Fire responses of bushland plants after the January 1994 wildfires in northern Sydney

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Abstract: In early January 1994 wildfires burned areas of bushland in northern Sydney (lat 33° 45' S, long 151° 05' E) in coastal south-eastern Australia. This paper reports observations of the fire responses for 828 species of bushland plants – 576 native species and 252 exotic species in the Lane Cove River and Narrabeen Lagoon catchment areas. Information recorded includes whether a species was killed by fire or resprouted post-fire, when seedlings were first observed following fire, and the times of first flowering and first fruiting (or spore production) after the fires. The estimated peaks of post-fire flowering or fruiting for a few species are given. It was not practicable to record data in all categories for all of the 828 species due to the logistical challenges involved in recording data across a large area of bushland, over a number of years.

The data presented add to the growing body of knowledge on plant fire responses and will assist the management and conservation of bushland in the study areas, as well as the broader Sydney region.

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Introduction

Fire plays an important role in the shaping of Australia's terrestrial ecosystems and the work of many researchers has created a rich literature about fire ecology in Australia (e.g. see Gill 1975, Gill *et al.* 1981, Gill *et al.* 1991, Gill *et al.* 1994, Williams & Gill 1995, Brown & Tohver 1995, DEST 1996, Gill *et al.* 1999, Bradstock *et al.* 2002).

When considering the responses of plant species to fire, a basic distinction is often made between species that are killed by fire and those that resprout after being burnt (Gill 1981, Gill & Bradstock 1992, Keith 1992, Benson & McDougall 1993). The former group have been called 'obligate seeders' (or 'non-sprouters') and the latter 'resprouters' (or 'sprouters') (Whelan 1995). Responses to fire may vary between different populations of a plant species (Gill 1981, Williams & Gill 1995, Bond & van Wilgen 1996, Keith 1996, Auld 1996, Auld 2001). Within a given population of a plant species, the response to fire may be somewhat variable. Such variability may be due to the size/stage of development of individual plants, the intensity of any given fire, the season in which a particular fire occurs, the length of time between successive fires and/or genetic variability between and (possibly) within populations of plants (Gill 1981, Whelan 1995, Morrison 1995, Auld 1996, Bond & van Wilgen 1996, Morrison & Renwick 2000, Myerscough *et al.* 2000, Auld 2001, Whelan *et al.* 2002).

Following a fire, the time taken by plants to flower after germination from seed, is known as the 'primary juvenile period'. The time required for resprouting plants to flower following a fire is called the 'secondary juvenile period' (Gill 1975). Benson (1985) and Benson & McDougall (1993, 2005) indicated that the time taken by plants following a fire to produce mature fruits is more important to the survival of a plant species, than is the time taken to first flowering. However, the first substantial post-fire flowering may be ecologically important for animals dependent on those flowers for food, e.g. nectar and pollen-feeding insects, birds and mammals. Benson (1985) observed that the initial onset of post-fire flowering often involves only a few advanced individuals. Keith *et al.* (2002a) suggested that the initial post-fire flowering season of most obligate seeder plant species is unlikely to result in the production of many seeds. A further delaying factor, for some species, is that they produce fruits that take a relatively long time to mature (Benson 1985). The long-term survival of a plant species can often depend on the formation of a viable seedbank (either in the soil or on the plants), which may take a number of years to accumulate following the initial onset of post-fire fruiting (Benson 1985, Auld 1996, Keith 1996, Benson & McDougall 1998, Auld *et al.* 2000, Myerscough *et al.* 2000, Keith *et al.* 2002a, Keith *et al.* 2002b).

The durations of primary and secondary juvenile periods may vary between populations of a given plant species, due to factors such as differences in the amount of post-fire rainfall, length of growing season and variations in nutrient availability and soil depth between different habitats (Bradstock & O'Connell 1988, Keith 1996, Benson & McDougall 1998, Keith *et al*. 2002a, Knox & Clarke 2004). Generally, the durations of primary juvenile periods for woody plant species are longer than those for herbaceous species (Keith 1996). Also, woody resprouters tend to have longer primary juvenile periods than woody obligate seeders (Keith 1996). Benson & McDougall (2005) indicated that the primary juvenile periods for many plant species in the bushland of the Sydney region are yet to be recorded.

The responses of flora to fire in south-eastern Australia have been studied by many researchers (see Table 1) while aspects of the fire ecology of individual Sydney plant species have also been studied (Table 2) There are a number of reviews covering fire ecology of major families in the Sydney context; Fabaceae (Auld 1996), Myrtaceae (Myerscough 1998), Proteaceae (Myerscough *et al*. 2000), Rutaceae (Auld 2001) and Orchidaceae (Weston *et al*. 2005). Benson & McDougall (1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2005) gathered together diverse ecological information, including fire response data, for bushland plants in the Sydney region. Their work drew on both published and unpublished sources.

Between late December 1993 and mid-January 1994 wildfires occurred in many parts of eastern NSW. Major fires occurred in a number of national parks around and within Sydney (Costello 1994, Gill & Moore 1996, 1998) including the burning of sizable tracts of bushland in the Lane Cove River and Narrabeen Lagoon catchment areas of northern Sydney (NSW State Coroner 1995). These fires provided the opportunity to record some of the post-fire responses of bushland plants in the Lane Cove River and Narrabeen Lagoon catchment areas, a study that continued over nearly 6 years following the 1994 fires.

Table 1 A selection of studies on fire responses of plant species in south-eastern Australia and the Sydney area

Researcher	Location	Type of observation
Purdie & Slatyer (1976) Purdie (1977)	Canberra	regeneration of plant species following fires in bushland
Wark *et al*. (1987) Wark (1996, 1997, 1999, 2000)	southern coastal Victoria	responses of plants, after a high intensity wildfire
Fox & Fox (1986) Fox (1988)	Myall Lakes	categorized the modes of post-fire regeneration for plant species in woodland and forest
Myerscough *et al*. (1995) Myerscough & Clarke (2007)	Myall Lakes	fire responses of plants in coastal heaths
Benwell (1998)	north-eastern NSW	modes of post-fire regeneration of coastal heathland plant species
Clarke & Knox (2002) Knox & Clarke (2004) Clarke *et al*. (2005)	New England Tablelands	responses of woody plants following fires
Walsh & McDougall (2004)	Kosciuszko National Park	recovery of plants in treeless subalpine vegetation after a major wildfire
	Sydney area studies	
Siddiqi *et al*. (1976)	Bouddi NP	effects of fire on coastal heathland vegetation
Benson (1981)	Agnes Banks	modes of regeneration after fire for plant species on a sand deposit
Benson (1985)	Brisbane Water NP Glenorie	maturation periods for some shrub species after fires
Nieuwenhuis (1987)	Ku-ring-gai Chase NP	effects of fire frequency on bushland
Bradstock *et al*. (1997)	Brisbane Water NP	effects of high frequency fire in a coastal heathland
Auld *et al*. (2000)	Sydney area	soil seedbank longevity of plant species

Table 2 Individual plant species whose fire ecology has been studied in the Sydney area

Species (family)	Researcher
Acacia suaveolens (Fabaceae)	Auld 1986, Auld & Myerscough 1986, Warton & Wardle 2003
Angophora hispida (Myrtaceae)	Auld 1987
Banksia ericifolia (Proteaceae)	Bradstock & Myerscough 1981, Morris & Myerscough 1988
Banksia oblongifolia (Proteaceae)	Zammit 1988
Blandfordia nobilis (Blandfordiaceae)	Johnson *et al*. 1994
Eucalyptus luehmanniana (Myrtaceae)	Davies & Myerscough 1991
Persoonia lanceolata (Proteaceae)	Auld *et al*. 2007
Telopea speciosissima (Proteaceae)	Bradstock 1995

Various facets of fire ecology for groupings of plant species in the Sydney region have been studied, e.g. Auld & Denham (2006), Auld & O'Connell (1991), Auld & Tozer (1995), Bradstock (1990), Bradstock (1991), Bradstock *et al*. (1994), Bradstock & Myerscough (1988), Bradstock & O'Connell (1988), Cary & Morrison (1995), Clark (1988), Denham & Auld (2002), Keith & Bradstock (1994), Kenny (2000), Morrison (1995), Morrison *et al*. (1996), Morrison & Renwick (2000), Ooi *et al*. (2006, 2007), Pannell & Myerscough (1993), Pyke (1983), Thomas *et al*. (2007), Whelan & York (1998) and Zammit & Westoby (1987).

The conservation of biodiversity is an important objective in the management of Lane Cove and Garigal National Parks, the two major reserves in the study area (e.g. see NSW NPWS 1998a, 1998b), while, in recent years, local councils, supported by the community, have also placed increasing emphasis on the conservation of the flora and fauna of many smaller bushland reserves. The increased knowledge of plant responses to fire in this present study will assist in the management, for conservation purposes, of bushland in the Narrabeen Lagoon and Lane Cove River areas. Such information may also have broader application in the management of bushland in the Sydney region, particularly when used in conjunction with the findings of other researchers.

Methods

Study areas

The Lane Cove River valley is situated in the northern Sydney metropolitan area (lat 33° 45' S, long 151° 05' E), in the Central Coast botanical subdivision of NSW. In the course of European settlement during the last two centuries much of the catchment area has been cleared, for agriculture at first, and subsequently for urban development. Large areas of native vegetation have however survived along the Lane Cove River, and much of this bushland has been protected within Lane Cove National Park (see NSW NPWS 1998a for this Park's plan of management), with smaller portions included in reserves managed by local councils.

The environmental history of the Lane Cove River valley is documented by McLoughlin (1985) and McLoughlin & Wyatt (1993) and the general vegetation by Benson & Howell (1990, 1994). Clarke & Benson (1987) mapped and described 15 vegetation types, including mangrove forest, saltmarsh, tall forest, open-forest, woodland, shrubland and riparian shrubland for Lane Cove National Park (then known as Lane Cove River State Recreation Area). Most of the surviving bushland in the Lane Cove River area is sclerophyllous and occurs on sandstone geology, described in broad terms by Keith (2004) as the Sydney Coastal Dry Sclerophyll Forests. In the Lane Cove River area, these forests are dominated by a few species of eucalypt, most commonly *Angophora costata*, *Eucalyptus piperita* and *Corymbia gummifera*. The floristic diversity of the area is high.

Plant species lists compiled for bushland in the Lane Cove River area, include Coveny (1965–78), Beecroft Cheltenham Civic Trust (1976), Lane Cove River SRA Trust (1983), STEP Inc. (1985), Kubiak (1986–89, 1996), Clarke & Benson (1987), Smith & Smith (1993) and Martyn (1994). In the Lane Cove River area, watercourses and disturbed places, such as the edges of bushland, are frequently dominated by exotic plant species.

The Narrabeen Lagoon catchment area is about 15 km north-east of the Lane Cove River catchment area and is about 8 km closer to the coast. Benson & Howell (1990, 1994) provide general descriptions of vegetation in the Narrabeen Lagoon catchment. The floristic diversity of the Narrabeen Lagoon catchment area is comparable to that of the Lane Cove River area. Sheringham & Sanders (1993) mapped and described 21 vegetation types in the eastern section of Garigal National Park (centred on Deep Creek) including areas of open-forest, woodland, heathland, wetland, swamp and closed-forest. Heathland is much more common at the Narrabeen Lagoon area than at Lane Cove River (see Benson & Howell 1990, 1994). Plant species lists for the Narrabeen Lagoon area include Coveny (1965–75), National Trust of Australia (NSW) (1980), Kubiak (1992) and Sheringham & Sanders (1993). A plan of management has been prepared for Garigal National Park (NSW NPWS 1998b). Weed infestation in the Narrabeen Lagoon catchment area tends to be confined to some sections of major watercourses and to disturbed areas, such as the margins of bushland and along service tracks.

The management of fire for conservation purposes in the Lane Cove River and Narrabeen Lagoon catchment areas is complicated by the fragmentation of the bushland and by the pressures arising from surrounding suburban development. Clark & McLoughlin (1988) inferred what the frequency of fires may have been in the Lane Cove River area before the arrival of Europeans. Arson and the lighting of fires for management purposes are probably now the main factors influencing fire frequency. Generally, the study areas have experienced bushfires quite frequently in the recent past. However, there may be some patches of bushland within these catchments that escape being burnt for fairly long periods of time.

The 1994 fires

The Lane Cove River fire began on 6 January 1994 in the Browns Waterhole area and was probably deliberately lit (NSW State Coroner 1995). During that day bushland was burnt at North Epping, South Turramurra, Marsfield and West Pymble. Strong winds on 6 January and the following day rapidly forced fire downriver, with the spread accelerated by spotting. On 7 January, fire burnt bushland along Terrys Creek, Marsfield and downriver to Blue Gum Creek. Fire fighters backburned overnight on 7 January, along Delhi Rd. from Fullers Bridge to Plassey Rd. at North Ryde, in an attempt to contain the wildfire. However, strong winds on 8 January forced fire across Delhi Rd. into the Fairyland area and across the river into Mowbray Park and the Stringybark Creek area at Lane Cove West (NSW State Coroner 1995). The area of bushland burnt in the Lane Cove River catchment was variously estimated to be c. 383 ha (NSW NPWS 2002, DEC NSW 2005a, 2006a) or c. 580 hectares (NSW State Coroner 1995, Gill & Moore 1998). The former estimate may possibly have been limited to bushland burnt in Lane Cove National Park, whilst the latter was for all bushland 'affected' in the Lane Cove River area. The fires were generally described as being of a very high intensity (NSW State Coroner 1995).

The fire in the Narrabeen Lagoon catchment area began on 8 January 1994, having originated at Cottage Point on 7 January, and spread rapidly through the adjoining Ku-ring-gai Chase National Park (NSW State Coroner 1995). On 8 January, and over the next few days, wildfire burnt through bushland in the Deep Creek, Mullet Creek, Middle Creek, Jamieson Park and Wheeler Creek areas. This fire event was estimated to have burnt c. 1000 ha in the eastern section (centred on Deep Creek) of Garigal National Park (DEC NSW 2005b, 2006b). Additional bushland in the Narrabeen Lagoon catchment area, outside of Garigal National Park, was also burnt.

Field observations

Field observations of fire responses of bushland plants were made in Lane Cove River catchment area between January 1994 and October 1999 (a period of almost 6 years), with a few occasional observations in following years (Table 3). Field observations in the Narrabeen Lagoon catchment area, including any flowering or fruiting of plants, were made between March 1994 and late October 1994 (over approximately 8 months). The longer period of study in the Lane Cove River area meant that more observations of post-fire flowering and fruiting were made for plant species in that area, than in the Narrabeen Lagoon catchment.

Observations were recorded while walking through burnt bushland after the fires. No fixed transects or quadrats were used. Observations were made along tracks, roads and walking trails throughout the study areas (Table 3). As wide a variety of habitats as possible were looked at, including bushland away from tracks and known to contain species or vegetation types that did not occur along the tracks. Most of the main tracks, and many of the minor ones, were walked at least once, and some, many times.. The total distance walked, while making observations, during the course of this study was probably in the order of several hundred kilometres. The routes walked were often the same, particularly in the more intensively studied areas. Attention was given to repeatedly observing particular species at certain locations, so that parameters such as the time of first flowering and first fruiting could be recorded for some of the rarer or more localized plant species, as well as the more common species. The author's field experience in the study areas prior to the fires was drawn upon to help locate particular species that might otherwise have been overlooked. (Some new 'discoveries' of species, previously unrecorded by the author, were made following the fires). The main references used for plant identification were Harden (1990–1993, 2002), Harden & Murray (2000), Carolin & Tindale (1994), Fairley & Moore (1989) and Robinson (1991).

In the first few months following the fires, the main focus was on whether plant species in the study areas were killed by fire or had resprouted after being burnt. Sometimes the 'skeletons' of burnt plants could be found and, if these showed no sign of resprouting for some months after the fires, then this suggested that the plants were probably killed by fire. Such skeletons occasionally retained a few scorched leaves or fruits, which helped with the identification of the species killed by the fires. Areas that had evidently experienced the highest intensity fires tended to contain far fewer identifiable plant skeletons. In these situations, the presence of woody fruits, or cones, on fatally scorched plants helped with the identification of some species. In addition, it was often possible to recall that a species had occurred at a particular site prior to that location being burnt. If such a species appeared to be absent from that same site months after the fire, or was only present in the form of post-fire seedlings, then this also helped to decide whether that species was killed in the fires. Terrestrial orchids were amongst the most difficult plants to determine, as most of them were probably seasonally dormant at the time of the fires. Presumably, the terrestrial orchids mostly sprouted from dormant subterranean tubers after the fires (as discussed by Weston *et al*. 2005).

Other data recorded, in the first few months after the fires, included the first appearance of some seedlings and the early post-fire flowering and fruiting of some plant species. As the months and years went by, the time to first flowering and fruiting was recorded for more species. The likely peaks of post-fire flowering or fruiting were also subjectively estimated for a few species. Such 'peaks' of post-fire flowering and fruiting may plateau over a number of years. These estimates are probably best regarded as broadly indicative as their estimation may have been affected by the subjective nature of the observations and by variability between and within populations. The rate of maturation tends to vary between individual plants, within any population of a given species (e.g. see Benson 1985).

Fire patchiness and intensity

Benson (1985) suggested that varying fire intensities within single fire events are a common feature of fires affecting Hawkesbury sandstone vegetation in the Sydney region, and indicated that such variability may be, at least in part, due to landscape or habitat variation. Keith *et al*. (2002a) noted that topographically varied areas, such as the sandstone plateaus of the Sydney region, are likely to exhibit greater fire patchiness than areas of heathland burnt on extensive plains. Walsh & McDougall (2004) also reported variability in the wildfire intensity in the treeless subalpine vegetation of Kosciuszko National Park in southern NSW. Patches of vegetation that have not been burnt by a particular fire can act as fire 'refuges'. Such fire refuges can protect fire sensitive species and also provide sources of seed for dispersal to burnt areas after fires (Benson 1985, Williams *et al*. 1994, Gill & Bradstock 1995, Bradstock *et al*. 1997, Whelan *et al*. 2002). Morrison (2002) studied the effects of fire intensity on the plant species composition of bushland in Ku-ring-gai Chase National Park, following a wildfire of early January 1994.

The January 1994 fires in the Lane Cove River and Narrabeen Lagoon areas were generally of an apparently high intensity

Table 3. Dates of observations of fire responses for localities in the Lane Cove River and Narrabeen Lagoon catchment areas, following the January 1994 fires.

Localities	Dates of observations
Lane Cove River catchment	
Upper Stringybark Creek, Lane Cove West	1994 Apr.
Mowbray Park, Lane Cove West	1994 Feb, Apr, Jul, Oct, Dec. 1996 Jul, Sep, Oct. 1997 Mar. 1998 Sep, Oct.
Fairyland, North Ryde (south of Delhi Rd., west of Quebec Road, north-east of Epping Road & north of the river)	1994 Jan.(2), Mar, Aug.(2), Sep, Oct, Nov, Dec.(2) 1995 Jan, Mar, Apr, May (2), Jun, Aug, Sep, Oct, Dec. 1996 Apr, Aug, Oct, Dec. 1997 Jan, Apr, Sep(2), Nov. 1998 Mar, Jun, Sep, Oct. 1999 Jan., Oct. 2002 Oct. 2007 Oct.
Blue Gum Creek, Lindfield	1994 Feb, May , Jul, Oct, Nov. 1995 Sep, Dec. 1996 May , Dec. 1999 Oct.
Sir Phillip Game Reserve, Lindfield	1994 Jul.
Fullers Bridge to De Burghs Bridge, along the south (or west) bank of the river, North Ryde (variously including Plassey Road, Banksia Hill, Carter Creek, Tunks Hill, Riverside Drive, Riverside Walking Track & just north of Kobada Park)	1994 Feb, Mar.(2), Apr, May, Jun.(2), Jul, Aug.(2), Sep(2), Oct.(2), Nov, Dec. 1995 Jan, Mar, Jun, Aug, Sep.(2), Oct.(2), Nov, Dec(2) 1996 Jan.(2), Mar, Apr, May , Jun.(2), Jul, Aug.(2), Sep(2), Oct, Nov.(2) Dec. 1997 Jan, Feb, Mar, May , Jun, Jul, Aug, Sep, Oct.(2), Nov. 1998 Jun, Jul.(2), Aug.(2), Sep, Oct. 1999 Jan, Mar, Sep.(2), Oct. 2000 May 2002 Oct.
Fullers Bridge to De Burghs Bridge, north (or east) bank of the river (mostly Great North Walk)	1994 Feb, Mar, Jun, Jul, Aug, Sep, Oct, Dec. 1995 Mar, Jun, Sep, Oct. 1996 May, Aug, Sep, Oct, Nov. 1997 Feb, Aug, Nov. 1998 Aug.
De Burghs Bridge to Browns Waterhole, south bank of the river	1994 Mar.(2), May, Jun, Jul. 1995 Sep. 1996 May
De Burghs Bridge to Browns Waterhole, north bank of the river	1994 Mar.(2), Jul.(2), Aug, Sep, Oct, Dec. 1995 Sep. 1996 May, Jul, Sep. 1997 Jul, Oct, 1998 Aug. (2), Oct. 1999 Mar, Sep. (2) 2000 May. 2007 Aug.
Terrys Creek (from Somerset Park /Lucknow Park to Browns Waterhole)	1994 Mar.(2), May, Jul, Sep, Oct, Dec. 1995 Sep. 1996 May, Sep. 1997 Jul. 1998 Aug.
Upriver of Browns Waterhole, north bank of the river	1994 Mar, Sep. 1995 Mar.
Upriver of Browns Waterhole, south bank of the river	1994 Mar, Jul. 1996 May, Aug.
Narrabeen Lagoon catchment	
Mullet Creek area	1994 Apr, Sep.
Deep Creek area	1994 Mar, May (2), Jun, Aug, Sep.(2), Oct.
Middle Creek area	1994 Mar, Aug.
Jamieson Park	1994 Apr.
Oxford Creek area	1994 Mar, Oct.
Wheeler Creek area	1994 May, Aug.

– I noted a large proportion of the bushland burnt in both of the study areas experienced 100% tree and/or large shrub canopy scorch. However there was some patchiness– some patches were evidently burnt at low or moderate intensities, other patches of vegetation remained unburnt. During the earliest period of observations, the locations of unburnt patches were noted and plant responses in patches that were apparently burnt at lower intensities were recorded (e.g. *Muellerina eucalyptoides* (Loranthaceae) resprouted after an evidently low to moderate intensity fire). Observations of plant responses in apparently lower fire intensities were used to help understand the responses of the same species in the more severely scorched areas. For example, if a species was observed as being killed (as evidenced by the presence of scorched, dead plant skeletons) in the lower intensity areas (e.g. some of the edges of burnt areas), then this information complemented any observations that no plants of the same species could be found resprouting in the immediately adjoining areas that were evidently burnt at a higher intensity.

Results and discussion

Fire responses for 828 vascular plant species (576 native and 252 exotic species) were recorded in bushland of the Lane Cove River and Narrabeen Lagoon catchments, following the wildfires of January 1994 (Appendix 1). In many cases it was possible to determine whether a species resprouted or was killed by the fires, and generally, the more widespread and common a species, the greater was the opportunity to reliably determine the mode of regeneration. All fire responses reported here are for individual plants whose above-ground parts were 100% scorched. The responses of individual plants that were only partly burnt are not included.

It was not practicable to record data in all of the categories for all of the 828 species of plants because of the logistical challenges for one observer recording information across large areas of bushland, over a number of years. The first post-fire flowering, or fruiting, of some of the locally rarer species may have been missed. For example, the orchid *Orthoceras strictum* is rare in the bushland of the Lane Cove River area and one plant was seen with green fruits in January 1996, but it is possible that this species may have flowered a year earlier and simply been overlooked, due to its local rarity and inconspicuous colouration.

Fire responses of ferns and fern allies

The ferns and fern allies (pteridophytes) mostly resprouted after the January 1994 wildfires. The exceptions were mostly epiphytic or lithophytic species, such as *Hymenophyllum cupressiforme* (Hymenophyllaceae) and *Pyrrosia rupestris* (Polypodiaceae), which were killed when severely scorched. Most of the resprouting pteridophytes regenerated from below the ground, presumably from buried rhizomes. The treefern *Cyathea australis* (Cyatheaceae) resprouted from the apex of the trunk after the fires. Benson & McDougall (1993) noted that old plants may survive many bushfires. *Calochlaena dubia* (Dicksoniaceae) and *Pteridium esculentum* (Dennstaedtiaceae) resprouted very vigorously but a few *Calochlaena dubia* rhizomes were apparently killed by fire, probably because they were growing in shallow soil on top of a boulder. Benson & McDougall (1993) stated that *Calochlaena dubia* is a vigorous resprouter following fire and may produce shoots within a month of burning, even in the absence of rain.

The majority of the resprouting ferns produced spores within the first year after the fires. Amongst the earliest resprouting ferns to produce spores were *Blechnum cartilagineum* (Blechnaceae), *Pteridium esculentum* (Dennstaedtiaceae) and *Todea barbara* (Osmundaceae). These species had some fronds with mature sporangia by 10 weeks (March 1994) after the fires. L. McDougall observed that vigorous regrowth of *Blechnum cartilagineum* produced fertile fronds in less than 20 weeks after a high intensity fire at Killarney Heights, in northern Sydney (Benson & McDougall 1993).

Fire responses of conifers

Bond & van Wilgen (1996) stated that resprouting after fire is much rarer in conifers than in woody angiosperms. Of the few species of conifer in the study area *Callitris muelleri* (Cupressaceae) was killed by fire in the Narrabeen Lagoon area. At one site, seedlings (2 – 6 cm tall) were observed growing in the vicinity of fatally scorched adult plants, within 32 weeks of burning, and evidently grew from seed that was shed from cones, which opened after the fire, on the standing plants. Benson & McDougall (1993) recorded that this species is killed by fire and that seedling recruitment occurs mainly after fire.

Benson & McDougall (1993) documented that the low-growing coniferous shrub *Podocarpus spinulosus* (Podocarpaceae) resprouts at ground level or below, after being burnt and noted that this species probably has no soil-stored seedbank and that its seed is probably dispersed by birds. *Podocarpus spinulosus* resprouted vigorously after the 1994 fires in the Lane Cove River and Narrabeen Lagoon areas – no seedlings were observed in the burnt bushland of the Lane Cove River area in the first few years after the January 1994 fires. The resprouted male and female plants in the Lane Cove River area first started flowering in October 1995 and some mature fruit were produced by early December 1995 (c. 100 weeks after the fires). Stems of male plants occurred in groups separate from the grouped stems of female plants probably indicating spread by vegetative means.

Fire responses of monocotyledons

The great majority of monocotyledons resprouted following the 1994 fires, but a few species were killed e.g. *Caustis flexuosa* and *Caustis pentandra* (Cyperaceae). D. Benson observed *Caustis flexuosa* and *Caustis pentandra* were killed by fire at Leura swamp, in the Blue Mountains, west of Sydney (Benson & McDougall 2002). However, Williams & Clarke (2006) reported that *Caustis flexuosa* resprouted after fire, at Gibraltar Range National Park, in northern NSW.

Adams & Lawson (1984) studying the regeneration of epiphytic and lithophytic orchids (Orchidaceae) in East Gippsland, Victoria, following high intensity fires in March 1983, found that scorched individuals of *Dockrillia striolata* (*Dendrobium striolatum*) and *Thelychiton speciosus* (*Dendrobium speciosum*) showed some capacity to resprout from basal shoots. Weston *et al*. (2005) suggested that epiphytic and lithophytic orchids tend to grow in microhabitats that are less fire-prone and that *Cestichis reflexa* (*Liparis reflexa*) and *Thelychiton speciosus* are capable of resprouting after low intensity fires. In the study areas in northern Sydney the lithophytic orchids *Cestichis reflexa* and *Dockrillia linguiformis* were killed when severely scorched by the 1994 fires.

Post-fire flowering and fruiting of monocotyledons

Most of the monocotyledons flowered in the first year after the 1994 fires. *Imperata cylindrica* var. *major* (Poaceae) was one of the first plants to flower and fruit and vigorously resprouted, with new shoots visible within one week after the fires, flowered within 6 weeks (February 1994) and fruited within 11 weeks (March 1994). L. McDougall also observed that *Imperata* flowered prolifically within several weeks of the January 1994 high intensity fire at Narrabeen (Benson & McDougall 2005).

The four species of *Gahnia* (Cyperaceae) were amongst the slowest of the monocotyledons to flower and fruit after the fires in the Lane Cove River area (even though these *Gahnia* species resprouted vigorously). For example, the resprouting large sedge, *Gahnia clarkei*, took approximately 3 years (January 1997) following the fires, to produce fruits.

Xanthorrhoea arborea (Xanthorrhoeaceae) exhibited a marked delay between the post-fire development of its fruit at 63 weeks (March 1995) and the release of its seeds at c. 100 weeks (December 1995) after the study fires, in the Lane Cove River area. The related *Xanthorrhoea media* had developed its fruits at c. 49 weeks (December 1994) and was shedding its seeds at 56–63 weeks (January to March 1995), after the fires in the Lane Cove River area. Flowering of these two species occurred earlier in the Narrabeen Lagoon area (*Xanthorrhoea media:* 17–21 weeks, *Xanthorrhoea arborea:* 35–38 weeks after the fires) than in the Lane Cove River area (*Xanthorrhoea media:* 39–43 weeks, *Xanthorrhoea arborea:* flowered 51–56 weeks after the fires).

Keith (1996) recorded that in the Sydney region *Prasophyllum elatum* (Orchidaceae) flowers abundantly only after fire. In the Lane Cove River and Narrabeen Lagoon areas flowering seemed to be stimulated by the January 1994 fires and at several sites there were many more flowering stems of *Prasophyllum elatum* present in the first flowering season (September 1994) after the fires, than had been evident before the fires. At one previously long-unburnt site in the Lane Cove River area, *Diuris maculata* flowered much more in the first post-fire flowering season (August 1994), than it had prior to being burnt.

Jones (1988, 2006) noted that a number of Australian terrestrial orchids, including *Prasophyllum elatum*, flower much more profusely in the season following a hot summer fire, and indicated that high intensity fires (such as the Ash Wednesday bushfires of February 1983) can result in spectacular flowering displays of terrestrial orchids. Beardsell *et al*. (1986) noted a dramatic increase in flowering of *Diuris maculata* following hot summer bushfires. Weston *et al*. (2005) indicated that the long-term consequences of frequent fires on populations of terrestrial orchids are poorly understood. They suggested that a regime of high frequency fire could possibly deplete populations of some terrestrial orchid species, even though their flowering might appear (initially) to be stimulated by fire.

Bond & van Wilgen (1996) stated that fire-stimulated flowering is very common in monocotyledons and Keith (1996) listed Sydney region monocotyledons that flower abundantly only after fire, including *Blandfordia nobilis* (Blandfordiaceae), *Cyathochaeta diandra* (Cyperaceae), *Haemodorum corymbosum* (Haemodoraceae) and *Xanthorrhoea media* (Xanthorrhoeaceae). The January 1994 wildfires in the Narrabeen Lagoon and Lane Cove River areas were probably an important opportunity for such species to flower, set fruit and to consequently recruit seedlings into their populations. If fires occur too infrequently, then such species can decline (Keith 1996). A few species of woody dicotyledons may also be adversely affected by a regime of infrequent fires, due to their reliance on fire-stimulated flowering, e.g. *Angophora hispida* (Myrtaceae) and *Telopea speciosissima* (Proteaceae) (Keith 1996, Keith *et al*. 2002a). However, species such as *Angophora hispida* and *Telopea speciosissima* may also be adversely affected by too high a fire frequency (Auld 1987, Bradstock 1995).

Fire responses and post-fire flowering/fruiting of dicotyledons

A few species of dicotyledons showed variable responses to the January 1994 fires. The shrub *Gompholobium latifolium* (Fabaceae) was killed in the Lane Cove River area, but scattered plants of this species resprouted in the Narrabeen Lagoon area. Auld (1996) recorded that variation in fire response occurs within individual species of the genus *Gompholobium* and suggested that such variability can result from a number of causes, including genetic variation within a species. *Acacia oxycedrus* (Fabaceae) was killed by fire in the Lane Cove River area, but mostly resprouted after the January 1994 fires in the Narrabeen Lagoon area. Auld (1996) noted that *Acacia oxycedrus* is one of a number of *Acacia* species in the Sydney region that exhibit a variable fire response. The small shrub *Xanthosia pilosa* (Apiaceae) was mostly killed by the January 1994 fires in the Lane Cove River catchment area, but some plants there did resprout. L. McDougall found that *Xanthosia pilosa* displayed a variable fire response in Garigal National Park, northern Sydney (Benson & McDougall 1993). The shrub *Astrotricha longifolia* (Araliaceae) was probably mostly killed by the January 1994 fires at Lane Cove River, but a few scattered plants of this species resprouted.

Of the dicotyledons, the resprouting herb *Brunoniella pumilio* (Acanthaceae) was one of the first species to flower and fruit, and flowered within 6 weeks (February 1994) and fruited within 11 weeks (March 1994), after the fires, in the Lane Cove River area. The resprouting *Leptospermum trinervium* (Myrtaceae) was one of the earliest shrubs to produce some flowers, with one plant in the Narrabeen Lagoon area flowering 17 weeks (May 1994) after the fires. L. McDougall observed *Leptospermum trinervium* flowering from epicormic shoots 5 months after a high intensity fire (of January 1994) at Mona Vale (Benson & McDougall 1998). Myerscough & Clarke (2007) noted that *Leptospermum trinervium* flowered for the first time 307 days after a fire (of January 1991) at Myall Lakes, north of Sydney.

The flowering of some dicotyledon species peaked in the first year, or so, after the fires. For example, the herb *Lobelia dentata* (Lobeliaceae) commonly flowered in the first year after the fires, but no flowering plants of this species could be found in the Lane Cove River area within approximately two to three years after the fires. Klaphake (1995) observed that, at two locations in the Lane Cove River area, *Lobelia dentata* seemed only to appear following fire. Benson & McDougall (1997) found that this species apparently resprouted from a deeply-buried rhizome, on the Lambert Peninsula (just north of Sydney), where it flowered 6–7 months after a fire.

In bushland burnt in January 1994, in the Lane Cove River area, many individuals of the resprouting shrub *Lomatia silaifolia* (Proteaceae) flowered in December 1994 through to January 1995, though only a few individuals flowered in the following December 1996. Keith (1996) noted *Lomatia silaifolia* as one of a number of resprouting plant species in the Sydney region that flower abundantly only after fire. Denham & Whelan (2000) studied a site at Bulli Tops, south of Sydney, burnt in September 1992 and observed that most of the *Lomatia silaifolia* individuals at that locality flowered in the summer of 1993–94. However, only one plant flowered in the subsequent flowering season. Benson & McDougall (2000) noted that, in general, the secondary juvenile period for *Lomatia silaifolia* in the Sydney region is approximately one year. However, Knox & Clarke (2004) reported that resprouting *Lomatia silaifolia* did not flower within 3.5 years of experimental fires in grassy woodland on the New England Tablelands, northern NSW. They suggested that the longer primary juvenile period for several plant species in their study area, when compared with that for the same species in other regions, could be attributable to the shorter growing season in the New England Tablelands. However, they did not discuss whether such climatic differences might also affect the secondary juvenile period of species such as *Lomatia silaifolia*.

Some dicotyledon species apparently did not produce fruits the first time that they flowered after the 1994 fires. For example, at one site in the Lane Cove River area, a few seedlings of the fire sensitive (obligate seeder) shrub *Persoonia lanceolata* (Proteaceae) flowered for the first time after the fire in January 1996. These seedlings only had a few flowers each and most of the seedlings in the same population did not flower at that time. The few plants that did flower had apparently not produced any fruits by June 1996. This apparent initial lack of fruit production may have resulted from a dearth of effective pollinators. Native bees have been recognized as the probable main pollinators of a number of *Persoonia* species in eastern Australia, including *Persoonia lanceolata* (Bernhardt & Weston 1996) and tend to forage in areas where floral resources are abundant enough to sustain their activity. So, a very small number of *Persoonia lanceolata* flowers would not be likely to attract many, if any, bees. Keith *et al*. (2002a) suggested that most obligate seeders are not likely to produce many seeds in their first post-fire reproductive season, and Whelan (1995) suggested that this could possibly result from poor pollination when flower densities are low or that the resources of the smaller plants might not be sufficient to produce seeds, even though pollination of some flowers may have occurred.

In the Lane Cove River area, the fire sensitive (bradysporous obligate seeder) shrub *Hakea dactyloides* (Proteaceae) was amongst the slowest of the dicotyledons to reproduce, taking approximately 6.5 years after the January 1994 fires to produce a few fruits. Myerscough *et al*. (2000) suggested that the primary juvenile periods for a number of bradysporous obligate seeding species in the family Proteaceae may typically range from between five and eight (or nine) years.

Auld *et al*. (2007) studied a population of *Persoonia lanceolata* (Proteaceae) in bushland in Ku-ring-gai Chase National Park burnt by an extensive wildfire in January 1994. They found that the seedlings did not flower until 6 years after the fire and that the primary juvenile period was 7–8 years.

Fire ephemerals and 'fire-followers'

Bond & van Wilgen (1996) defined fire ephemerals as plant species that emerge only after fires, are short-lived, are usually dead before the next fire and depend on fire for regeneration. Gill (1999) indicated that a few fire ephemerals occur in Australian tall open forests and rainforests, but they appear to be rare in drier eucalypt forests.

Pelargonium inodorum (Geraniaceae) may be one of the few species in the Lane Cove River area that could be regarded as a true 'fire ephemeral'. *Pelargonium inodorum* seemed to be a rather short-lived species, apparently disappearing from the burnt bushland by about 2 years after the fires, in the Lane Cove River area. Benson & McDougall (1997) noted that *Pelargonium inodorum* has been recorded growing in burnt *Imperata cylindrica* grassland and also from the remains of an old campfire. Walsh & McDougall (2004) stated that *Pelargonium australe* and *Pelargonium helmsii* had been rarely collected in the alpine and subalpine vegetation of Kosciuszko National Park, before the wildfires of January 2003, but were locally abundant after those fires. They deduced that these species may have long-lived seedbanks. *Pelargonium inodorum* may also have a long-lasting soil seedbank, in the bushland of northern Sydney, where it seems to be mostly evident following disturbance, particularly fire. Another possible fire ephemeral may be *Rorippa gigantea* (Brassicaceae), which was seen flowering and beginning to form fruit along Deep Creek (Narrabeen Lagoon catchment), within 38 weeks of that area being burnt. Benson & McDougall (1994) noted that the recruitment of *Rorippa gigantea* seedlings tends to occur after disturbance and may be fire-related.

There may be a number of plant species in the study areas that do not meet the strict definition of 'fire ephemeral' (see above: Bond & van Wilgen 1996), but only tend to be abundant in recently burnt areas. These species could be regarded as 'fire-followers'. For example, Benson & McDougall (1993) observed that the seeds of *Actinotus helianthi* (Apiaceae) germinate rapidly after fire, or after other disturbance, such as clearing. They also stated that some very limited germination of *Actinotus helianthi* may occur at undisturbed sites. They noted that an abundance of this species may indicate fire within the previous few years, or that there may have been some other recent disturbance. *Actinotus helianthi* was very abundant in the burnt bushland of the Lane Cove River area in the first few years after the January 1994 fires, but its abundance declined markedly thereafter. *Actinotus helianthi* is often super-abundant in recently burnt areas, in the bushland of northern Sydney, but can persist in relatively small numbers in rocky areas that have apparently not been burnt for many years. Auld (2001) noted that some other fast-growing fire sensitive plant species, such as *Acacia suaveolens* (Fabaceae) and *Boronia serrulata* (Rutaceae), when found growing in long unburnt areas, may be restricted to the more open patches of habitat associated with sandstone rock outcrops. *Actinotus helianthi* probably cannot be regarded as a true 'fire ephemeral', given that this species may display some limited germination in undisturbed sites and may be found growing in relatively small numbers in areas of bushland that have apparently not been burnt for a long time. Whelan et al. (2002) described a pattern of post-fire increase in abundance followed by a decline, which occurs in some animal and plant species. They labelled this pattern as 'facilitation and decline'. This pattern is somewhat similar to the post-fire behaviour shown by *Actinotus helianthi*.

Another example of a 'fire-follower' may be *Pimelea linifolia* subsp. *linifolia* (Thymelaeaceae). Benson & McDougall (2001) indicated that this taxon is generally killed by fire in the bushland of the Sydney region and often germinates in great numbers after fire. Morrison *et al*. (1995) observed that the abundance of *Pimelea linifolia* tended to decline with increasing time-since-fire and Morrison (2002) found that this taxon is more abundant in burnt areas than in unburnt areas, in sandstone vegetation of the Sydney region. Purdie & Slatyer (1976) noted that *Pimelea linifolia* tended to disappear from sclerophyll woodland near Canberra, in areas that had not been burnt for more than a decade. *Pimelea linifolia* subsp. *linifolia* was killed by the January 1994 fires and was super-abundant in parts of the bushland of the Lane Cove River area in the first few years after the fires; its abundance markedly declined in subsequent years. A few individuals can persist in bushland in northern Sydney that has apparently not been burnt for many years.

Delayed seedling establishment in Persoonia pinifolia

Seedling establishment of the obligate seeder shrub *Persoonia pinifolia* (Proteaceae) was somewhat slow after the January 1994 fires. No seedlings were seen in the vicinity of fatally scorched adults within 27–31 weeks of the fires (at several burnt sites in the Lane Cove River area and one site in the Narrabeen Lagoon catchment area). Post-fire seedlings of this species (11cm, 19cm, 29cm and 44cm tall) were first observed over 2 years after the fires (124 weeks) in the Lane Cove River area in May 1996. This apparently slow post-fire establishment could indicate that this species relies upon the importation of seed by birds after widespread fires, or that germination of seed in the soil was delayed. Auld *et al*. (2000) found that *Persoonia pinifolia* has a relatively short-lived soil seedbank that depends on annual inputs for its maintenance and that fecundity may possibly diminish with time since fire, due to predation upon its seeds; the fleshy fruits are dispersed by mammals and birds (Buchanan (1989) observed that *Persoonia pinifolia* seeds were frequently present in pellets regurgitated by pied currawongs (*Strepera graculina*) in November). For some species, such as *Persoonia pinifolia*, the primary juvenile period (as strictly defined) may be shorter than the time taken to produce fruits after fires because seedlings are slow to establish after fire.

Responses of rainforest species

Floyd (1989) noted that 'pioneer' rainforest plant species in south-eastern Australia often have features that enable them to recover following fires, e.g. the insulating, corky bark of *Endiandra sieberi* (Lauraceae) and the resprouting capabilities of species such as *Acmena smithii* (Myrtaceae) and *Synoum glandulosum* (Meliaceae). Floyd (1990) observed that some areas of warm temperate rainforest in the Blue Mountains, west of Sydney, were apparently adversely affected by more intense and/or very frequent fires. Chesterfield *et al*. (1990) found that some warm temperate rainforest species, e.g. *Acmena smithii*, resprouted after a wildfire in Victoria, but some other species were killed. Floyd (1990) and Keith (2004) indicated that a series of fires, within a few decades, can lead to a deterioration of patches of warm temperate rainforest in southern NSW. Campbell & Clarke (2006) observed that most woody understorey rainforest species vigorously resprouted after some fires in wet sclerophyll forest, on the New England Tablelands of northern NSW. However, they found that there was generally a lack of post-fire seedling recruitment of these rainforest species. One of the areas that they studied (in Washpool National Park) was burnt by high intensity fire in 2002, but had not been previously burnt for at least 50 years.

A few rainforest species grow in some of the more sheltered, moist and fertile sites in the study areas. The wildfires in the study areas were generally of such an apparently high intensity that many of the (usually) wetter areas of vegetation, such as those containing rainforest species, were burnt. The majority of rainforest tree and shrub species in the Lane Cove River and Narrabeen Lagoon catchment areas resprouted following the fires of January 1994. For example, individuals of the species *Ceratopetalum apetalum* (Cunoniaceae), *Schizomeria ovata* (Cunoniaceae), *Trochocarpa laurina* (Ericaceae) and *Acmena smithii* (Myrtaceae) resprouted after experiencing 100% leaf scorch in the fires.

Responses of exotic species

Keith (1996) considered that fire might enhance the invasion of bushland by some weed species, particularly where other forms of disturbance are also present and suggested that the resulting competition might lead to the decline or extinction of some populations of native plant species. Gill (1999) indicated that some exotic plants, such as *Lantana camara* (Verbenaceae), can act as 'fuel species', perhaps suggesting that concentrations of such weeds may intensify fires. Milberg & Lamont (1995) observed that weed species tended to increase, following fire, in some linear roadside woodland remnants in Western Australia. Walsh & McDougall (2004) found that the weed *Cirsium vulgare* (Asteraceae) seemed to increase in the treeless subalpine vegetation of Kosciuszko National Park, following the wildfires of January 2003. Some highly invasive weeds may take advantage of fires to spread from weed-infested areas into adjoining bushland. Whelan *et al*. (2002) noted that some weed species probably do not have a long-lived, dormant seedbank and suggested that such weeds may rely on long-distance seed dispersal to re-establish populations in burnt areas after fire. In some circumstances, fires may have the potential to accelerate weed invasion of native vegetation, but weed infestation can occur in the absence of fire, especially when other forms of disturbance occur. Reidy *et al*. (2005) recorded observations of weed and native plant regeneration in Lane Cove National Park, following the fires of January 1994 and discussed the effectiveness of bush regeneration efforts after the fires.

Generally, exotic species in the Lane Cove River and Narrabeen Lagoon catchments recovered vigorously following the January 1994 wildfires. Many populations of weed species rapidly re-established themselves by growing from soil seedbanks and/or by resprouting after the fires. For example, in the study areas, the troublesome environmental weeds *Ligustrum sinense* (Oleaceae), *Rubus ?discolor* (Rosaceae) and *Lantana camara* (Verbenaceae) all resprouted quickly and vigorously after the fires. These resprouting weed species subsequently flowered and fruited profusely in the burnt parts of the Lane Cove River area, within a handful of years after the fires of January 1994.

In the Lane Cove River bushland, seedlings of the exotic shrub *Chrysanthemoides monilifera* subsp. *monilifera* (Asteraceae) were observed 19 weeks after the January 1994 fires, growing in the immediate vicinity of fatally scorched adult plants. These post-fire seedlings flowered in September 1995 and had produced mature fruits by December 1995. It seems that *Chrysanthemoides monilifera* subsp. *monilifera* may have as fast a rate of maturation as (if not faster than) a number of fire-sensitive native shrub species, of a similar size, in the study areas. This could be one factor enabling this weed to compete with native plants. Weiss (1984) and DEC NSW (2006c) noted that *Chrysanthemoides monilifera* subsp. *monilifera* is killed by fire. Wark *et al*. (1987) and Wark (1999) observed that there was prolific germination of this taxon, following wildfire in some bushland areas of the north-eastern Otway ranges, in Victoria. Weiss *et al*. (1998) noted that *Chrysanthemoides monilifera* subsp. *monilifera* can flower rapidly in burnt areas.

A few of the exotic species recorded post-fire, e.g. *Helianthus annuus* (Asteraceae), possibly grew from seed deliberately introduced by people into the bushland after the January 1994 fires, to feed the surviving populations of native birds. Some of the other exotic species may have entered the burnt bushland as seed from adjoining unburnt areas, in the aftermath of the fires e.g. the seeds of many exotic Asteraceae species could easily have been blown into the burnt areas from adjoining unburnt weed thickets and surrounding suburban areas. Also, birds and flowing streams may have introduced some weed seed into the burnt bushland after the fires. Buchanan (1989) found evidence to indicate that the pied currawong (*Strepera graculina*) is an important agent in the dispersal of some major environmental weeds, such as *Ligustrum sinense*, *Ligustrum lucidum* and *Lantana camara*, in the Lane Cove River area.

Concluding remarks

In general, the majority of the observations recorded in this study are similar to the findings of many other researchers. Most of the recorded differences between various studies, in parameters such as the time to first flowering after fire, or in the mode of regeneration for a given species, are probably due to natural variations in populations and conditions between different study sites and study dates. Benson & McDougall (1998, 2005) briefly discussed such variations, with respect to some contradictory observations of fire responses reported for some of the species in their *Ecology of*

Sydney Plant Species series of papers. However, it is possible that some of the discrepancies in the recorded modes of regeneration of particular species may be due to occasional errors by observers. For example, following the January 1994 fires in the Lane Cove River area, I observed *Lobelia dentata* flowering in many long unburnt localities, where I had not previously recorded this species. Subsequently, I assumed that many of these plants were probably seedlings, even though I had not seen any cotyledons on these plants, immediately after their first post-fire emergence. However, my assumption may have been incorrect, as Benson & McDougall (1997) observed that *Lobelia dentata* apparently resprouted after fire from a very deeply-buried fleshy rhizome, at one locality in the Sydney region.

The observations reported in this paper provide useful information for the conservation of bushland in the broader Sydney region, and in particular for planning of fire management for bushland in the Lane Cove River and Narrabeen Lagoon catchments. For example, basic information such as the time a plant species takes to first produce fruits, following fire, can be used in the estimation of 'fire interval thresholds', as discussed by Bradstock *et al*. (1995) and Keith *et al*. (2002b). Such guidelines for bushland management can be refined, as more researchers record their observations of the responses of plants to various fires in different areas of bushland.

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Appendix 1. Observations on fire responses (after 100% leaf scorch) of vascular plants in the Lane Cove River (LCR) (observations mainly Jan 1994 – Oct 1999) and Narrabeen Lagoon (NL) (Mar – Oct 1994) catchments, following the fires of January 1994.

R = majority of adult plants resprouted after the fires;
K = majority of adult plants killed by the fires;
r = a small proportion of adult plants of this species resprouted after the fires;
k = a small proportion of adult plants of this species were killed by the fires;
pR = probably resprouted after the fires; **pK** = Probably killed by the fires;
?R= possibly resprouted; **?K** = Possibly killed.
Note: 'possibly' = say 50–70% sure of observation; 'probably' = say 80–90% sure of observation.
Seedlings first observed = first time seedlings noticed (adv = advanced seedlings).
First flowering and fruiting times(or spore production) after the fires are shown for resprouted plants (Resp) and plants from seed. (If unclear whether plants grew from seed or resprouted, then time of first flowering or fruiting bridges both columns and is underlined).
Flowering time in **bold type** = sizable proportion of population was flowering (e.g. when first flowering involved only a few plants).
Primary and **secondary juvenile periods** are given for some species.
Probable or **possible peaks of post-fire flowering** (prob.pk.pf.flower.; poss.pk.pf.flower.) or **fruiting** (prob.pk.pf.fruit.; poss.pk.pf.fruit.) are given in the left hand column.
* = exotic species (introduced plants growing in bushland, or in weed thickets and patches of weeds in close proximity to bushland).
Other abbreviations: **grn**. = green fruit; **imm**. = immature fruit; **ri**. = ripe fruit; **(shd)** = shedding seed or spores; **w** = weeks**;** **y** = year(s); **m.i.f**. = moderate intensity fire; **(1)** = one plant; **buds** = flowers in bud; **prob.** = probably; **c.**= approximately.

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
PTERIDOPHYTES									
Adiantaceae									
Adiantum aethiopicum (s.lat.)	R	R				50w			c.1y
Adiantum hispidulum	R					41w			41w–(shd)
Aspleniaceae									
Asplenium australasicum	K								
Asplenium flabellifolium	R	R				26w			26w
Blechnaceae									
Blechnum ambiguum	R	R				50w			63w–(shd)
Blechnum camfieldii		R				38w			38w
Blechnum cartilagineum	R	R				10w			10w–(shd)
Blechnum indicum	R	R				10w			10w–(shd)
Blechnum nudum	R					33w			33w–(shd)
Doodia aspera	R	R				23w			23w
Doodia caudata	R					23w			23w
Doodia linearis	R					15w			29w–(shd)
Cyatheaceae									
Cyathea australis	R					49w			c.1y
Davalliaceae									
Davallia solida var. pyxidata	K/r	K/r							
**Nephrolepis cordifolia*	R/k	R							
Dennstaedtiaceae									
Histiopteris incisa	R	R							

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Hypolepis muelleri	R					44w–grn			
Pteridium esculentum	R	R				10w			10w–(shd)
Dicksoniaceae									
Calochlaena dubia	R	R				50w			c.1y
Gleicheniaceae									
Gleichenia dicarpa	R/k								
Gleichenia microphylla	R								
Gleichenia rupestris	R	pR							
Sticherus flabellatus	K/r	K/R				35w–grn			
Grammitaceae									
Grammitis ?stenophylla		K							
Hymenophyllaceae									
Hymenophyllum cupressiforme		K							
Lindsaeaceae									
Lindsaea linearis	R					50w			c.1y
Lindsaea microphylla	R	R				21w			21–50w
Lycopodiaceae									
Lycopodiella lateralis		pK							
Osmundaceae									
Todea barbara	R	R				10w			10w
Polypodiaceae									
Platycerium bifurcatum	K								
Pyrrosia rupestris	K	K							
Psilotaceae									
Psilotum nudum	K/r	K/r				50w–grn			
Pteridaceae									
Pteris tremula	pR								
**Pteris vittata*	R					23w			
Schizaeaceae									
Schizaea bifida (s.lat.)	R	R				63w			
Schizaea rupestris	pR	R				38w–grn			
Selaginellaceae									
Selaginella uliginosa		R							
Sinopteridaceae									
Cheilanthes distans		?K					140w		
Cheilanthes sieberi	R					23w			23w
Pellaea falcata	R								
Thelypteridaceae									
Christella dentata	R					23w			23w
GYMNOSPERMS									
Cupressaceae									
Callitris muelleri		K	32w						
Pinaceae									
**Pinus radiata*		K							
Podocarpaceae									
Podocarpus spinulosus	R	R		92w		100w			c.2y
Zamiaceae									
Macrozamia communis	R	R							
DICOTYLEDONS									
Acanthaceae									
Brunoniella pumilio (poss.pk.pf.flower.c.1y)	R			6w		11w			26w–(shd)
Pseuderanthemum variabile	R	R		7w		10w			20w–(shd)
**Thunbergia alata*	pR			26w					

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Aceraceae									
**Acer negundo*	R								
Aizoaceae									
Tetragonia tetragonioides	?K		7w		39w		39w–grn		
Amaranthaceae									
Alternanthera denticulata	R			10w					
**Amaranthus hybridus*	?K				12w		19w		
**Amaranthus viridus*	?K		9w						
Amygdalaceae									
**Prunus cerasus*	R								
**Prunus persica*	R	R							
Anacardiaceae									
**Toxicodendron succedaneum*	R								
Apiaceae									
Actinotus helianthi (prob.pk.pf.flower.c.2–3y)	K	K	15w		41w		56w	56w–(shd)	
Actinotus minor	K	K	24w		42w				
Centella asiatica	R					10w			
**Ciclospermum leptophyllum*					28w		43w–grn		
**Eryngium pandanifolium*	R			50w–buds					
**Foeniculum vulgare*	R	R	9w(1)	50w–buds		63w			63w–(shd)
**Hydrocotyle bonariensis*	R	pR		11w		20w			
Hydrocotyle peduncularis	R		15w	10w		16w			
Platysace lanceolata (prob.pk.pf.flower.c.3–5y)	R	R	15w	56w		63w			63w
Platysace linearifolia (prob.pk.pf.flower.c.2–3y)	R/k	R	24w	63w		64w–imm			
Platysace stephensonii		R	17w						
Trachymene incisa		R		35w		35w			35+w–(shd)
Xanthosia pilosa (prob.pk.pf.fi.flower.c.4y)	K/r	K	22w		85w				
Xanthosia tridentata	K		20w						
Apocynaceae									
**Nerium oleander*	R	R		150w					
Parsonsia straminea		K/R							
**Vinca major*	R			36w					
Araliaceae									
Astrotricha floccosa		K	13w						
Astrotricha latifolia	K		44w		146w				
Astrotricha longifolia (prob.pk.pf.flower.c.3y)	K/r		43w		92w		101w–imm	c.2–3y	
**Hedera helix*	R								
Polyscias sambucifolia	R		38w	51w,101w		114w–ri			c.2–3y
Asclepiadaceae									
**Araujia sericifera*	R	R	10w				61w–(grn)		
**Gomphocarpus ?fruticosus*					38w(buds)				
Marsdenia suaveolens	R	R		10w		32w			32+w
Tylophora barbata	R			43w					
Asteraceae									
**Ageratina adenophora*	R	R	42w	38w		44w			44w–(shd)
**Ageratina riparia*	R		63w	34w		38w			40w–(shd)
**Ageratum houstonianum*		?K			38w				
**Ambrosia artemesiifolia*		?R			13w(1)				
**Arctotheca calendula*					38w				
**Aster subulatus*					61w		63w–(shd)		
**Bidens pilosa*	pK	pK	7w		13w		19w	19w–(shd)	

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
**Bidens subalternans*	pK		12w		12w		16w–grn.		
**Bidens tripartita*	pK				15w		15w		
Brachyscome angustifolia var. *angustifolia*	pR			11w		16w–(shd)			16w–(shd)
Cassinia aculeata	K						136w	c.3y(shd)	
Cassinia denticulata	K								
Cassinia longifolia				202w(buds)					
**Chrysanthemoides monilifera* subsp. *monilifera*	K		19w		88w		101w	c.2y(shd)	
**Cirsium vulgare*	?R			26 & 38w		46,51w–(shd)			
**Conyza bonariensis*	pK				38w		50w	61w–(shd)	
**Coreopsis lanceolata* (prob.pk.pf.flower.c.2–3y)		R	10w	42w					
Cotula australis	pK						15w		
**Crassocephalum crepidioides*	pK		15w		15w		15w	39w	
**Delairea odorata*	pK			125w					
**Dimorphotheca pluvialis*				36w					
**Dittrichia graveolens*				63w					
**Erechtites valerianifolia*	pK				28w		30w	39w	
**Erigeron karvinskianus*	R			10w		27w			27w–(shd)
Euchiton sphaericus				43w		43w			
**Facelis retusa*						43w–(shd)			
**Galinsoga parviflora*	pK		7w		12w		15w	15w	
**Gamochaeta americana*	K/R					10w			10w–(shd)
**Gamochaeta pensylvanica*	pK		15w		15w		15w	15w	
**Gamochaeta spicata*	pK						27w	27w–(shd)	
**Helianthus annuus*					12w				
Helichrysum elatum (prob.pk.pf.flower.c.3y)	?K	pK			87w		97w	c.2y(shd)	
Helichrysum rutidolepis	R			18w		18w			
Helichrysum scorpioides	R			16w		23w			43w–(shd)
**Hypochaeris radicata*	R			10w		10w			10w
**Lactuca serriola*	?K				50w		50w		
Lagenifera gracilis	R			9w		12w			12w–(shd)
Olearia microphylla (prob.pk.pf.flower.c.4–5y)	K/r				85w		94w	c.2–3y(shd)	
Olearia tomentosa		K/r	35w						
Ozothamnus diosmifolius (prob.pk.pf.flower.c.3–4y)	K/r		36w		100w		104w	c.2y(shd)	
Pseudognaphalium luteoalbum					41w		43w	43w–(shd)	
**Roldana petasitis*	R	R				38w			
Senecio hispidulus var. *hispidulus*	pK				38w		44w	44w–(shd)	
**Senecio madagascariensis*	pK				15w		20w	26w–(shd)	
Senecio minimus					43w–buds				
**Senecio pterophorus*				154w					
Sigesbeckia orientalis	pK		11w		11w		16w	16w–ri.	
**Solidago canadensis*	R			16w		33w			33w–(shd)
**Soliva sessilis*						43w(grn)			
**Sonchus oleraceus*	pK		8w		15w		15w	15w	
**Tagetes minuta*		pK			20w		20w	20w	
**Taraxacum officianale*	R			11w		25w			25w–(shd)
**Xanthium occidentale*	K								
Avicenniaceae									
Avicennia marina var. *australasica*	R/K								
Balsaminaceae									
**Impatiens walleriana*	pK		18w		18w				

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Basellaceae									
**Anredera cordifolia*	pR	R	19w(1)	Note: aerial tubers forming within 39w of fire.					
Baueraceae									
Bauera ?microphylla		R							
Bauera rubioides	K	K/r	23w		90w		198w	c.4y	
Bignoniaceae									
Pandorea pandorana	R			26w		50w			c.1y–(shd)
Boraginaceae									
**Echium plantagineum*				38w		38w(grn)			
Brassicaceae									
**Brassica fruticulosa*	pK		12w		12w		28w	28w–(shd)	
**Brassica juncea*	pK				43w				
**Brassica tournefortii*		?K			42w				
**Capsella bursa–pastoris*		pK	20w		20w		20w	20w–grn	
**Cardamine flexuosa*	pK		15w				15w	15w–(shd)	
**Cardamine hirsuta*	pK				24w		24w	24w	
**Coronopus didymus*	pK		15w				15w	15w	
**Lobularia maratima*	pK				23w				
Rorippa gigantea					38w		38w–imm		
**Rorippa nasturtium–aquaticum*	?K						43w–imm		
Buddlejaceae									
**Buddleja davidii*	R	R		51w					
**Buddleja madagascariensis*		R		38w					
Campanulaceae									
Wahlenbergia communis (s.lat.)				38w		43w–grn.			
Wahlenbergia gracilis	?K		24w	15w		23w–(shd)			
Caprifoliaceae									
**Lonicera japonica*	R	R							
Caryophyllaceae									
**Cerastium glomeratum*	pK		23w		23w		23w	23w–(shd)	
**Petrorhagia velutina*		pK			38w		38w	44w–(shd)	
**Polycarpon tetraphyllum*	pK				43w		44w	44w	
**Silene gallica var. gallica*	pK				36w		38w	38w–grn	
**Stellaria media*	pK						15w	15w–(shd)	
Casuarinaceae									
Allocasuarina distyla		K	17w		86w		167w		
Allocasuarina littoralis	K/r		10w	124w			179w		
Allocasuarina torulosa	R	R							
Casuarina glauca	R	R							
Celastraceae									
Maytenus silvestris	R	R				124w–ri			c.2–3y
Chenopodiaceae									
**Atriplex ?prostrata*	pK		10w						
**Chenopodium album*	pK	pK					20w		
Chloanthaceae									
Chloanthes stoechadis		pK	10w		42w–(1)				
Clusiaceae									
Hypericum gramineum	R			11w		38w			38w–(shd)
**Hypericum perforatum*	R			43w		50w			63w–(shd)
Convolvulaceae									
Calystegia marginata	pK		9w		41w		46w	46w–grn	
Convolvulus erubescens						51w–(shd)			
Dichondra repens (s.lat.)			9w			18w(1)			
**Ipomoea cairica*		R							
**Ipomoea indica*	R	R		15w					

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	NL	Seedlings first observed	First flowering Resp	Seed	First fruiting Resp	Seed	Juvenile periods Primary	Secondary
Polymeria calycina	pR	R		38w		56w			
Crassulaceae									
**Crassula multicava*		pR		38w					
Crassula sieberiana	pK	pK	13w		26w		26w		
Cunoniaceae									
Callicoma serratifolia (poss.pk.pf.flower.c.3+y)	R		15w	91w		108w			c.2y(shd)
Ceratopetalum apetalum	R								
Ceratopetalum gummiferum	R	R	101w	50w					c.2–3y
Schizomeria ovata	R	R							
Dilleniaceae									
Hibbertia aspera	R			50w					
Hibbertia bracteata	R	R		38w, **87w**					
Hibbertia cistiflora		pK							
Hibbertia dentata (prob.pk.pf.flower.c.4–5y)	R		39w	38w					
Hibbertia diffusa	R			23w–buds					
Hibbertia fasciculata (prob.pk.pf.flower.c.3–5y)	pK		51w		56w, **87w**				
Hibbertia linearis (prob.pk.pf.flower.c.4–6y)	K	K	26w		72w, **86w**				
Hibbertia nitida	K		135w–adv						
Hibbertia riparia (s.lat.)	R			89w		108w			
Hibbertia scandens	R	R							
Hibbertia serpyllifolia		R							
Droseraceae									
Drosera auriculata	pR	pR		26w		26w			26w–(shd)
Drosera binata	R	R		17w					
Drosera peltata	pR	pR		17w		32w			32w–(shd)
Drosera spatulata	pR	pR		41w		63w			63w–(shd)
Elaeocarpaceae									
Elaeocarpus reticulatus	R	R		201w		c.5y-grn			c.5y–a few fruit
Ericaceae									
Styphelioideae									
Acrotriche divaricata		K							
Brachyloma daphnoides (prob.pk.pf.flower.c.3–5y)	R	R		40w,**86w**					
Dracophyllum secundum	K	K	67w				c.3y	c.3–4y	
Epacris crassifolia	K	K	20w						
Epacris longiflora	K	K	88w–adv		124w				
Epacris microphylla (prob.pk.pf.flower.c.4–6y)	K	K	61w		86w				
Epacris obtusifolia		K	38w(1)						
Epacris pulchella	K	K			120w		122w	c.2–3y(shd)	
Epacris purpurascens var. *purpurascens*	K				c.3–4y				
Leucopogon amplexicaulis	pK	K	63w		87w–(1)		142w	c.3–4y	
Leucopogon appressus (poss.pk.pf.flower.c.5+y)	K	K	75w–adv		108w				
Leucopogon ericoides (prob.pk.pf.flower.c.4–6y)	K				135w		143w	c.3y	
Leucopogon esquamatus	pK	K					196w	c.4y	
Leucopogon juniperinus	K				c.3–4y				
Leucopogon lanceolatus	R	R		88w		90w–grn			c.2–3y
Leucopogon microphyllus (prob.pk.pf.flower.c.4–6y)	K	K			75w				
Leucopogon setiger	K	K			c.4y				

Family/Species (Post–fire fl, fr peaks)	**Fire Response**		**Seedlings first observed**	**First flowering**		**First fruiting**		**Juvenile periods**	
	LCR	**NL**		**Resp**	**Seed**	**Resp**	**Seed**	**Primary**	**Secondary**
Lissanthe strigosa subsp. *?subulata*		R		37w–(1)					
Melichrus procumbens					c.3–4y(1)				
Monotoca elliptica	K/r								
Monotoca scoparia	R	R		67w					
Sprengelia incarnata		K							
Styphelia longifolia	K		126w–(1)–adv		186w		195w	c.4y	
Styphelia triflora	K		61w				149w	c.3y	
Styphelia tubiflora	K	K	64w		124w		242w	c.4–5y	
Trochocarpa laurina	R	R							
Woollsia pungens	K	K	72w–adv		120w				
Euphorbiaceae									
Amperea xiphoclada	R	R		16w		38w			50w–grn
Bertya brownii		K	13w						
Breynia oblongifolia (poss.pk.pf.flower.c.3–4y)	R	R		46w		63w			63w
**Chamaesyce supina*	pK						9w		
**Euphorbia depauperata* var. *pubescens*	pK				43w				
**Euphorbia peplus*	pK		7w				9w	9w	
Glochidion ferdinandi	R	R				76w			c.2–3y
Micrantheum ericoides (prob.pk.pf.fruit.c.5–6y)	K	K	30w		85w		86w	c.2–3y	
Monotaxis linifolia		pK							
Omalanthus populifolius	R		6w						
Phyllanthus hirtellus	R	R	26w	23w		38w			43w–grn.
**Phyllanthus tenellus*	pK				18w				
Poranthera corymbosa	pK				94w				
Poranthera ericifolia	pK	K	38w		38w		43w	50w	
Poranthera microphylla	pK	pK	15w		18w		18w	18–39w	
Ricinocarpos pinifolius	R	R	133w–adv	86w		94w			c.2y
**Ricinus communis*	pK	pK	8w		25w		25w	25–38w	
Eupomatiaceae									
Eupomatia laurina		R							
Fabaceae									
Caesalpinioideae									
**Senna pendula*	R	R	7w	61w		85w			c.2y
Faboideae									
Bossiaea heterophylla	pK	?r	10w		67w		97w	c.2y(shd)	
Bossiaea obcordata (poss.pk.pf.fruit.c.4–5y)	R			36w		100w			c.2y–(shd)
Bossiaea scolopendria	R	K	?63w?	86w		104w			c.2y–(shd)
Daviesia alata		?K							
Daviesia ulicifolia	?K	?K	37w		37w		c.4y		
Desmodium ?gunnii	R			11w					
Desmodium rhytidophyllum		R		13w		13w			
Dillwynia floribunda var. *floribunda*	pK	K	63w		90w				
Dillwynia retorta (prob.pk.pf.flower.c.5y)	K	K	10w		85w		150w	c.3y(shd)	
Dillwynia rudis	K	pK					90w	c.2y	
**Dipogon lignosus*	R		10w	38w		50w			c.1y–(shd)
**Erythrina crista–galli*	R	R		13w					
**Erythrina* x *sykesii*	R	R		38w					
**Genista monspessulana*	K		11w		86w		104w	2y	
Glycine clandestina	R	pR		35w					
Glycine tabacina	R	pR	8w	10w		30w			30w–(shd)

Family/Species (Post–fire fl, fr peaks)	**Fire Response**		**Seedlings first observed**	**First flowering**		**First fruiting**		**Juvenile periods**	
	LCR	**NL**		**Resp**	**Seed**	**Resp**	**Seed**	**Primary**	**Secondary**
Gompholobium glabratum	pK		23w				89w	c.2y	
Gompholobium grandiflorum	R	?k		90w		125w			c.2–3y(shd)
Gompholobium latifolium (prob.pk.pf.fruit.c.4–5y)	K	R	37w		140w		154w	c.3y(shd)	
Hardenbergia violacea (prob.pk.pf.flower.c.3–5y)	R	pR	7w	31w		40w			c.1y
Hovea linearis (s.lat.)	R	R		31w		100w			c.2y
Hovea longifolia	K		30w		190w		198w	c.4y	
Kennedia rubicunda	?K/r	?K/r	6w		35w		46w	c.1y	
**Lotus angustissimus*	pK	pK	27w		37w		43w	43w	
**Medicago arabica*	pK				38w		38w		
**Medicago polymorpha*	pK				33w		38w		
**Melilotus indicus*	pK	pK			26w		38w		
Mirbelia rubiifolia	pK	K	17w		141w		3–4y	c.3–4y(shd)	
Mirbelia speciosa subsp. *speciosa*					189w				
Phyllota grandiflora	pR	R		37w					
Phyllota phylicoides (prob.pk.pf.flower.c.4–5y)	R/k	R	63w	86w					
Platylobium formosum (prob.pk.pf.flower.c.3–5y)	R	R	36w	36w,**87w**		101w			c.2y–(shd)
Podolobium ilicifolium		K/R	35w	38w					
**Psoralea pinnata* (prob.pk.pf.flower.c.4y)	pK		12w		92w		122w	c.2–3y(shd)	
Pultenaea daphnoides (prob.pk.pf.flower.c.3–5y)	K	K	20w		86w		150w	c.3y(shd)	
Pultenaea flexilis (poss.pk.pf.flower.c.5+y)	K	K	10w		88w				
Pultenaea mollis (prob.pk.pf.flower.c.3–5y)	?K		97w–adv		140w		154w	c.3y(shd)	
Pultenaea polifolia		K							
Pultenaea retusa	pK				86w		90w	c.2y	
Pultenaea stipularis (prob.pk.pf.flower.c.3–5y)	K	K	21w		90w		104w	c.2–3y(shd)	
Pultenaea tuberculata (prob.pk.pf.flower.c.5–6y)	K	K	24w		61w**c.2y**				
Pultenaea villosa	K		26w						
Sphaerolobium minus					90w				
**Trifolium campestre*	pK				41w		43w		
**Trifolium cernuum*	pK				16w		38w		
**Trifolium dubium*	pK				43w		43w		
**Trifolium glomeratum*	pK				36w				
**Trifolium repens*	pK				36w				
**Vicia hirsuta*	pK						38w		
**Vicia sativa*	pK	?K			37w		37w		
**Vicia tetrasperma*	pK		11w		33w		36w		
Viminaria juncea (poss.pk.pf.flower.c.2–5y)	K	pK	17w		91w		100w	c.2y(shd)	
**Wisteria ?sinensis*	R								
Mimosoideae									
**Acacia baileyana*	pK		44w–adv		135w		198w	c.3–4y	
Acacia binervia	K		124w–(adv)		142w		198w	c.3–4y	
Acacia echinula					186w				
(?)Acacia elata*	?K								
Acacia falcata	pK		51w–adv				90w–grn	c.2–3y	
Acacia floribunda	R/k	k		135w					
Acacia hispidula	pK				61w		124w	c.3y	
Acacia implexa		R							
Acacia irrorata subsp. *irrorata*					153w				
Acacia linifolia (prob.pk.pf.fruit.c.4–6y)	K	K	9w		56w		97w	c.2–3y(shd)	

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	NL	Seedlings first observed	First flowering Resp	Seed	First fruiting Resp	Seed	Juvenile periods Primary	Secondary
Acacia longifolia subsp. *longifolia* (prob.pk.pf.flower.c.4–6y)	K	K	10w		85w		149w	c.3y(shd)	
Acacia longissima	K		88w–adv		153w		169w		
Acacia myrtifolia (prob.pk.pf.fruit.c.4y)	K	K	25w		131w		149w	c.3y(shd)	
Acacia oxycedrus	K	R/k	17w		136w				
Acacia parramattensis	pK/r								
Acacia parvipinnula	?K				135w				
**Acacia podalyriifolia*	pK	K	36w		124w		154w	c.3y(shd)	
**Acacia saligna*		R	21w		140w		145w(grn)		
Acacia schinoides	K		51w		154w		235w	c.5y	
Acacia suaveolens (prob.pk.pf.flower.c.2–4y)	K	K	15w		71w		97w	c.2y(shd)	
Acacia terminalis (prob.pk.pf.flower.c.3–4y)	K	K	12w		91w		149w	c.3y(shd)	
Acacia ulicifolia (prob.pk.pf.flower.c.3–5y)	K	K	10w		67w		101w	c.2–3y(shd)	
**Paraserianthes lophantha* subsp. *lophantha*					87w		163w	c.3y(shd)	
Fumariaceae									
**Fumaria capreolata* subsp. *capreolata*	pK		12w		12w		12w		
**Fumaria ?officianalis*			15w		15w		15w		
Gentianaceae									
**Centaurium tenuiflorum*	?K				43w				
Geraniaceae									
Geranium homeanum	R		10w	19w		19w			
Pelargonium inodorum (prob.pk.pf.flower.c.1y)			20w		35w		44w–(shd)		
Goodeniaceae									
Dampiera purpurea (prob.pk.pf.flower.c.2–3y)	R		33w	36w		49w			c.1y–(shd)
Dampiera stricta (prob.pk.pf.flower.c.2–3y)	R	R	21w	31w		64w			
Goodenia bellidifolia	R	R	26w	31w		51w			c.1y–(shd)
Goodenia hederacea	R			39w		49w			c.1y
Goodenia heterophylla (prob.pk.pf.flower.c.2–3y)	R	R		20w		46w			46w–(shd)
Goodenia ovata	K	K	20w		143w		146w	c.2–3y	
Goodenia paniculata		pR			10–20w				
Goodenia stelligera					31w(1)				
Scaevola ramosissima	R	R		16w		51w			c.1y
Velleia lyrata					36w		51w–(shd)		
Haloragaceae									
Gonocarpus micranthus subsp. *micranthus*	pK	pK	12w		43w				
Gonocarpus salsoloides		pK	17w						
Gonocarpus teucrioides (prob.pk.pf.flower.c.2–3y)	K/r	K	10w		94w		100w	c.2y	
Hamamelidaceae									
**Liquidambar styraciflua*	R								
Lamiaceae									
Hemigenia purpurea	pK	K	51w		100w		104w	c.2y	
Plectranthus parviflorus	pK	pK	15w		49w		49w		
Prostanthera denticulata		K							
Prostanthera linearis	K	K/r			150w				
**Prunella vulgaris*	?K		19w		51w		51w	c.1y–(shd)	

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	Fire Response NL	Seedlings first observed	First flowering Resp	First flowering Seed	First fruiting Resp	First fruiting Seed	Juvenile periods Primary	Juvenile periods Secondary
***Stachys arvensis**	pK				16w		23w	23w–(shd)	
Lauraceae									
Cassytha glabella (prob.pk.pf.flower.c.3–6y)	K		33w		61w		91w	c.2–3y(ripe)	
Cassytha pubescens (poss.pk.pf.fruit.c.5y)	K				150w		191w	c.3–4y	
**Cinnamomum camphora*	R	R		94w					
Endiandra sieberi		R							
Lentibulariaceae									
Utricularia dichotoma		?R			32w				
Utricularia lateriflora		?R			32w				
Linaceae									
**Linum trigynum*	?K	?K			38w		38w		
**Reinwardtia indica*	pR			23w					
Lobeliaceae									
Lobelia alata (prob.pk.pf.flower.c.3y)	?R		20w		49w		63w		
Lobelia dentata (prob.pk.pf.flower.c.1y)					19w		49w–(shd)		
Lobelia gracilis					49w		67w		
Pratia purpurascens	R	pR		6w		15w			15w–grn
Loganiaceae									
Logania albiflora (poss.pk.pf.flower.c.4–6y)	R	R	63w	87w		163w	c.4y(1)		c.3y(shd)
Mitrasacme polymorpha (prob.pk.pf.flower.c.3y)	pK	K			37w		43w	c.1y	
Loranthaceae									
Amyema congener subsp. *congener*	K	The host of this mistletoe was also killed by the same fire.							
Muellerina eucalyptoides	R(1)m.i.f	One plant resprouted after low to medium intensity fire. The canopy of its host was not 100% scorched.							
Malaceae									
**Cotoneaster ?franchetti*	R	R							
**Cotoneaster glaucophyllus*	R					122w			c.2–3y(ripe)
**Eriobotrya japonica*		k							
**Pyracantha angustifolia*	R					122w			c.2–3y(ripe)
**Pyracantha crenulata*	R					125w			c.2–3y(ripe)
**Pyracantha fortuneana*	R								
Malvaceae									
Hibiscus diversifolius		?K	?13w						
**Malva parviflora*	?K				11w		11w		
**Modiola caroliniana*	?K		7w		38w		50w	c.1y–(shd)	
**Pavonia hastata* (poss.pk.pf.fruit.c.2+y)	pK		9w				44w(1)		
**Sida rhombifolia* (poss.pk.pf.flower.c.3y)	pK		6w		15w		28w	28w–(shd)	
Meliaceae									
**Melia azedarach*	R								
Synoum glandulosum	R	R							
Menispermaceae									
Sarcopetalum harveyanum	R	R							
Stephania japonica var. discolor	R	R	9w(1)	50w					
Menyanthaceae									
Villarsia exaltata		pR		20w		20w			20w–(shd)
Monimiaceae									
Wilkiea huegeliana		?K							

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Moraceae									
Ficus coronata	R								
**Ficus pumila*	?K								
Ficus rubiginosa	R	R				140w			
**Morus alba*	R	R				44w			c.1–2y
Myrsinaceae									
Aegiceras corniculatum	R/k								
Rapanea variabilis (syn. *Myrsine variabilis*)	R	R	39w	122w–buds					
Myrtaceae									
Acmena smithii	R	R							
Angophora bakeri (poss.pk.pf.fruit.c.1–2y)	R		67w	50w		61w			61–67w(shd)
Angophora costata	R		35w						
Angophora hispida (prob.pk.pf.flower.c.1–2y)	R	R	104w	32w,**49w**		61w			61w(shd)
Austromyrtus tenuifolia (poss.pk.pf.flower.c.3+y)	R	R		150w		163w–ri.			c.3y
Babingtonia densifolia	K	K	61w–adv		2y,**3y**		164w	c.3–4y(shd)	
Babingtonia pluriflora	R					124w			
Backhousia myrtifolia	R								
Baeckea brevifolia		R							
Baeckea diosmifolia	R	R		46w		56w			56w
Baeckea imbricata	K	K					184w	c.3–4y	
Baeckea linifolia	R	R		161w		190w			c.3–4y
Callistemon citrinus	R	R		97w					
Callistemon linearis	R	R		92w		144w			c.3y
Calytrix tetragona (poss.pk.pf.flower.c.4+y)	K	K;r–m.i.f	71w		139w			c.?3–4y?	
Corymbia gummifera	R					163w			c.3+y
Darwinia biflora (poss.pk.pf.flower.c.5+y)	K		36w		91w				
Darwinia fascicularis var. *fascicularis* (poss.pk.pf.flower.c.5+y)	K	K	31w		139,**186w**				
Darwinia procera		K							
Eucalyptus botryoides		R							
Eucalyptus haemastoma	R		75w	139w		177w			c.3–4y
Eucalyptus luehmanniana		R							
Eucalyptus obstans		R							
Eucalyptus paniculata	R		?85w–adv						
Eucalyptus pilularis	R		?49w						c.4–5y
Eucalyptus piperita	R		?49w						c.3–5y
Eucalyptus punctata		R							
Eucalyptus racemosa	R								
Eucalyptus resinifera	R			190w–buds					
Eucalyptus saligna	R								
Eucalyptus umbra		R							
Euryomyrtus ramosissima	pK				139w				
Kunzea ambigua	K	K	24w		97w		100w	c.2–4y	
Kunzea capitata	R	K/r	31w	91w					
Leptospermum arachnoides (prob.pk.pf.flower.c.2–3y)	R	R		97w		124w			c.2–3y
Leptospermum grandifolium	R	R							
Leptospermum juniperinum		R							

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	NL	Seedlings first observed	First flowering Resp	Seed	First fruiting Resp	Seed	Juvenile periods Primary	Secondary
Leptospermum parvifolium	R			90w		108w			c.3–4y(shd)
Leptospermum polygalifolium (prob.pk.pf.flower.c.4y)	R			94w		143w			c.3y
Leptospermum squarrosum	K	K	22w		169w		184w	c.3–5y	
Leptospermum trinervium (poss.pk.pf.flower.c.4y)	R	R	?126w	17w,31+w		37w–grn.			c.2y(shd)
Melaleuca deanei	R			90w–m.i.f.					
Melaleuca hypericifolia	k/r								
Melaleuca linariifolia (prob.pk.pf.flower.c.4y)	R	R	6w	94w					
Melaleuca nodosa	R			91w		100w			c.2+y
Melaleuca styphelioides		R							
Micromyrtus ciliata (prob.pk.pf.flower.c.4y)	pK	K	32w		88w				
Syncarpia glomulifera	R	R							c.5y
Tristania neriifolia		R							
Tristaniopsis collina	R	R		154w					
Tristaniopsis laurina	R	R				124w			c.2–3y(shd)
Ochnaceae									
**Ochna serrulata*	R	R				93w–grn			
Olacaceae									
Olax stricta (poss.pk.pf.flower.c.4–5y)	?R				120w		198w		
Oleaceae									
**Jasminum polyanthum*	?R				87w				
**Ligustrum lucidum*	R		44w	156w					
**Ligustrum sinense* (poss.pk.pf.flower.c.5+y)	R	R	39w	92w		122w			c.2–3y
Notelaea longifolia	R	R				101w			c.2y(ripe)
Onagraceae									
Epilobium billardierianum var. *cinereum*	R			11w		11w–(shd)			
**Epilobium ?ciliatum*					38w		38w(green)		
**Ludwigia peruviana*		R				20w–grn			
**Oenothera mollissima*							39w(green)		
Oxalidaceae									
Oxalis "corniculata" (s.lat.)	pR				10w		12w		
**Oxalis debilis* var. *corymbosa*	pR				19w				
**Oxalis incarnata*	pR				12w				
**Oxalis latifolia*	pR				8w				
**Oxalis pes–caprae*	pR				26w				
Passifloraceae									
**Passiflora edulis*							150w(grn)		
Passiflora herbertiana (prob.pk.pf.flower.c.4y)	pR				122w		122w(grn)		
**Passiflora suberosa*							262w(grn)		
Phytolaccaceae									
**Phytolacca octandra*			7w		15w		29w	29w–ri	
Pittosporaceae									
Billardiera scandens (poss.pk.pf.flower.c.4–5y)	R	R		38w		101w			c.2y
Bursaria spinosa (poss.pk.pf.flower.c.5y)	R	R		51w		71w–(shd)			c.1–2y(shd)
Pittosporum revolutum (prob.pk.pf.flower.c.5 y)	R	R		36w,88w		41w–grn			

Family/Species (Post–fire fl, fr peaks)	**Fire Response**		**Seedlings first observed**	**First flowering**		**First fruiting**		**Juvenile periods**	
	LCR	**NL**		**Resp**	**Seed**	**Resp**	**Seed**	**Primary**	**Secondary**
Pittosporum undulatum	k/r				242w		262w	At least 5 years	
Rhytidosporum procumbens (prob.pk.pf.fruit.c.3–4y)	?K	? r			43w		43w		
Plantaginaceae									
**Plantago lanceolata*	R	pR		10w		10w			50w–(shd)
**Plantago major*					50w		50w(grn)		
Polygalaceae									
Comesperma ericinum (prob.pk.pf.flower.c.3–5y)	pK				87w		101w	c.2y	
Comesperma sphaerocarpum	pR			16w		16w(grn)			Less than 1 year
Comesperma volubile (prob.pk.pf.flower.c.3–5y)	?K				89w				
**Polygala myrtifolia*					142w				
**Polygala virgata*	K				142w		142w	c.2–3y	
Polygonaceae									
**Acetosa sagittata*	R					30w			30w–(shd)
**Acetosella vulgaris*					39w		39w(grn)		
**Fallopia convolvulus*							17w		
**Persicaria capitata*	R			19w					
Persicaria decipiens					20w				
Persicaria lapathifolia					20w		20w		
Persicaria strigosa					20w				
Rumex brownii	R			9w		19w			
**Rumex conglomeratus*							50w		
**Rumex crispus*	R				41w		51w–(shd)		
Portulacaceae									
**Portulaca oleracea*							15w(grn)		
Primulaceae									
**Anagallis arvensis*					37w		50w		
**Primula malacoides*					38w				
Samolus repens	?K				49w		49w(grn)		
Proteaceae									
Banksia ericifolia	K	K	17w		177w		234w	c.4–5y–a few fruit	
Banksia integrifolia		R/k							
Banksia marginata (poss.pk.pf.flower.c.10+y)	K	K	21w		169w		218w	c.4–5y–a few fruit	
Banksia oblongifolia	R	R	17w	114w		234w			c.4–5y– a few fruit
Banksia robur		R	32w						
Banksia serrata	R		12w	108w		177w			c.3–4y–a few fruit
Banksia spinulosa	R			122w		201w			c.3–4y
Conospermum ericifolium (prob.pk.pf.flower.c.3–5y)		K			91w		97w–(shd)	c.2y(shd)	
Conospermum longifolium subsp. *angustifolium*		K							
Conospermum longifolium subsp. *longifolium*	R	R		37w		42w			c.1–2y
Grevillea buxifolia (prob.pk.pf.flower.c.4–6y)	K	K	9w		86w		114w	c.2–3y(shd)	
Grevillea linearifolia (poss.pk.pf.flower.c.5–6y)	K	K	30w		87w		120w	c.2–3y(shd)	
**Grevillea robusta*			28w(1)						
Grevillea sericea (prob.pk.pf.flower.c.4–6y)	K	K	10w		56w,**2y**		114w	c.2–3y(shd)	

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	Fire Response NL	Seedlings first observed	First flowering Resp	First flowering Seed	First fruiting Resp	First fruiting Seed	Juvenile periods Primary	Juvenile periods Secondary
Grevillea speciosa (poss.pk.pf.flower.c.5y)	K	K			136w				
Hakea dactyloides (s.str.)	K	K	32w				c.6.5y	c.6.5y–a few fruit	
Hakea gibbosa	K	K	30w		129w		159w	c.3–4y	
Hakea laevipes subsp. *laevipes*	R	R		97w		200w			c.4y
Hakea propinqua	K	K	21w		124w		177w	c.3–5y–a few fruit	
Hakea salicifolia	K	K	41w		295w–buds		c.6.5y	c.6.5y–a few fruit	
Hakea sericea	K		24w		129w		163w	c.3–4y	
Hakea teretifolia	K	K	22w		153w		184w	c.3–5y	
Isopogon anemonifolius	R			90w		196w			c.3–4y–a few fruit
Isopogon anethifolius	R/K	R/K	124w–adv	142w	?198w		242w	c.4–5y–a few fruit	
Lambertia formosa	R			71w,**94w**		195w			c.3–4y
Lomatia myricoides	R	R		163w		184w			c.3–4y(shd)
Lomatia silaifolia (prob.pk.pf.flower.c.1y)	R		104w(1)	49w		63w–(shd)			c.1–2y(shd)
Persoonia lanceolata (poss.pk.pf.fruit.c.4–6y)	K	K			108w		196w	c.3–4y	
Persoonia laurina	R			101w		131w			c.2–3y
Persoonia levis	R	R	64w(1)	50w		100w			c.2y–a few fruit
Persoonia linearis	R	R	140w–adv	108w		133w			c.2–3y
Persoonia pinifolia	K	K	124w–adv		270w		295w	c.5–6y–a few fruit	
Petrophile pulchella	K	K	24w				191w	c.3–5y–a few fruit	
Stenocarpus salignus	R	R		154w		163w			c.3–4y
Telopea speciosissima	R			c.1–2y		c.2–3y			c.2–3y–a small pop.
Xylomelum pyriforme	R	R	133w–adv	39w		133w			c.2–3y
Ranunculaceae									
Clematis aristata	R			38w					
Ranunculus plebeius	?K				41w				
**Ranunculus repens*	R			39w		44w–grn.			c.1y
Rhamnaceae									
Cryptandra amara (prob.pk.pf.flower.c.3–5y)	pK				71w		75w		
Cryptandra ericoides		K			64w				
Pomaderris discolor (prob.pk.pf.flower.c.4–6y)	K				140w		249w		
Pomaderris elliptica		K			195w				
Pomaderris ferruginea (prob.pk.pf.flower.c.4–6y)	K		63w–adv		140w		149w	c.2–3y	
Pomaderris intermedia (prob.pk.pf.flower.c.4–6y)	K		50w		89w		143w		
Rosaceae									
**Potentilla indica*	R					23w			
**Rubus ?discolor*	R			38w		49w			c.1y
Rubiaceae									
**Galium aparine*	?K				44w		44w	c.1y	
Galium binifolium			36w						
Morinda jasminoides (poss.pk.pf.fruit.c.5+y)	R			101w–grn					c.2y
Opercularia aspera	R	R	21w			23w			
Opercularia varia	pR				33w		33w		
Pomax umbellata	pK	pK	15w		38w		49w	c.1y–(shd)	
**Richardia stellaris*	?R						25w		
Rutaceae									
Asterolasia correifolia		K							

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Boronia ledifolia (prob.pk.pf.flower.c.4–5y)	K	K	23w		85w		97w–(shd)	c.2y	
Boronia mollis		pK	35w						
Boronia pinnata (poss.pk.pf.flower.c.3+y)	R	R		37w,**89w**		97w–(shd)			c.2y
Boronia polygalifolia	pR								
Boronia rigens	K	pK							
Correa reflexa (prob.pk.pf.flower.c.4–5y)	pK	pK	85w		**131w**		89w–grn	c.2y	
Crowea saligna		?K	22w						
Eriostemon australasius		K/r	17w						
Leionema dentatum (poss.pk.pf.flower.c.10+y)	K	K	30w		189w		247w	c.4–5y	
Phebalium squamulosum subsp. *squamulosum*		K							
Philotheca salsolifolia subsp. *salsolifolia* (prob.pk.pf.flower.c.5–6y)	pK	K			89w,**135w**		141w–grn	c.2–3y	
Zieria laevigata		?K	17w				97w		
Zieria pilosa (poss.pk.pf.fruit.c.3y)	pK		15w		63w,**85w**		85w	c.2y	
Zieria smithii (poss.pk.pf.flower.c.3–5y)	K		26w		88w		143w	c.2–3y	
Salicaceae									
**Populus alba*	R								
**Salix ?alba*		R							
**Salix babylonica* (s.lat.)	R								
Santalaceae									
Exocarpos cupressiformis	R	R	26w	61w			190w		
Leptomeria acida	K		122w–adv		163w		190w	c.3–5y	
Sapindaceae									
**Cardiospermum grandiflorum*	R		7w		63w		89w		
Dodonaea pinnata		pK	31w						
Dodonaea triquetra (prob.pk.pf.fruit.c.4–5 y)	K	pK	6w		63w		87w–grn	c.2–3y	
Scrophulariaceae									
**Verbascum virgatum*							51w		
**Veronica persica*					38w		38w		
Veronica plebeia	R		19w		39w		44w(grn)		
Simaroubaceae									
**Ailanthus altissima*	R	R							
Solanaceae									
**Cestrum parqui*	R			41w		51w			c.1y–grn
**Datura ferox*							16w(grn)		
**Datura stramonium*			8w		8w		12w(grn)		
Duboisia myoporoides		R							
**Lycopersicon esculentum*			12w		15w		29w		
**Petunia ?(hybrid)*					35w				
**Physalis peruviana*					140w		140w		
Solanum americanum					37w		37w		
Solanum aviculare			16w		50w		94w(grn)		
**Solanum chenopodioides*	R			7w		50w			
**Solanum mauritianum*	R	pR		36w		41w			c.1y
Solanum prinophyllum			13w		35w		35w		
Solanum vescum			20w		38w		38w		

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
Stackhousiaceae									
Stackhousia nuda		R		17w(1)					
Stackhousia viminea	pK	pK	32w		37w		42w	c.1y	
Sterculiaceae									
Commersonia fraseri	R			63w					
Lasiopetalum ferrugineum (prob.pk.pf.flower.c.4–5y)	K	K	22w		87w		97w	c.2y(shd)	
Lasiopetalum parviflorum	K				144w				
Rulingia dasyphylla (prob.pk.pf.flower.c.3–4y)			20w		38w		92w	c.2y(shd)	
Stylidiaceae									
Stylidium graminifolium	R			30w		51w			c.1–2y
Stylidium lineare (poss.pk.pf.flower.c.3y)	?K	K/r	?75w	?42w	93w		104w	c.2y(shd)	
Stylidium productum	R	pR	26w		97w		101w(grn)		c.2–3y?
Thymelaeaceae									
Pimelea curviflora (poss.pk.pf.flower.c.2y)					56w		61w		
Pimelea linifolia (prob.pk.pf.flower.c.3–5y)	K	K	22w		56w		75w	c.2y(shd)	
Wikstroemia indica		?K							
Tremandraceae									
Tetratheca ericifolia		K							
Tetratheca glandulosa	R	R		90w					
Tetratheca thymifolia	R/?k	R	38w						
Tropaeolaceae									
**Tropaeolum majus*					26w		26w		
Ulmaceae									
**Celtis australis*	R								
Trema tomentosa var. *viridis*		?K	10w						
Urticaceae									
Urtica incisa					38w				
Verbenaceae									
Clerodendrum tomentosum	R	R		143w–buds		4y–grn.			
**Lantana camara*	R	R		16w		20w–grn			
**Verbena bonariensis* (s.lat.)	R		11w		37w		56w		
**Verbena litoralis* (s.lat.)	R			7w		10w			
**Verbena rigida*					12w		23w–(shd)		
Violaceae									
Hybanthus monopetalus (prob.pk.pf.flower.c.2–3y)	R			36w		43w– grn			c.1y
Viola hederacea	R		10w		10w		38w		
**Viola odorata*	R								
Vitaceae									
Cayatia clematidea	R	R		51w		51w–grn			c.1y
Cissus hypoglauca	R	R							
**Vitis sp.*		R							
MONOCOTYLEDONS									
Agavaceae									
**Agave americana*	R			19w					
**Yucca aloifolia*	R								
Alliaceae									
**Nothoscordum borbonicum*	pR	pR		9w		18w			
Alstroemeriaceae									
**Alstroemeria pulchella*	pR			49w		49w			
Amaryllidaceae									
**Amaryllis belladonna*	pR					12w			

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	NL	Seedlings first observed	First flowering Resp	Seed	First fruiting Resp	Seed	Juvenile periods Primary	Secondary
***Clivia miniata**	R								
**Narcissus sp.*	pR	pR		18w					
Anthericaceae									
Caesia parviflora	R	R		37w, **42w**		49w			c.1y
**Chlorophytum comosum*	pR			16w					c.1y
Laxmannia gracilis (s.str.)	?K				43w(1), **46w**		51w–(shd)		
Sowerbaea juncea		R		32w					
Thysanotus juncifolius	pR	pR		17w			64w–(shd)		
Thysanotus tuberosus	R			46w					
Tricoryne simplex	R			16w		41w			c.1y
Araceae									
**Colocasia esculenta*	pR	pR							
Gymnostachys anceps		R		35w		35w			
Arecaceae									
Livistona australis		R		35w					
**Phoenix ?canariensis*	R								
Asparagaceae									
**Asparagus aethiopicus*	R			50w					
**Asparagus asparagoides*	R					46w			c.1y
**Asparagus officinalis*	pR					18w			
**Asparagus scandens*	R								
Blandfordiaceae									
Blandfordia nobilis (prob.pk.pf.flower.c.2y)	R	R		46w,**49w**		56w–(shd)			56w–(shd)
Cannaceae									
**Canna indica*	R	R		38w					
Centrolepidaceae									
Centrolepis strigosa	pK			36w		44w			44w–(shd)
Colchicaceae									
Burchardia umbellata	R	R		36w		46w			46w–(shd)
Commelinaceae									
Commelina cyanea	R	R		10w					
**Tradescantia fluminensis* (poss.pk.pf.flower.c.3y)	R			43w					
Cyperaceae									
Baumea juncea	R	R		49w		51w			
Baumea rubiginosa	R	R		38w					
Carex inversa	?R				15w				
Caustis flexuosa	K	K	56w		c.2–3y				
Caustis pentandra	K	K					198w	c.4y	
Chorizandra cymbaria	R	R		31w		42w			c.1y
Chorizandra sphaerocephala		R		17w		32w			32w–(shd)
Cyathochaeta diandra (prob.pk.pf.flower.c.1y)	R	R		45w		56w			
**Cyperus albostriatus*	pR	pR		26w					
**Cyperus brevifolius*	R			10w		10w			
**Cyperus eragrostis*	R			10w		10w			
Cyperus ?polystachyos	R			10w					
Fimbristylis dichotoma	pR						71w–(shd)		
Gahnia clarkei	R					159w			c.3y
Gahnia erythrocarpa	R	R		91w		201w			c.3–4y
Gahnia melanocarpa	R					125w			c.2–3y
Gahnia radula	R	R		90w					c.2–3y
Gymnoschoenus sphaerocephalus		R							
Isolepis ?cernua	R			10w					
Isolepis inundata					28w				

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	NL	Seedlings first observed	First flowering Resp	Seed	First fruiting Resp	Seed	Juvenile periods Primary	Secondary
**Isolepis prolifera*	pR						63w		
Lepidosperma filiforme		?K							
Lepidosperma gunnii	pR					61w			
Lepidosperma laterale	R			49w		56w			56w
Lepidosperma limicola		R		32w					
Lepidosperma neesii	R	R		35w		63w			
Ptilothrix deusta (prob.pk.pf.flower.c.1y)	R	R		10w		32w			c.1y–(shd)
Schoenus apogon	?K	?K			38w				
Schoenus brevifolius	R			41w		63w			
Schoenus ericetorum	R			36w					
Schoenus imberbis	R	R		37w		76w			
Schoenus melanostachys	R	R		35w		51w			c.1y
Schoenus moorei	R	R		32w		51w			c.1y
Schoenus paludosus		K							
Schoenus turbinatus					104w–buds				
Schoenus villosus	R			56w–buds					
Tetraria capillaris	R			50w					
Tricostularia pauciflora	pR					104w			
Haemodoraceae									
Haemodorum corymbosum	R	R		42w		64w			
Haemodorum planifolium (prob.pk.pf.flower.c.1y)	R	R		42w		56w			56w–(shd)
Hypoxidaceae									
Hypoxis hygrometrica (s.lat.)	pR			16w					
Iridaceae									
**Anomatheca laxa*	pR			40w					
**Aristea ecklonii*	pR	R		41w		44w			
**Crocosmia* X *crocosmiiflora*	pR	pR		18w		38w–grn			
**Freesia* hybrid	pR			33w		38w			
**Gladiolus angustus*	pR	pR		40w					
Patersonia glabrata	R	R		38w		49w			c.1y–(shd)
Patersonia sericea	R	R		31w		44w			c.1y–(shd)
**Romulea rosea*	pR			33w					
**Sisyrinchium iridifolium*		?K			42w		42w		
**Sisyrinchium* species A	?K	?K			42w		44w		
**Watsonia meriana* cv. Bulbillifera	pR	pR		38w		Note: Bulbils began to be shed within 50w of fire.			
Juncaceae									
**Juncus articulatus*	R			10w					
**Juncus bufonius*							38w(grn)		
Juncus continuus		R		42w–buds					
Juncus planifolius							40w		
Juncaginaceae									
Triglochin procerum (s.str.)		pR		20w		20w			20w
Liliaceae									
**Lilium formosanum*	R	R		26w		29w–grn			
Lomandraceae									
Lomandra cylindrica	R			40w		56w			56w–(shd)
Lomandra filiformis subsp. *filiformis*	R	R		35w		51w			c.1y
Lomandra fluviatilis	R								
Lomandra glauca	R	R		36w		49w			c.1y
Lomandra gracilis	R	R		38w		51w			c.1y–(shd)
Lomandra longifolia	R	R	131w	34w		50w			c.1y–(shd)
Lomandra micrantha	R			64w					
Lomandra multiflora	R	R		41w		51w			c.1y

Family/Species (Post–fire fl, fr peaks)	Fire Response LCR	Fire Response NL	Seedlings first observed	First flowering Resp	First flowering Seed	First fruiting Resp	First fruiting Seed	Juvenile periods Primary	Juvenile periods Secondary
Lomandra obliqua	R	R		41w		49w			c.1y
Luzuriagaceae									
Eustrephus latifolius	R	pR		15w		35w			35w–ri
Geitonoplesium cymosum		R		35w–buds					
Orchidaceae									
Acianthus caudatus	pR			28w		38w			
Acianthus fornicatus	pR			23w		33w			
Acianthus pusillus	pR			16w		26w			
Caladenia carnea	pR			36w					
Caladenia catenata	pR			34w		39w			
Caladenia testacea					86w (1)				
Caleana major	pR	pR		37w		49w			
Calochilus campestris	pR	pR		37w		42w			
Calochilus paludosus	pR	pR		37w		41w			
Calochilus robertsonii	pR			39w					
Cestichis reflexa		K	Lightly burnt plants resprouted from pseudobulbs –NL.						
Chiloglottis sp.		pR		10w					
Corybas pruinosus		pR		Leaves emerged within 35w of fire.					
Cryptostylis erecta	pR			46w		108w			
Cryptostylis subulata	pR				101w		101w–grn		
Cymbidium suave	pK	pK		Resprouted, low intensity–flowered 92w after fire.					
Dipodium roseum	pR				101w				
Dipodium variegatum	pR			49w					
Diuris aurea		pR		37w		42w			
Diuris maculata (prob.pk.pf.flower.c.1y)	pR			30w		36w			
Dockrillia linguiformis	K	K			143w–buds				
Eriochilus petricola	pR			64w					
Genoplesium fimbriatum		pR		10w		21w			
Genoplesium pumilum		pR				17w			
Genoplesium rufum	pR	pR		16w		24w			
Glossodia major		pR		31w					
Glossodia minor	pR	pR		31w		36w			
Lyperanthus suaveolens	pR			36w					
Microtis unifolia (s.lat.)	pR	pR		36w		43w			
Orthoceras strictum							104w		
Prasophyllum elatum	pR	pR		36w		43w			
Prasophyllum striatum		pR				22w			
Pterostylis acuminata	pR			18w					
Pterostylis concinna	pR			29w		30w			
Pterostylis daintreana		pR		22w		31w			
Pterostylis longifolia	pR			24w					
Pterostylis nutans	pR	pR		30w		36w			
Rimacola elliptica	pR	pR		38w					
Thelymitra ixioides	pR	pR		31w		43w–(shd)			
Thelymitra pauciflora	pR	pR		37w		42w			
Philydraceae									
Philydrum lanuginosum		pR				20w			
Phormiaceae									
Dianella caerulea	R	R		41w		49w			c.1y
Dianella prunina	R	R		43w		51w			c.1y
Dianella revoluta	R			94w					
Thelionema caespitosum	R			91w		100w			
Poaceae									
**Agrostis capillaris*					43w				
**Agrostis stolonifera*					43w				
**Andropogon virginicus*	R	R		15w		20w			20w

Family/Species (Post–fire fl, fr peaks)	**Fire Response**		**Seedlings first observed**	**First flowering**		**First fruiting**		**Juvenile periods**	
	LCR	**NL**		**Resp**	**Seed**	**Resp**	**Seed**	**Primary**	**Secondary**
Anisopogon avenaceus (poss.pk.pf.flower.c.1–2y)	R	R		41w		49w			c.1y–(shd)
Aristida benthamii		R		17w		32w			32w–(shd)
Aristida calycina var. *calycina*	R					26w			26w–(shd)
Aristida ramosa	R	R		8w		17w			17w
Aristida vagans	R			6w		15w			15w–(shd)
Aristida warburgii	R			11w		16w			16w
**Arundo donax*	R								
Austrodathonia ?linkii							30w–(shd)		
Austrodanthonia tenuior	R			11w		18w			18w
Austrostipa pubescens	R					49w			c.1y–(shd)
**Avena sativa*					23w		43w–(shd)		
**Briza maxima*	?K				43w		50w	1y–(shd)	
**Briza minor*	?K	?K			28w		43w	43w	
**Briza subaristata*							51w		
**Bromus catharticus*					39w				
**Bromus diandrus*					41w				
**Chloris gayana*		R		13w		35w			
**Cortaderia selloana*	R	R		18w		20w			
Cymbopogon refractus	R			9w		19w			19w
Deyeuxia quadriseta					39w		44w		
Dichelachne crinita	R	pR		37w		49w			c.1y–(shd)
Dichelachne micrantha	R			16w					
Dichelachne parva					39w				
Dichelachne rara					41w				
Digitaria parviflora	R	R		13w		30w			30w–(shd)
Echinopogon caespitosus	R			8w		15w			15w
**Ehrharta erecta*	R			12w			38w		
**Eleusine indica*					15w				
Entolasia marginata	R			9w		28w			28w–(shd)
Entolasia stricta	R	R		8w		22w			22w
Eragrostis ?brownii	R			8w					
Eragrostis leptostachya	R			9w					
Hemarthria uncinata	R	R		11w					
**Hordeum distichon*					12w		40w		
Imperata cylindrica var. *major*	R			6w		11w			11w
Lachnagrostis filiformis					39w		44w		
**Lolium multiflorum*					38w				
**Lolium perenne*					44w				
**Melinis repens*	R			19w		26w			
Microlaena stipoides	R			8w		15w			15w
Oplismenus aemulus	?K				19w				
Panicum simile	R			15w		16w			
**Paspalum dilatatum*	R			10w		15w			15w
**Paspalum quadrifarium*	R	R		11w		28w			28w–(shd)
**Paspalum urvillei*	R			9w		9w			
**Pennisetum clandestinum*	R	pR							
**Pennisetum macrourum*	R			50w					
Phragmites australis	R					71w			c. 1–2y
**Phyllostachys aurea*	R								
**Poa annua*					30w				
Poa labillardieri	R			9w					
**Setaria gracilis*	R			9w		10w			
**Setaria palmifolia*	R	R		16w		30w			
**Setaria sphacelata*		R		38w		38w			

Family/Species (Post–fire fl, fr peaks)	Fire Response		Seedlings first observed	First flowering		First fruiting		Juvenile periods	
	LCR	NL		Resp	Seed	Resp	Seed	Primary	Secondary
**Sorghum bicolor*					23w		23w		
**Sporobolus africanus*					19w				
Sporobolus creber	pR			15w					
Themda australis	R	R		13w		49w			c.1y
**Vulpia bromoides*					43w				
Restionaceae									
Baloskion tetraphyllum subsp. *meiostachyum*		R							
Chordifex dimorphus		K/ r	One plant resprouted. Others apparently killed.						
Chordifex fastigiatus		K	One plant resprouted, but it was not 100% scorched.						
Empodisma minus	R								
Eurychorda complanata		pK	Unable to find this species in one location where it previously occurred before the fire (as observed 38w after the fire).						
Leptocarpus tenax		R			32w				
Lepyrodia scariosa	R	R		56w					
Smilacaceae									
Smilax australis	R	R		35w– (1)					
Smilax glyciphylla	R			46w		50w			c.1y
Typhaceae									
Typha ?orientalis	pR					85w			
Uvulariaceae									
Schelhammera undulata	R	R		13w		44w			44w–grn.
Xanthorrhoeaceae									
Xanthorrhoea arborea (prob.pk.pf.flower.c.1y)	R	R		35w,51w		100w			c.2y–(shd)
Xanthorrhoea media (prob.pk.pf.flower.c.1y)	R	R		17w,39w		56w			56–63w(shd)
Xanthorrhoea ?minor				38w					
Xanthorrhoea resinifera	R	R		43w					
Xyridaceae									
Xyris gracilis	R			51w					
Xyris juncea		R		17w		32w			
Xyris operculata		R		32w					
Zingiberaceae									
**Hedychium gardnerianum*	R					88w			