roots after fire. Resprouting from basal stem tissue suggests that moderate fire-frequencies have been a selective force (Bellingham and Sparrow 2000), but resprouting may also confer an advantage by enabling individuals to survive and regenerate after mechanical damage inflicted by tree- and limb-fall (Ashton 2000; Paciorek et al. 2000; Kanno et al. 2001). Similarly, root-suckering is an effective means of invading unoccupied space after disturbance events such as tree-fall (Stocker 1981; Kammesheidt 1999; Bellingham and Sparrow 2000).

Do fire-response traits vary between rainforest and sclerophyllous species?

There was a clear dichotomy between rainforest (mesophyllous and coriaceous) and sclerophyllous taxa in relation to post-fire seedling recruitment. The majority of sclerophyllous taxa that resprouted also had post-fire seedling recruitment, whereas most rainforest taxa resprouted but lacked post-fire seedling recruitment. This may be explained by resource gradients across the wet sclerophyll ecotone affecting species composition. At the rainforest interface the quantity and quality of light reaching the forest floor is much lower than at the eucalypt forest edge and these conditions are generally unfavourable for the recruitment of shade-intolerant taxa (Turton and Duff 1992). The prevalence of mesophyllous species at the rainforest interface reduces the probability of fire and species with gap-phase regeneration dominate the community (Unwin 1989; Adam 1992; Harrington and Sandersen 1994). The general absence of post-fire seedling recruitment in rainforest taxa is likely to reflect that recruitment syndromes in rainforest are linked to canopy disturbance rather than fire *per se*. In contrast, post-fire seedling recruitment was common in sclerophyllous taxa: these species respond to broad-scale disturbance in order to regenerate and gap-phase recruitment is rare (Melick 1990).

The dichotomy in seedling recruitment syndromes was reflected in the CCA, with species that lack post-fire recruitment closely associated with increasing canopy cover. In contrast, species with post-fire seedling recruitment, regardless of the adult plant response to fire, were positively associated with more open habitats as indicated by increasing ground and understorey cover. At the landscape scale, productivity gradients have been linked to ratios of obligate seeders to resprouters across habitats (e.g. Clarke et al. 2005). However, within the wet

sclerophyll ecotone, the productivity gradient appears to be driving the prevalence of post-fire seedling recruitment more than adult fire responses.

Paradoxically, most rainforest species vigorously resprouted and similar numbers of rainforest and sclerophyll species were killed by fire. Other studies have reported rainforest species coppicing or resprouting after fire (Stocker 1981; Chesterfield et al. 1991; Williams 2000). Hence the notion of a split 'fire-intolerant' vs. 'fire-tolerant' flora does not appear to be explained simply by differences in resprouting ability. Recently, however, Fensham et al. (2003) demonstrated that recurrent fires caused increased mortality in tree species from monsoon rainforest compared to surrounding savannah, suggesting fundamental differences in sprouting ability. Remaining unresolved is the question of whether quintessential sclerophyllous species are more 'fire-tolerant' than their mesophytic cousins in the same genus or family, and what the mechanisms for this tolerance are.

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Appendix 1. Life-history traits of 65 montane wet sclerophyll forest understorey species at Washpool and Mummel Gulf National Parks on the New England Tablelands. * indicates species not included in CCA; ** fire response of species recorded at both sites. Nomenclature follows Harden (1990; 1991; 1992; 1993).

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Family	Species	Growth Form	Leaf type	Dispersal Mode	Seed Bank	Fire		Site
						Response	Post-fire Recruitment	
Fabaceae	<i>Acacia faiciformis</i>	Small Tree	Sclerophyll	Invertebrate	Soil	IV & V	+	WPNP
Fabaceae	<i>Acacia irrorata</i>	Small Tree	Sclerophyll	Invertebrate	Soil	II	+	WPNP
Fabaceae	<i>Acacia maidenii</i>	Tree	Sclerophyll	Invertebrate	Soil	IV & V	+	MGNP, WPNP**
Fabaceae	<i>Acacia melanoxylon</i>	Tree	Sclerophyll	Invertebrate	Soil	II	+	MGNP, WPNP**
Fabaceae	<i>Acacia ulicifolia*</i>	Shrub	Sclerophyll	Invertebrate	Soil	II	+	MGNP
Myrtaceae	<i>Acmena smithii</i>	Tree	Mesophyll	Vertebrate	Dispersed	V	-	MGNP, WPNP**
Epacridaceae	<i>Acrotriche aggregata</i>	Shrub	Sclerophyll	Vertebrate	Soil	V	+	MGNP
Myrtaceae	<i>Archirhodomyrtus beckleri</i>	Small Tree	Mesophyll	Vertebrate	Soil	V	-	MGNP, WPNP**
Rutaceae	<i>Asterolasia correifolia</i>	Small Tree	Mesophyll	Passive	Soil	II	+	WPNP
Proteaceae	<i>Banksia integrifolia</i> subsp. <i>monticola</i>	Tree	Sclerophyll	Wind	Canopy	VI	+	MGNP, WPNP**
Proteaceae	<i>Banksia spinulosa*</i>	Shrub	Sclerophyll	Wind	Canopy	V	+	MGNP
Euphorbiaceae	<i>Breynia cernua</i>	Shrub	Mesophyll	Vertebrate	Dispersed	IV & V	-	WPNP
Cunoniaceae	<i>Caldduvia paniculosa</i>	Tree	Mesophyll	Passive	Soil	V	+	MGNP, WPNP**
Cunoniaceae	<i>Callicoma serratifolia</i>	Tree	Mesophyll	Passive	Soil	V	-	WPNP
Lauraceae	<i>Cinnamomum oliveri</i>	Tree	Coriaceous	Vertebrate	Soil	V	-	WPNP
Rubiaceae	<i>Coprosma quadrifida</i>	Shrub	Sclerophyll	Vertebrate	Soil	V	-	MGNP, WPNP**
Lauraceae	<i>Cryptocarya foveolata</i>	Small Tree	Mesophyll	Vertebrate	Soil	V	-	MGNP
Lauraceae	<i>Cryptocarya glaucescens</i>	Small Tree	Mesophyll	Vertebrate	Soil	V	-	WPNP
Lauraceae	<i>Cryptocarya rigida</i>	Small Tree	Mesophyll	Vertebrate	Soil	V	-	MGNP, WPNP
Celastraceae	<i>Denhamia celestroides</i>	Small Tree	Coriaceous	Passive	Soil	V	-	WPNP
Ebenaceae	<i>Diospyros australis</i>	Small Tree	Coriaceous	Vertebrate	Soil	V	-	MGNP
Sauindaceae	<i>Dodonaea megazyga*</i>	Small Tree	Mesophyll	Passive	Soil	II	+	WPNP
Monimiaceae	<i>Doryphora sassafras</i>	Tree	Coriaceous	Passive	Dispersed	IV & V	-	WPNP
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>	Small Tree	Coriaceous	Vertebrate	Soil	V	+	MGNP, WPNP**
Lauraceae	<i>Endiandra muelleri</i>	Tree	Mesophyll	Vertebrate	Soil	V	-	MGNP, WPNP
Eupomatiaceae	<i>Eupomatia laurina</i>	Shrub	Mesophyll	Vertebrate	Dispersed	IV & V	-	WPNP

RESPONSES OF UNDERSTOREY SPECIES TO FIRE

Family	Species	Growth Form	Leaf type	Dispersal Mode	Seed Bank	Fire		Site
						Response	Recruitment	
Fabaceae	<i>Goodia lotifolia</i>	Shrub	Mesophyll	Invertebrate	Soil	IV & V	+	MGNP, WPNP
Proteaceae	<i>Hakea eriantha</i>	Shrub	Sclerophyll	Wind	Canopy	V	+	MGNP, WPNP
Monimiaceae	<i>Hedycarya angustifolia</i>	Small Tree	Mesophyll	Vertebrate	Dispersed	V	-	MGNP, WPNP
Fabaceae	<i>Indigofera australis</i>	Shrub	Mesophyll	Invertebrate	Soil	IV & V	-	MGNP, WPNP
Epacridaceae	<i>Leucopogon hookeri</i>	Shrub	Sclerophyll	Vertebrate	Soil	V	-	MGNP
Epacridaceae	<i>Leucopogon lanceolatus</i> subsp. <i>lanceolatus</i>	Shrub	Sclerophyll	Vertebrate	Soil	V	+	MGNP, WPNP**
Proteaceae	<i>Lomatia silaifolia</i>	Shrub	Sclerophyll	Wind	Canopy	IV & V	+	WPNP
Myrtaceae	<i>Lophostemon confertus</i>	Tree	Sclerophyll	Passive	Canopy	V	-	MGNP, WPNP
Rutaceae	<i>Melicope micrococca</i>	Shrub	Mesophyll	Vertebrate	Soil	IV & V	+	WPNP
Oleaceae	<i>Notelaea</i> sp. A	Small Tree	Coriaceous	Vertebrate	Soil	V	-	MGNP, WPNP**
Asteraceae	<i>Olearia alpicola</i>	Shrub	Coriaceous	Wind	Dispersed	V	-	MGNP
Asteraceae	<i>Olearia covenyi</i>	Shrub	Coriaceous	Wind	Dispersed	V	-	MGNP
Asteraceae	<i>Olearia oppositifolia</i>	Shrub	Coriaceous	Wind	Dispersed	V	-	MGNP
Euphorbiaceae	<i>Omalanthus nitens</i> *	Small Tree	Mesophyll	Vertebrate	Soil	II	-	WPNP
Proteaceae	<i>Orites excelsa</i>	Tree	Sclerophyll	Wind	Dispersed	II	-	MGNP, WPNP
Asteraceae	<i>Ozothamnus diosmifolius</i>	Shrub	Mesophyll	Passive	Dispersed	IV	-	WPNP
Proteaceae	<i>Persoonia conjuncta</i>	Shrub	Sclerophyll	Vertebrate	Soil	II	+	MGNP, WPNP
Proteaceae	<i>Persoonia linearis</i>	Shrub	Sclerophyll	Vertebrate	Soil	V	+	MGNP
Proteaceae	<i>Persoonia media</i>	Shrub	Sclerophyll	Vertebrate	Soil	II	+	MGNP, WPNP
Proteaceae	<i>Persoonia rufa</i>	Shrub	Sclerophyll	Vertebrate	Soil	II	+	WPNP
Thymeliaceae	<i>Pimelea ligustrina</i> subsp. <i>ligustrina</i>	Shrub	Mesophyll	Passive	Soil	II	+	MGNP, WPNP
Thymeliaceae	<i>Pimelea neo-anglica</i>	Shrub	Sclerophyll	Passive	Soil	V	-	MGNP
Pittosporaceae	<i>Pittosporum undulatum</i>	Small Tree	Mesophyll	Vertebrate	Soil	IV & V	-	MGNP, WPNP**
Fabaceae	<i>Podolobium ilicifolium</i>	Shrub	Sclerophyll	Invertebrate	Soil	IV & V	+	MGNP

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Araliaceae	<i>Polyscias sambucifolia</i> subsp. A	Tree	Mesophyll	Vertebrate	Soil	IV	-	MGNP, WPNP**
Fabaceae	<i>Pultenaea</i> sp. B	Shrub	Sclerophyll	Invertebrate	Soil	II	+	WPNP
Rubiaceae	<i>Psychotria loniceroides</i>	Shrub	Mesophyll	Vertebrate	Soil	IV & V	-	MGNP
Myrsinaceae	<i>Rapanea howittiana</i>	Small Tree	Coriaceous	Vertebrate	Soil	V	-	WPNP
Myrsinaceae	<i>Rapanea variabilis</i>	Small Tree	Coriaceous	Vertebrate	Soil	V	-	MGNP, WPNP**
Myrtaceae	<i>Rhodamnia rubescens</i> *	Shrub	Mesophyll	Vertebrate	Soil	IV & V	-	WPNP
Cunoniaceae	<i>Schizomeria ovata</i>	Shrub	Mesophyll	Vertebrate	Soil	V	-	MGNP, WPNP**
Solanaceae	<i>Solanum densevestitum</i>	Shrub	Mesophyll	Vertebrate	Soil	IV & V	-	WPNP
Meliaceae	<i>Synoum glandulosum</i>	Small Tree	Mesophyll	Vertebrate	Dispersed	V	-	MGNP, WPNP**
Winteraceae	<i>Tasmannia insipida</i>	Shrub	Mesophyll	Vertebrate	Soil	V	-	WPNP
Winteraceae	<i>Tasmannia stipitata</i>	Shrub	Mesophyll	Vertebrate	Soil	IV & V	-	MGNP
Epacridaceae	<i>Trochocarpa laurina</i>	Small Tree	Sclerophyll	Vertebrate	Soil	V	+	MGNP, WPNP**
Epacridaceae	<i>Trochocarpa</i> sp A	Shrub	Sclerophyll	Vertebrate	Soil	V	-	MGNP
Rutaceae	<i>Zieria arborescens</i>	Small Tree	Mesophyll	Invertebrate	Soil	II	+	WPNP
Rutaceae	<i>Zieria smithii</i> subsp. smithii	Shrub	Mesophyll	Invertebrate	Soil	II	+	WPNP

