

Recovery of Victorian rare or threatened plant species after the 2009 bushfires

Black Saturday Victoria 2009 – Natural values fire recovery program

Arn Tolsma, Geoff Sutter, Fiona Coates



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Front Cover photograph: *Pultenaea weindorferi* (Swamp Bush-pea) at Bunyip State Park, October 2010 (Geoff Sutter).

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Summary

Between October 2010 and September 2011, searches were conducted for known pre-fire populations of 67 rare or threatened plant species following the Victorian bushfires of 2009, to determine their post-fire persistence and recovery. Populations of 42 species (comprising 183 individual records) were located, and were assessed for size, viability, reproductive traits and threats. Populations of 25 species (comprising 77 individual population records) were sought but not found, or were deemed impractical to pursue after an initial field reconnaissance.

Most located populations were recovering with no obvious decline in size: indeed, many species had germinated profusely from seed and were temporarily in high numbers. Few populations appeared threatened, partly due to the high abundance of germinants and the sheer volume of total post-fire regeneration. Deer, blackberries and future road widening were identified as possible threats to the recovery of some populations. However, the greatest threat to many plant populations is likely to come from another fire. Many woody species had not yet reached reproductive maturity within two years of the fires. Therefore, the occurrence of another fire prior to plants establishing viable seed stores would pose a threat to the local persistence of populations of species regenerating predominantly or solely from seed.

1 Introduction

On 7th February 2009, following a period of exceptional fire weather (Bureau of Meteorology 2009; DSE 2009) numerous bushfires ignited and burnt across Victoria. Large areas of public land were affected, especially in the North east and Gippsland areas. Bushfires also occurred on other dates, including in the south-west of the state.

Populations of a large number of Victorian Rare or Threatened Species (VROT) (DSE 2005) were known to be within the areas burnt by these fires. Eight of these VROT species are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and 15 under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG).

The post-fire responses of many of these species have not been adequately documented, hence there is currently an incomplete understanding of their likely response to the 2009 fires. Basic life-cycle information may also be lacking, such as the time required for species to reach viable, reproductive maturity. This is of concern, as time to reproductive maturity of key species is a major factor that helps determine minimum and maximum tolerable fire intervals (Noble and Slatyer 1981; Cheal 2010).

Following fire, plants may be subject to various pressures that might affect their recovery. These include grazing (Leigh and Holgate 1979; Robertson 1985; Tolhurst and Oswin 1992), weed invasion (Meredith 1987; Milberg and Lamont 1995), drought, erosion, and another fire before species are able to produce adequate stores of viable seed (Gill 1981; Noble and Slatyer 1981). Potential threats to the long-term persistence of populations of VROT plants burnt in 2009 are largely unknown, but are important to identify to ensure that appropriate management decisions can be made.

Accordingly, surveys were required to assess the degree to which rare and threatened plants were affected by the fires, their post-fire recovery (mode, abundance and distribution), life-cycle attributes (such as time to reproductive maturity), post-fire threats that might impact on their recovery and persistence and management actions that could assist in securing their recovery.

The specific aims of the project were to:

- determine the number of rare or threatened plant species potentially affected by the 2009 fires,
- determine which species were likely to be most at risk,
- undertake field surveys for known populations of 'at-risk' species,
- quantify the recovery of species in terms of abundance and distribution,
- identify and record vital attributes, particularly mode of regeneration and attainment of reproductive maturity,
- identify any significant threats to populations of VROT plants,
- recommend on-ground actions where appropriate.

This report presents a brief discussion of each priority species, including specific threats, followed by a broader discussion of threats across the fire area.

2 Methods

The methods used for this project were adapted from those used for previous surveys (Coates *et al.* 2004; Kohout *et al.* 2009).

Many fires occurred in 2009, in a range of vegetation types and across a wide geographical area and it was impossible given funding and time constraints to field-assess more than a small sample of all threatened populations. Therefore, to ensure attention was focussed on the species at most potential risk and for practical purposes, it was first necessary to narrow down the areas of concern, by determining which of the larger fires contained the greatest numbers of VROT species and species populations. All fires that occurred in Victoria during the 2008–2009 fire season (with the exception of those in the Mallee, which were excluded from this project) were identified from data located on DSE's Fireweb. A short list for further investigation was extracted, which included all larger bushfires (for practical purposes those over 1200 hectares in size) that occurred mostly on public land (forests, parks and reserves) (Table 1). A shapefile for the 13 short-listed fires was then generated in GIS (Arcview 3.3, ESRI Inc.) from data sourced from DSE's Spatial Datamart (Fire100_year.shp). This became the provisional study area.

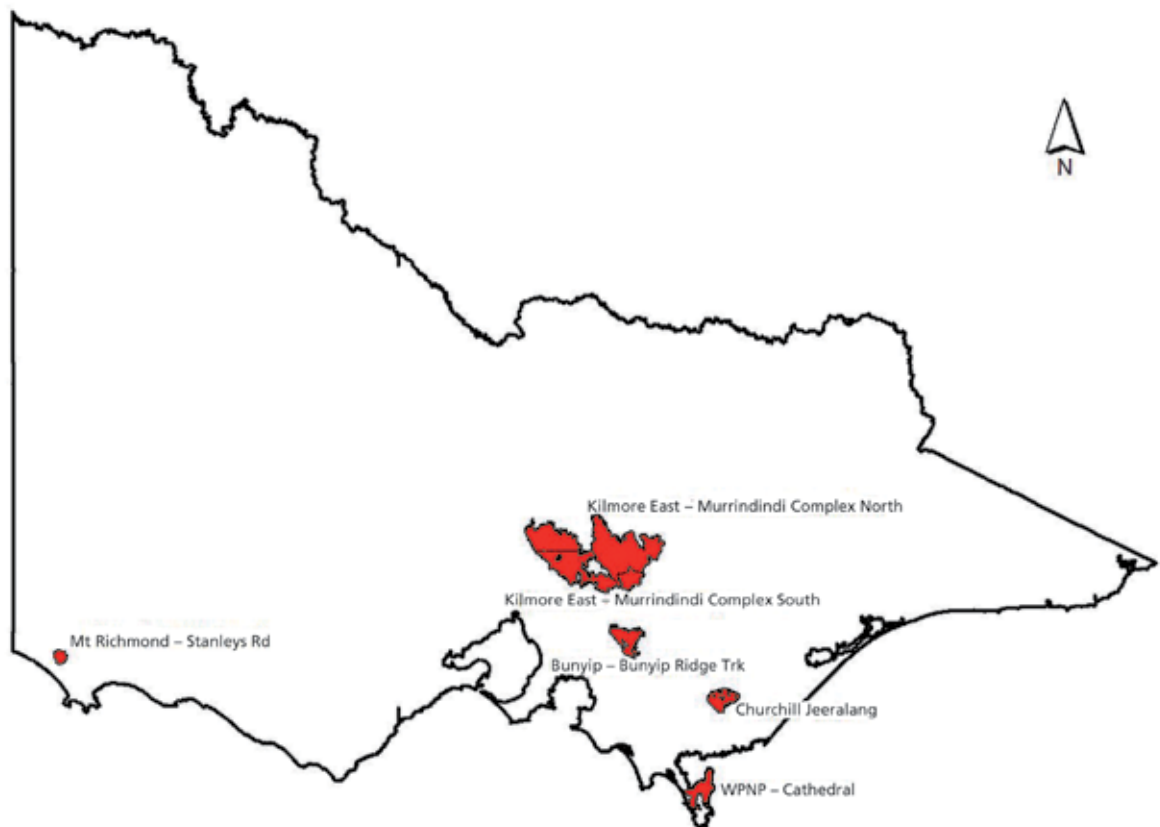
VROT plant species records within the provisional study area were then identified. Location records for all known populations of VROT plant species were sourced from DSE's Spatial Datamart, in the form of a GIS shapefile (threatened flora shapefile, THFLO100.shp). Records were limited to those entered prior to 2008, as more recent data had not been incorporated at the commencement of this project. The threatened flora shapefile was then 'clipped' in GIS using the short-list fire (provisional study area) shapefile to remove all VROT plant records that were not contained within the 13 fire boundaries (Table 1). The remaining data thus included the known populations of all VROT species within the provisional study area.

Records were then examined for each fire area to determine the total number of species and populations within them. Fire areas were excluded from further investigation if they contained no VROT plant records, or if the records for particular species constituted only a small proportion of all known records (i.e., those species were adequately represented outside the fire area). This narrowed the final study area to six fires (Table 1 and Figure 1), containing a provisional list of 163 VROT species (Appendix 1). Note that plant species were restricted to vascular plants, ferns and some club mosses, due to the difficulty in accurately identifying many non-vascular plants.

Table 1. Major fires on public land in the 2008–2009 fire season, and the number of VROT plant species recorded within those fire areas. For completeness, fires excluded from final assessment are also shown. Note the small number of threatened species therein.

Fire name	Area (ha)	No. of VROT species
Included in final assessment:		
Kilmore East – Murrindindi Complex North	168 542	49
Kilmore East – Murrindindi Complex South	86 875	31
Bunyip State Park – Bunyip Ridge Track	26 200	23
Wilson's Promontory National Park – Cathedral	25 200	66
Churchill – Jeeralang	24 486	9
Mt Richmond – Stanleys Road	6 083	14
Excluded from final assessment:		
Beechworth – Library Road	33 577	4
Dargo – White Timber Spur	13 640	3
Muskvale – Hogans Road	2 658	3
East Tyers – Thomson	1 778	0
Murmuring Creek – Coopracambra	1 777	2
Mitta – Limestone Gap	1 608	0
Yarram – Napier Road	1 365	1

Figure 1. Six major fire areas searched electronically for VROT flora species.




It was impractical to attempt to find populations of all 163 VROT species. Therefore, all species on the provisional list were allocated, with the assistance of expert opinion, to a priority category that reflected the urgency or importance of their assessment (Appendix 1). Species priority categories were:

1. Highest priority. Listed under the EPBC or listed under the FFG, endemic to Victoria, or possibly at risk owing to particular known regenerative attributes or fire sensitivity (25 species).
2. Victorian Rare or Threatened (VROT) status of vulnerable, endangered or unknown (DSE 2005), or where additional post-fire information was deemed to be of benefit (12 species).
3. VROT status of rare, and was an obligate seeder, or was contained within a geographically-restricted area, or had more than 20% of their known records burnt (44 species).
4. VROT status of rare, but would be difficult to locate or identify (8 species).
5. Lowest priority. Assess opportunistically only if visiting general area. Were minor records in separate areas impractical to assess, or were already known to

regenerate well post-fire, or were already subject to separate post-fire assessments and actions, such as orchids (Duncan 2011) (74 species).

Departmental databases (for example, Flora Information System, Biodiversity Interactive Mapping), herbarium records and oral records were used to collate location and identification information for the 89 VROT species that had a priority rating of 1 to 4. Duplicate records were removed, and individual populations with inaccurate locations (mostly pre-GPS records with a recorded accuracy of 500–2000 m) were given low search priority under the assumption that they were unlikely to be readily found. Conversely, high search priority was given to recent records with accurate location information, such as those from VROT data and recovery plans, particularly if the original floristic quadrats contained multiple priority species.

Searches commenced in October 2010 for known populations, with the timing of the searches coinciding as much as possible with the peak flowering times of individual species. Using grid references and quadrat maps (where available), the location of the original quadrat or record was found, and the area searched for the relevant rare species. Detailed notes were made of population size or extent, mode of regeneration (by carefully digging around a sample of plants where appropriate), whether flowering



or fruiting at the time, and other relevant information such as topography, drainage, soil type, aspect, estimated fire severity and other species present. Sightings of any rare or threatened species that were not on the original priority list were also documented. The general area around the population was then examined to determine if there were any obvious potential threats to the recovery or persistence of the population, such as high-threat weeds or heavy browsing. Recommendations for future site management were recorded if applicable.

Most surveys were completed by May 2011, with the exception of the Mt Richmond-Stanleys Road and Churchill-Jeeralang fire areas. Surveys in these two areas, surveys for additional species known to flower in late-winter to early-spring, and follow-up surveys for some species not located previously were undertaken in September 2011.

Data for new populations found will be provided in electronic form to regional staff, and records will be incorporated in Actions for Biodiversity Conservation database (ABC) and Victorian Biodiversity database (VBA), during 2012.

3 Results of population surveys

Forty two species, comprising 89 known population records and 94 new records, were located during the surveys (Table 2). The largest number (and proportion) of species found was in the Kilmore East – Murrindindi North fire area.

Efforts were made to locate a further 25 species (comprising 77 individual populations) but without success (Table 2). Failure to locate these known populations may have been due to several factors. These include incorrect (or inaccurate) grid references, lack of flowering material at the time preventing positive identification, dense post-fire regeneration hampering the search, or senescence of the original plants (in the case of older records). Some searches for particular populations were abandoned after field reconnaissance of the area because sites were inaccessible (the post-fire vegetation was too dense over a long distance, or the site was considered unsafe), or the location was obviously in error (for example, when a wetland species was mapped well away from any wetland area), or the vegetation around a low-priority record was not burnt, or the site appeared to be on private property.

Field searches for the remaining 22 priority species were considered impractical after examining population records. This was usually because the only population records were in remote areas that were difficult to access (such as the

swampy, north-east corner of Wilsons Promontory), or records were simply too old and inaccurate (for example, “12 miles inland from Drouin”).

Within this section we will present a brief discussion of each species for which a search was instigated (in alphabetical order), including specific threats to any of their populations. This will be followed in the next section by a broader discussion of main threats across the fire area.

The VROT status for each plant is included in the heading. Abbreviations are:

- e, endangered in Victoria
- k, poorly known in Victoria
- r, rare in Victoria
- v, vulnerable in Victoria
- L, listed (FFG)

A summary list of species searched for by fire area is presented in Table 3, which will allow regional staff to rapidly identify species of concern in their area. ‘A’ indicates those species for which some form of follow-up action is recommended.

Table 2. VROT species, existing FIS records searched, and new records found across 6 fire areas.

Fire name	Priority VROT species	Species found	Species not found	Existing records found	New records found	Records not found
Kilmore E – Murrindindi N	29	18	3	24	32	12
Kilmore E – Murrindindi S	17	9	3	28	10	11
Bunyip State Park – Bunyip Ridge	17	8	4	20	27	22
Wilsons Promontory	36	13	13	13	23	26
Churchill – Jeeralang	5	2	1	1	2	3
Mt Richmond	8	2	3	3	0	3
TOTAL ACROSS ALL FIRES	89*	42*	25*	89	94	77

* Note that the same species may be recorded in more than one fire area.

Table 3. VROT species described in this report, with shading indicating the fire areas in which they were searched for. 'A' indicates that follow-up action has been recommended (refer to text).

Species	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Acacia alpina</i>						
<i>Acacia leprosa</i> var. <i>graveolens</i>						
<i>Acacia leprosa</i> var. <i>uninervia</i>						
<i>Acacia uncifolia</i>						A
<i>Acacia verticillata</i> subsp. <i>ruscifolia</i>						A
<i>Adiantum diaphanum</i>						
<i>Adriana quadripartita</i>						
<i>Allocasuarina media</i>						
<i>Argentipallium dealbatum</i>						
<i>Asplenium obtusatum</i> subsp. <i>north.</i>						
<i>Australina pusilla</i>						
<i>Baeckea latifolia</i>						
<i>Baumea laxa</i>						
<i>Brachyscome obovata</i>						
<i>Carex blakei</i>			A			
<i>Cephalomanes caudatum</i>						
<i>Cladium procerum</i>						A
<i>Correa reflexa</i> var. <i>lobata</i>	A					
<i>Cyathea cunninghamii</i>		A				
<i>Derwentia nivea</i>						
<i>Epacris microphylla</i> var. <i>rhombofolia</i>				A		
<i>Epacris petrophila</i>			A			
<i>Eucalyptus alligatrix</i> subsp. <i>allig.</i>						
<i>Eucalyptus fulgens</i>				A		
<i>Eucalyptus kitsoniana</i>						
<i>Eucalyptus willisii</i> subsp. <i>willisii</i>						A
<i>Euchiton umbricola</i>						
<i>Exocarpos syrticola</i>						A
<i>Gahnia grandis</i>	A					
<i>Gaultheria hispida</i>						
<i>Goodia pubescens</i>						
<i>Grevillea barklyana</i>	A					
<i>Grevillea chrysophaea</i>		A				
<i>Grevillea monslacana</i>			A			

Species	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Grevillea repens</i>			A	A		
<i>Hakea decurrens</i> subsp. <i>platytaenia</i>						
<i>Haloragis myriocarpa</i>						
<i>Herpolirion novae-zelandiae</i>						
<i>Hibbertia hirticalyx</i>						
<i>Lastreopsis hispida</i>						
<i>Leonema bilobum</i> subsp. <i>serrulatum</i> (subsp. 3)	A					
<i>Leptecophylla juniperina</i> subsp. <i>oxycedrus</i>						
<i>Lindsaea trichomanoides</i>						A
<i>Monotoca glauca</i>						A
<i>Olearia asterotricha</i>	A					
<i>Oreobolus oxycarpus</i> subsp. <i>oxycarpus</i>						
<i>Pellaea nana</i>						
<i>Persoonia arborea</i>	A			A		
<i>Pimelea drupacia</i>						
<i>Pneumatopteris pennigera</i>						
<i>Pomaderris apetala</i> subsp. <i>maritima</i>						
<i>Pomaderris helianthemifolia</i> subsp. <i>minor</i>			A			
<i>Pomaderris oraria</i> subsp. <i>oraria</i>						A
<i>Pultenaea weindorferi</i>						
<i>Pultenaea williamsonii</i>						
<i>Richea victoriana</i>			A			
<i>Schoenus carsei</i>						A
<i>Sowerbaea juncea</i>						A
<i>Tetratheca stenocarpa</i>	A					
<i>Thismia rodwayi</i>						
<i>Tmesipteris elongata</i>						
<i>Tmesipteris ovata</i>	A					
<i>Tmesipteris parva</i>	A					A
<i>Trochocarpa clarkei</i>						
<i>Wittsteinia vacciniacea</i>			A			
<i>Xanthosia tasmanica</i>						
<i>Xerochrysum papillosum</i>						

3.1 *Acacia alpina* – Alpine Wattle (r)

Local habitat

This is a small shrub 1–2 metres high, generally confined to shallow soils in alpine and subalpine areas (Walsh and Entwisle 1996).

During the current surveys, this species was found in open snow gum woodland at Lake Mountain with variable slope and aspect, in discrete patches previously occupied by the fire-killed parent shrubs. Recruits formed a virtual monoculture, and had the appearance of an island of low vegetation within a sea of taller vegetation, often grasses.

Surrounding vegetation usually included resprouting *Eucalyptus pauciflora* over *Scaevola hookeri*, *Stylidium graminifolium*, *Prostanthera cuneata* and *Geranium potentilloides*. Other common species, depending on location, included *Podolobium alpestre*, *Poa ensiformis*, *Tasmannia xerophila*, *Grevillea monslacana*, *Derwentia nivea* and *Callistemon ptyoides*.

Mode of regeneration

Regenerating profusely by seed in areas occupied previously by the dead parent plants (Figure 2). Two years after the fire, seedlings had reached only 25 cm high and they remained reproductively immature.

Key threats

No direct threats were observed. However, another fire before plants reach reproductive maturity is likely to affect their future persistence at these locations.

Management recommendations

- Prevent another fire from burning the plateau until such time as plants reach viable reproductive maturity.

Figure 2. *Acacia alpina* seedlings at Lake Mountain, 20/1/2011.



3.2 *Acacia leprosa* var. *graveolens* – Southern Varnish Wattle (k)

Local habitat

The *Acacia leprosa* – *Acacia verniciflua* group has recently undergone taxonomic revision (Maslin and Murphy 2009), with *Acacia leprosa* now comprising five varieties. *Acacia leprosa* var. *graveolens* [previously known as *Acacia verniciflua* (southern variant)] is the most wide-spread and common (Maslin and Murphy 2009). It is a shrub or small tree most common south of the Great Dividing Range, from the Grampians through to Orbost (Walsh and Entwisle 1996).

Population sizes varied substantially, from small localised populations (Figure 3) to tens of thousands of plants over an extended area. They were found on a range of soils and aspects in the Kinglake area, including ridges with brown clay-loam, moderate NW slopes with yellow-brown rocky clay soil, steep SW slopes and gentle easterly slopes.

Around Kinglake, associated vegetation often included *Eucalyptus macrorhyncha* or *Eucalyptus obliqua* (sometimes with *Eucalyptus goniocalyx*, *Eucalyptus polyanthemus* or *Eucalyptus cypellocarpa*), commonly over *Goodenia ovata*, *Cassinia aculeata*, *Pteridium esculentum*, *Opercularia varia*, *Pultenaea gunnii*, *Lomandra* spp., *Dillwynia* spp. and *Tetrarrhena juncea*. Other species present, depending on location, included *Dianella revoluta*, *Lomatia ilicifolia*, *Correa reflexa*, *Pultenaea scabra*, *Poranthera microphylla*, *Wahlenbergia* spp., *Rytidosperma pallidum* and *Spyridium parvifolium*.

Large new populations of this species were also recorded in the Traralgon South Flora and Fauna Reserve on sandy soils. Associated species included *Eucalyptus polyanthemus* over *Cassinia longifolia*, *Hydrocotyle laxiflora*, *Geranium potentilloides*, *Cymbonotus preissianus*, *Poa labillardierei*, *Euchiton collinus*, *Desmodium* spp. and *Glycine clandestina*.

Figure 3. *Acacia leprosa* var. *graveolens*, Kinglake National Park, 12/1/2011.



Mode of regeneration

Prolific regeneration from seed, often over an extended area. For example, one dense population in the Traralgon South Flora and Fauna Reserve extended along North Boundary Track for around 1 km, in a swath over 100 m wide, and was estimated to contain in excess of 100,000 plants. Seedlings were up to 2.5 m high two years after the fire, with some individuals budding but not yet flowering. However, all populations were flowering by September 2011, with some shrubs up to 4 m high. Much of the population is expected to eventually die back to the soil seedbank as plants senesce and the overstorey matures again.

Key threats

Some minor evidence of browsing was observed, but no other obvious threats. However, another fire before plants establish a viable seed bank is likely to have a severe impact on any affected population.

Management recommendations

- Protect population from another fire until such time as plants can establish a viable seed store.

Note that juvenile leaves of this species are morphologically very similar to those of *Acacia leprosa* var. *uninervia*, and without flowering material the young plants can be very difficult to confidently identify. Intermediate leaves are common. Therefore, few populations of *Acacia leprosa* were able to be reliably allocated to the level of variety. Separation of this species into different varieties is not useful in terms of species management, and consideration should be given to treating them as forms only.

3.3 *Acacia leprosa* var. *uninervia* – Large-leaf Cinnamon Wattle (r)

Local habitat

The *Acacia leprosa* – *Acacia verniciflua* group has recently undergone taxonomic revision (Maslin and Murphy 2009), with *Acacia leprosa* now comprising five varieties. *Acacia leprosa* var. *uninervia* [previously known as *Acacia leprosa* (large phyllode variety)] is less common than the previously mentioned *Acacia leprosa* var. *graveolens* (Maslin and Murphy 2009), but is similar in shape and size (Walsh and Entwisle 1996).

A large population of this species was found in a swath averaging ~ 15 m wide above the track and ~ 10 m wide below the track, extending virtually the entire length of the walking track from the carpark to Masons Falls, Kinglake National Park, on brown clay loam soil (Figure 4). Seedlings were up to 2.5 m high two years post-fire, with many budding but not yet flowering. However, by September 2011 plants were up to 3.5 m high, and most were flowering.

Associated species near Masons Falls included *Eucalyptus obliqua* and *Eucalyptus cypellocarpa* over *Pomaderris aspera*, *Goodenia ovata*, *Pultenaea scabra*, *Pteridium esculentum*, *Cassinia aculeata*, *Tetrarrhena juncea*, *Polyscias sambucifolia* and *Spyridium parvifolium*.

This species was also found in large numbers along other tracks in the park with drier vegetation, including *Eucalyptus macrorhyncha* over *Gonocarpus tetragynus*, *Opercularia varia*, *Rhytidosporum procumbens*, *Lomandra filiformis*, *Dillwynia phylloides*, *Correa reflexa*, *Lomatia ilicifolia*, *Dianella revoluta* and *Spyridium parvifolium*.

Figure 4. *Acacia leprosa* var. *uninervia*, Masons Falls, Kinglake National Park, 12/9/2011.



Mode of regeneration

Prolific regeneration from seed, usually over an extended area. Seedlings were up to 2.5 m high two years post-fire, with many budding but not yet flowering. However, by September 2011 plants were up to 3.5 m high, and most were flowering. Much of the population is expected to eventually die back to the soil seedbank as plants senesce and the overstorey matures again.

Key threats

Some minor signs of browsing. No other obvious threats noted, although another fire before plants establish a viable seed bank is likely to have a severe impact on any affected population.

Management recommendations

- Protect population from another fire until such time as plants can establish a viable seed store.

Note that juvenile leaves of this species are morphologically very similar to those of *Acacia leprosa* var. *graveolens*, and without flowering material the young plants can be very difficult to confidently identify. Intermediate leaves are common. Therefore, few populations of *Acacia leprosa* were able to be reliably allocated to the level of variety. Separation of this species into different varieties is not useful in terms of species management, and consideration should be given to treating them as forms only.

3.4 *Acacia uncifolia* – Coast Wirilda (r)

Local habitat

Previously known as *Acacia retinodes* var. *uncifolia*, this large shrub or tree to 10 m tall occurs on coastal dunes from Geelong to Wilsons Promontory (Walsh and Entwisle 1996).

During the current surveys, populations were found on sand dunes at the end of Tin Pot Track and near Limestone Track at Wilsons Promontory National Park (Figure 5). At the former site plants were scattered throughout the burnt area for a distance of ~200 m. *Leptospermum laevigatum* was common at both sites, while other species, depending on location, included *Solanum aviculare*, *Adriana quadripartita*, *Swainsona lessertiifolia*, *Pomaderris paniculosa* subsp. *paralia*, *Olearia axillaris*, *Muehlenbeckia adpressa*, *Hibbertia* sp, *Kennedia prostrata* and *Ficinia nodosa*.

Mode of regeneration

Specimens examined during this survey were regenerating by seed. The seeds germinate in response to moderate to hot temperatures, but the species is also known to resprout from rhizomes (DPIW 2008). Some seedlings were up to 1.2 m high within two years of the fire, but average height was around 50 cm. No flowering material was observed at the time.

Figure 5. *Acacia uncifolia* with signs of browsing, Wilsons Promontory National Park, 25/10/2010.



Key threats

Many plants are being browsed, probably by Hog Deer, which have created numerous tracks throughout the dunes and a perceptible odour. However, the volume of seedlings present suggests that the level of browsing is unlikely to threaten recovery of the populations. This species might be sensitive to frequent burning, preferring longer fire intervals (DPIW 2008), and another fire prior to re-establishment of a viable seed store is likely to be deleterious.

Management recommendations

- Monitor abundance of Hog Deer and implement control if necessary (and if practical)
- Protect populations from fire until viable seeds stores are re-established.

3.5 *Acacia verticillata* subsp. *ruscifolia* – Broad-leaf Prickly Moses (r)

Local habitat

This is a shrub to tall tree growing to around 10 m high, not known from further north than Wilsons Promontory (Walsh and Entwisle 1996). However, no populations were located at Wilsons Promontory National Park during the current surveys. This was attributed to a combination of positional inaccuracy and the difficulty in confirming the identity of plants with characteristics intermediate with those of other varieties.

Mode of regeneration

Not confirmed, but presumably by seed.

Key threats

Not known.

Management recommendations

- Future searching to confirm vital attributes.

3.6 *Adiantum diaphanum* – Filmy Maidenhair (e, L)

Local habitat

This species is a fern adapted to moist conditions, which grows on rocks near streams and waterfalls in sheltered gullies (DCE 1997). It is now believed to occur only in a few locations in the Strzelecki Ranges in South Gippsland (DCE 1997).

An early location record provided for Bunyip State Park was very inaccurate (i.e., “on creek 12 miles inland from Drouin”), precluding a useful search.

Mode of regeneration

Not confirmed, but presumably through the spread of both rhizomes and spores. It is known to form small colonies (Walsh and Entwisle 1994).

Key threats

Refer to Action Statement (DCE 1997).

Management recommendations

Refer to Action Statement (DCE 1997).

3.7 *Adriana quadripartita* – Coast Bitter-bush (v)

Local habitat

This is a spreading shrub to 3 m high, mostly confined to coastal and near-coastal areas west from Wilsons Promontory (Walsh and Entwisle 1999).

During these surveys they were located growing on sand dunes at the end of Tin Pot Track, and on a steep easterly slope off Tongue Point Track, Wilsons Promontory National Park.

Associated species at the former location included *Leptospermum laevigatum*, *Solanum aviculare*, *Acacia uncifolia*, *Swainsona lessertiifolia*, *Pomaderris paniculosa* subsp. *paralia* and *Olearia axillaris*.

Associated species at the latter location included *Calomeria* sp., *Acacia uncifolia*, *Muehlenbeckia adpressa*, *Solanum aviculare*, *Dichondra repens*, *Olearia axillaris*, *Pomaderris paniculosa* subsp. *paralia*, *Tetragona tetragonioides*, *Leptospermum laevigatum*, *Swainsona lessertiifolia* and *Lomandra longifolia*.

Mode of regeneration

Regenerating from seed, with seedlings up to 1.2 m high within two years post-fire and flowering. The number of individual plants was not counted, but exceeded 50 at each location.

Key threats

No obvious threats.

Management recommendations

None at this stage.

3.8 *Allocasuarina media* – Prom Sheoak (k)

Local habitat

This is a small shrub growing to around 3 m high, known only from low, sandy woodlands at Wilsons Promontory and near Gembrook (Walsh and Entwisle 1996).

Plant populations were located growing on sandy soils on gentle south-westerly slopes on the west side of Five Mile Road and off Millers Landing Track, Wilsons Promontory (Figure 6). More were scattered around the general area. Common species present included *Banksia serrata* (and sometimes *Eucalyptus baxteri*) over *Pteridium esculentum*, *Lepidosperma laterale*, *Bossiaea cinerea*, *Acacia suaveolens*, *Hypolaena fastigiata*, *Xanthorrhoea australis*, *Drosera peltata* and *Xanthosia tridentata*. *Leucopogon parviflorus*, *Leucopogon virgatus* and *Amperea xiphoclada* were also commonly present near Millers Landing.

Mode of regeneration

Above-ground plant material was killed by fire and around one third of mature plants showed no signs of resprouting at the time of the survey. Other plants had multiple resprouts around the base (up to ~10 per parent), while a few were resprouting from roots up to ~20 cm from the stem base. Sprout height at 20 months post-fire was up to ~40 cm, but typically ~25 cm. Some seedlings were observed a distance away from parent plants, consistent with this species having winged seeds (Walsh and Entwisle 1996). However, it was not possible to accurately determine the ratio of seedlings:resprouts without unduly damaging plants. It appears that the post-fire abundance of this species will be little different from the pre-fire abundance.

Key threats

Some browsing is occurring on resprouts, although the relative contribution by native and introduced animals is not known. The total number of regenerating plants suggests that browsing is unlikely to threaten the recovery of the population.

Management recommendations

None at this stage.

3.9 *Argentipallium dealbatum* – Silver Everlasting (r)

Local habitat

Argentipallium dealbatum is a tufted, rhizomatous perennial growing to around 50 cm in height, occurring in near-coastal heathlands (Walsh and Entwisle 1999).

This species had been recorded in swamp vegetation within the Lower Glenelg National Park, but we searched an area around 50 m x 100 m without success. Dense post-fire regeneration and swampy terrain made searching difficult.

Mode of regeneration

Not confirmed, but presumably a combination of regeneration from rhizomes and seeds.

Key threats

Not known.

Management recommendations

None at this stage.

Figure 6. *Allocasuarina media*, Wilsons Promontory, 26/10/2010.



3.10 *Asplenium obtusatum* subsp. *northlandicum* – Shore Spleenwort (v)

Local habitat

This is a rhizomatous fern that grows among coastal rocks and in coastal scrub (Walsh and Entwisle 1994).

An existing population recorded at Wilsons Promontory was in a remote area with inaccurate location, hence a search was impractical.

Mode of regeneration

Not confirmed, but likely to be via a combination of spores and rhizomes.

Key threats

Not known.

Management recommendations

None at this stage.

3.11 *Australina pusilla* subsp. *pusilla* – Small Shade-nettle (r)

Local habitat

This is a perennial herb with stems to around 4 cm high that grows in moist undergrowth, and has been recorded only in the Otway Ranges and at Wilsons Promontory (Walsh and Entwisle 1996).

The known populations at Wilsons Promontory were in very remote areas, hence considered impractical to search.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage.

3.12 *Baeckea latifolia* – Subalpine Baeckea (r)

Local habitat

Baeckea latifolia (previously known as *Baeckea utilis* var. *latifolia*) (Bean 1997) is a shrub that occurs only around Lake Mountain and the Baw Baw Plateau, where it is found along streams and around bogs (Walsh and Entwisle 1996; Bean 1997).

During the current surveys, this species was found on flat to gentle slopes in and around the margins of alpine bogs at Lake Mountain (Figure 7) and Mt Bullfight. Populations were generally located in the transition zone from snow gum woodland to bog, hence were associated with a range of wetter or drier vegetation, with or without tree canopy cover.

Vegetation generally consisted of *Eucalyptus pauciflora* over *Derwentia nivea*, *Scaevola hookeri*, *Callistemon ptyoides*, *Epacris paludosa*, *Carex blakei*, *Wittsteinia vacciniacea* and *Olearia algida*. Other species commonly present depending on location included *Isolepis* spp., *Senecio* spp., *Prostanthera cuneata*, *Blechnum penna-marina*, *Gonocarpus micranthus* and *Tasmannia xerophila*. *Sphagnum cristatum* was present in wetter (bog) locations.

Mode of regeneration

Plants examined were resprouting from around the base of top-killed parent plants, with resprouts to 60 cm high around two years post-fire (typically ~30–40 cm). This regeneration mode matches that of the more common *Baeckea gunniana* (McCarthy *et al.* 2003). Seedlings were not observed, and resprouts showed no sign of flowering within two years of the fire.

Key threats

No obvious threats observed, and no sign of deer browsing was seen. The potential impact of another fire before resprouts reach survival age is unknown.

Management recommendations

None at this stage.

Figure 7. *Baeckea latifolia* resprouting at Lake Mountain, 19/1/2011.



3.13 *Baumea laxa* – Lax Twig-sedge (r)

Local habitat

This species is a rhizomatous, tufted perennial with culms growing to around 55 cm high, and confined to wet, sandy heathlands and swamps in a few areas around Portland and Wilsons Promontory (Walsh and Entwisle 1994).

Known populations at Wilsons Promontory were not found during the current surveys. One location had an incorrect or inaccurate grid reference, with no appropriate vegetation types in the vicinity.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage.

3.14 *Brachyscome obovata* – Baw Baw Daisy (r)

Local habitat

Brachyscome obovata is a perennial daisy confined to wet, peaty ground in the alpine/sub-alpine zone (Walsh and Entwisle 1999). It is locally common around edges of shallow pools and drainage lines at Echo Flat and elsewhere around Lake Mountain (Figure 8). Many of these areas appeared to have been barely scorched, aided by the wetness of the substrate and the short stature of the vegetation.

Associated species commonly present included *Empodisma minus*, *Sphagnum cristatum*, *Carex blakei*, *Gonocarpus micranthus*, *Scaevola hookeri* and *Asperula gunnii*.

Mode of regeneration

Some individuals appear to have regenerated from seed, while others, being stoloniferous, have probably resprouted. Many individuals were flowering when assessed two years after the fire.

Key threats

No obvious threats observed.

Management recommendations

None at this stage.

Figure 8. *Brachyscome obovata*, Lake Mountain, 19/1/2011.



3.15 *Carex blakei* – Alpine Sedge (r)

Local habitat

This is a rhizomatous sedge that can be locally common in wet grasslands and *Sphagnum* bogs across the alpine and subalpine zone (Walsh and Entwisle 1994). At Lake Mountain and Mt Bullfight, this species appears to replace *Carex gaudichaudiana* as the common wetland sedge.

Associated species commonly included *Bossiaea foliosa*, *Scaevola hookeri*, *Poa costiniana* and *Herpolirion novae-zelandiae*. Other species, depending on location, included *Schoenus calyptratus*, *Derwentia nivea*, *Empodisma minus*, *Astelia alpina* and *Gonocarpus micranthus*.

Mode of regeneration

This species is rhizomatous, and had resprouted after fire, consistent with other alpine sedges within this genera (McCarthy *et al.* 2003). Two years post-fire, plants were up to 40 cm high and were flowering.

Key threats

Some plants showed signs of browsing at Mt Bullfight, probably by deer or rabbits (scats from both animals were observed). However, this should have little impact on the population as plants are locally common.

Management recommendations

- Monitor deer activity at Mt Bullfight.

3.16 *Cephalomanes caudatum* – Jungle Bristle-fern (r)

Local habitat

This is a rhizomatous species that grows on the trunks of tree ferns, particularly *Cyathea australis*, in rainforest (Walsh and Entwisle 1994). One population was found in an unburnt gully south of Five Mile Rd, Wilsons Promontory, where its location protected it from fire.

Associated species included *Syzygium smithii* and *Acacia melanoxyton* over *Dicksonia antarctica*, *Cyathea australis*, *Fieldia australis*, *Blechnum wattsi*, *Microsorium sp.*, *Olearia argophylla* and *Bedfordia arborescens*.

Mode of regeneration

Not confirmed, but probably from both spores and rhizomes.

Key threats

Unknown. Its preferred location in gully affords protection against fire.

Management recommendations

No recommendations.

3.17 *Cladium procerum* – Leafy Twig-sedge (r)

Local habitat

This is a rhizomatous perennial that often forms clumps in swampy areas and the margins of streams and lakes near the coast (Walsh and Entwisle 1994). A known population at Millers Landing, Wilsons Promontory was not found, despite the species being reasonably common in that earlier survey. This saline swamp was burnt at a moderate intensity, and we found no evidence of regeneration of this species.

Mode of regeneration

Not confirmed

Key threats

Unknown

Management recommendations

- Opportunistic future monitoring to determine if and when species regenerates.

3.18 *Correa reflexa* var. *lobata* – Powelltown Correa (r)

Local habitat

This is a perennial shrub to 2 m high that can be locally common in moist forest in the ranges east of Melbourne (Wilson 1998; Walsh and Entwisle 1999). Known populations were not initially confirmed in the Bunyip fire area during the current surveys, perhaps due to the difficulty in identifying this species from vegetative material alone, and its tendency to grade with var. *reflexa*. However, several small populations of 20 to 50 plants were later located within burnt areas at Bunyip by ARI staff (pers. comm., Michele Kohout and Judy Downe). These were in areas mostly dominated by *Eucalyptus obliqua*, with the understorey including *Gahnia radula*, *Dampiera stricta*, *Acacia myrtifolia*, *Helichrysum scorpioides* and *Acrotriche serrulata*.

Mode of regeneration

Not confirmed

Key threats

Unknown

Management recommendations

- Search recently-identified locations to confirm mode of regeneration and threats.

3.19 *Cyathea cunninghamii* – Slender Tree-fern (v, L)

Local habitat

This is a tall, slender species to 20 m high, restricted to riparian and rainforest communities between the Otway Ranges and East Gippsland (Walsh and Entwisle 1994). Plants are generally found in small numbers in wet, sheltered areas adjacent to streams, but not in situations subject to flood (Mueck 1990). Searches for known populations of this species were conducted in gullies at Wilsons Promontory. However, despite these gullies being largely unburnt, no plants were found.

In Traralgon Creek Flora Reserve, we found dead stems in a lightly burnt area that we believe were from this species (the size and quantity matched information provided), although it was difficult to confidently identify them without fronds (Figure 9). This species can also hybridise with *Cyathea australis*, producing the intermediate *Cyathea X marcescens* (Keel 1993; DPIPWE 2011b), further complicating positive identification from trunks alone. Fire burnt down into this gully, and although the gully bottom was only lightly scorched this appeared to be sufficient to crown-kill the plants. Associated species here included *Nothofagus cunninghamii* over *Dicksonia antarctica*, *Cyathea australis*, *Australina pusilla*, *Bedfordia arborescens*, *Stellaria flaccida*, *Polystichum proliferum*, *Urtica incisa* and *Hedycarya angustifolia*.

Another known population had been recorded in the nearby Cooks Gully Flora Reserve, which contained similar vegetation. This reserve had not been burnt but, as at Wilsons Promontory, the species was not confirmed. The presence of several dead stems that were consistent with those of this species indicates that plants observed previously may have senesced without being able to regenerate, suggesting that it may have specific establishment conditions.

Mode of regeneration

From spores (DPIPWE 2011a). Plants are often found in previously disturbed microsites (DPIPWE 2011a), suggesting that a couple of years with more open conditions might be required for establishment. Such conditions may currently exist at Traralgon Creek Flora Reserve. However, altered soil deposition and scouring levels may impact on plant establishment (DPIPWE 2011a), so on-going logging on the steep slopes above Traralgon Creek and Cooks Gully Flora Reserves could impact on such establishment or persistence.

Key threats

An extended period without a protective canopy might be detrimental to this species, and logging and increased fire frequency are listed as threats (DPIPWE 2011a).

Management recommendations

- Buffer areas around reserves should be strictly adhered to, to ensure that wet, shady conditions are re-established and maintained
- Opportunistic monitoring in the coming years to determine if some of these ferns re-establish, particularly at Traralgon Creek Flora Reserve.

Figure 9. Dead *Cyathea cunninghamii* trunk, Traralgon Creek Flora Reserve, 27/9/2011.



3.20 *Derwentia nivea* – Milfoil Speedwell (r)

Local habitat

Derwentia nivea is a semi-woody shrub scattered in alpine and sub-alpine areas, often in disturbed habitats (Walsh and Entwisle 1999). During the current surveys this species was widespread across the Lake Mountain plateau and Mt Bullfight at the interface between snow gum woodland and bog, generally in more open areas (Figure 10). It was found on flat to gentle slopes on a variety of aspects.

In woodlands at Lake Mountain the vegetation consisted of *Eucalyptus pauciflora* commonly over *Prostanthera cuneata*, *Scaevola hookeri*, *Poa ensiformis*, *Olearia algida*, *Tasmannia xerophila* and *Geranium potentilloides*. Towards bog margins the associated vegetation included *Callistemon ptyoides*, *Sphagnum cristatum*, *Isolepis* spp., *Gonocarpus micranthus*, *Baeckea latifolia*, *Empodisma minus* and *Epacris paludosa*. Species composition differed slightly at Mt Bullfight, and depending on location included *Bossiaea foliosa*, *Poa costiniana*, *Richea continentis*, *Leptospermum grandifolium* and *Pultenaea muelleri*.

Mode of regeneration

This species was regenerating from seed in large numbers, consistent with previously described responses to fire (ASP 2011). Many individuals were large (to 70 cm around two years post-fire, with multiple stems), but we found no evidence that any were resprouting from burnt parent material. Many plants were flowering at the time of the survey (two years post-fire).

Key threats

No obvious threats noted, and regenerating plants were locally common.

Management recommendations

None at this stage.

Figure 10. *Derwentia nivea*, Lake Mountain, 19/1/2011.



3.21 *Epacris microphylla* var. *rhombofolia* – Mountain Coral Heath (r)

Local habitat

This is a slender shrub to around 2 m high, confined in Victoria to a few areas of high elevation bog and wet heath between Blue Range and Snowy Range (Walsh and Entwisle 1996). In the current surveys it was uncommon and scattered at the edges of streams and bogs at Mt Bullfight and within the O'Shannassy Catchment. Associated species depended on the location. In the O'Shannassy Catchment they included *Leptospermum grandifolium*, *Richea* sp., *Baeckea gunniana*, *Scaevola hookeri*, *Isolepis* sp., *Gonocarpus micranthus*, *Juncus* sp., *Luzula modesta*, *Carex blakei*, *Epacris paludosa* and *Empodisma minus*. *Nothofagus cunninghamii* was sometimes present in the treeline. At Mt Bullfight, associated species included *Empodisma minus*, *Baeckea gunniana*, *Poa costiniana*, *Gonocarpus micranthus*, *Scaevola hookeri*, *Carex blakei* and *Sphagnum cristatum*. *Epacris petrophila*, normally found at a higher elevation than *E. microphylla* var. *rhombofolia*, has an interesting co-occurrence here at Mt Bullfight (Tolsma and Shannon 2009).

Mode of regeneration

Regenerating by seed (Figure 11), and usually in low numbers. Seedlings remained small two years post-fire at only 3–7 cm high, and are likely to remain reproductively immature for some years.

Figure 11. *Epacris microphylla* var. *rhombofolia* seedling at Mt Bullfight, 25/2/2011.



Key threats

Several *Salix cinerea* (Grey Sallow willow) plants were observed near populations at Blue Range Rd and at Mt Bullfight. Weeds are of concern in these high-altitude wetlands, because they are highly susceptible to invasion for prolonged periods after disturbance (McDougall 2007). Willows in particular established in large numbers after the 2003 and 2006/2007 fires (McMahon *et al.* 2009; Tolsma 2009), and have the capacity to fundamentally alter the hydrological functioning of wetlands. Deer wallows were also evident at Mt Bullfight and could impact on populations given the small number of wetlands and the low abundance of regenerating plants. This feral pest is believed to be in high numbers in the Yarra Ranges (Forsyth *et al.* 2009).

Populations will also remain vulnerable to another fire until such time as they reach reproductive age and can re-establish a viable seed store.

Management recommendations

- Search all wetlands in study area for willows and remove them. Searching is best undertaken in autumn when the leaves begin to turn yellow
- Measure/clarify and manage (if practical) deer activity at Mt Bullfight
- Protect area from another fire until plants can re-establish viable seed stores.

3.22 *Epacris petrophila* – Snow Heath (r)

Local habitat

Epacris petrophila is an erect shrub to around 80 cm high that grows in frost hollows and around the margins of bogs and pools (Walsh and Entwisle 1996). It is known only from around Lake Mountain, the Baw Baw Plateau and Mt Howitt.

In the current surveys it was scattered and locally uncommon at the edge of pools and in raised areas within wetlands at Mt Bullfight (Figure 12). Associated species included *Poa costiniana*, *Oreomyrrhis eriopoda*, *Asperula gunnii*, *Empodisma minus* and *Gonocarpus micranthus*. *Epacris microphylla* var. *rhombofolia* also occurs at Mt Bullfight (Tolsma and Shannon 2009).

The area was patchily burnt, with fire severity considered low to moderate.

Mode of regeneration

This species was expected to regenerate from seed, consistent with other species within the genus. However, extensive searching failed to find any seedlings in the vicinity of burnt parents. It is not known if this species has particular germination requirements that are not yet being met, or if the fire was simply not hot enough to stimulate seed germination.

Key threats

No obvious threats were observed. The absence of seedlings is of concern, but it is not known whether the species would benefit from a hot fire, or no fire, or merely additional time.

Management recommendations

- Monitor known populations and determine if seedlings establish in later years as conditions change.

Figure 12. Unburnt *Epacris petrophila* at Mt Bullfight, 25/2/2011.



3.23 *Eucalyptus alligatrix* subsp. *alligatrix* – Silver Stringybark (includes *E. alligatrix* s.l.) (r)

Local habitat

This species is a rough-barked tree to 15 m high, with a very restricted distribution around the Jamieson – Big River area in Victoria (Walsh and Entwisle 1996; ANBG 2011).

One known population found was on a flat area between the Big River and Big River Rd, in the Murrindindi fire area. Associated vegetation included *Eucalyptus viminalis* over *Acacia dealbata*, *Pomaderris aspera*, *Microlaena stipoides*, *Lomandra longifolia*, *Coprosma quadrifida*, *Gonocarpus tetragynus*, *Clematis aristata* and *Dichondra repens*.

Weeds were common, reflecting proximity to the road, and these included *Anthoxanthum odoratum*, *Hypochaeris radicata*, *Plantago lanceolata*, *Holcus lanatus* and *Rosa rubiginosa*. Another population extended up a ridge with moderate NNW slope on the south side of Eildon-Jamieson Rd. Associated species here included *Eucalyptus radiata*, *Eucalyptus viminalis* and *Eucalyptus dives* over *Acacia dealbata*, *Exocarpos cupressiformis*, *Lomandra longifolia*, *Poa sieberiana*, *Acrotriche prostrata*, *Hibbertia obtusifolia*, *Pimelea linifolia*, *Viola hederacea*, *Dianella revoluta*, *Pteridium esculentum*, *Gonocarpus tetragynus*, *Coprosma quadrifida*, *Cassinia aculeata* and *Hardenbergia violacea*.

Mode of regeneration

This species appeared to be resilient to fire, as it was regenerating both from seed and vegetatively (Figure 13). Seedlings were observed to 2.5 m high, although they were not abundant, probably reflecting the sparse number of adults. Mature plants survived the fire and were coppicing along the trunk and lower branches to a height of around 15 m, depending on scorch height. One burnt juvenile with a DBH of ~2.5 cm was observed to be resprouting from near the base.

Figure 13. Coppice on trunk of *Eucalyptus alligatrix* subsp. *alligatrix* beside Big River, 21/1/2011.



Key threats

No obvious threats observed, and weeds that were present are unlikely to hinder post-fire recovery.

Management recommendations

- No obvious recommendations at this stage.

3.24 *Eucalyptus fulgens* – Green Scentbark (r)

Local habitat

Eucalyptus fulgens is a tree to 20 m tall that in Victoria is found between Healesville and the Latrobe Valley (Walsh and Entwisle 1996).

Four known populations were located along the Kinglake-Glenburn Rd in the Murrindindi fire area, on a gentle slope leading towards the creek. Associated species common to all sites included *Eucalyptus obliqua* and *Eucalyptus radiata* over *Pultenaea gunnii*, *Acrotriche prostrata*, *Tetrarrhena juncea*, *Lomatia ilicifolia*, *Coprosma quadrifida* and *Viola hederacea*. Two additional populations in this area were not found, most likely due to incorrect grid references. Two small known populations were found in the area of the Bunyip fire, where associated species varied. At one location they included *Eucalyptus radiata* over *Gahnia sieberiana*, *Gleichenia dicarpa*, *Lepidosperma filiforme*, *Empodisma minus*, *Platysace heterophylla* var. *heterophylla*, *Xanthosia dissecta*, *Acacia oxycedrus*, *Patersonia* sp. and *Tetrarrhena juncea*. At the second location, associated species included *Eucalyptus cephalocarpa* over *Gahnia radula*, *Acacia oxycedrus*, *Tetrarrhena juncea*, *Melaleuca squarrosa*, *Gonocarpus tetragynus*, *Bauera rubiginosa* and *Empodisma minus*.

Mode of regeneration

Regenerating by seed (Figure 14) and vegetatively. Adults survived the fire and displayed epicormic resprouting from trunks and larger branches depending on flame height. No fruit or buds were observed on epicormic growth. Some saplings also appeared to have survived, with one appearing to be recoppicing after being knocked over by roadside mowing. A small number of seedlings was found, most in open areas away from canopy shade, and these were up to 30 cm high two years post-fire.

Figure 14. *Eucalyptus fulgens* seedling at Kinglake, 24/5/2011.



Key threats

No obvious threats were noted. A shortage of seedlings could be cause for concern in the event that another fire impacts on existing mature plants.

Management recommendations

- Monitor seedling regeneration.

3.25 *Eucalyptus kitsoniana* – Bog Gum (r)

Local habitat

This is a small, smooth-barked, mallee-like tree growing to around 8 m high, endemic to Victoria and found on coastal lowlands between Portland and Yarram (Walsh and Entwisle 1996).

A known population of around 100 mature plants was found on sandy loam soil at Wilsons Promontory, on a moderate northerly slope leading into a shallow drainage line, 150 m north of Five Mile Rd. Associated species included *Leptospermum continentale*, *Gahnia radula*, *Gleichenia dicarpa*, *Pteridium esculentum*, *Baumea* spp, *Xanthosia tridentata*, *Empodisma minus*, *Allocasuarina* spp, *Patersonia glabrata*, *Correa reflexa*, *Xanthosia tasmanica* and *Acacia myrtifolia*.

Mode of regeneration

Seedlings and sprouts were observed. Scattered seedlings had reached up to 80 cm high within two years of fire, but were typically ~30 cm. Adults possessed a Mallee habit as previously described (Walsh and Entwisle 1996), and were ~8 m high prior to the fire. Adult trees were top-killed and were resprouting vigorously from the base (Figure 15). Multiple sprouts were already up to 3 m high within two years post-fire and bearing buds, suggesting a relatively rapid return to reproductive maturity. One small juvenile around 10 mm diameter at base was also resprouting, suggesting that this species is resilient to at least a single fire.

Key threats

No obvious threats noted. Plants were regenerating vigorously.

Management recommendations

- No specific actions required.

Figure 15. *Eucalyptus kitsoniana* resprouting at Wilsons Promontory, 21/2/2011.



3.26 *Eucalyptus willisii* supsp. *willisii* – Promontory Peppermint (r)

Local habitat

This is a tree to 15 m high, or mallee, endemic to Victoria, and found on sandy plains or granite hills along the coast east of Cranbourne (Walsh and Entwisle 1996).

A small, known population was located on a gentle westerly slope on sandy soil, south of Five Mile Road, Wilsons Promontory. Associated species included *Eucalyptus baxteri* over *Xanthorrhoea minor*, *Leptospermum continentale*, *Banksia spinulosa*, *Dillwynia glaberrima*, *Hakea decurrens*, *Allocasuarina* spp, *Hypolaena fastigiata*, *Xanthosia tridentata*, *Schoenus lepidosperma*, *Platysace heterophylla* var. *heterophylla*, *Tetradlea pilosa*, *Billardiera scandens* and *Baumea* spp.

Mode of regeneration

Regenerating by seed (Figure 16) and vegetatively. Mature trees survived the fire, and displayed epicormic shoots on trunks and upper branches. Five seedlings were found, to 40 cm high, two years post-fire. Dense post-fire regeneration, including of *Eucalyptus baxteri*, made searching difficult and might also suppress seedling growth.

Key threats

No obvious threats noted. General vegetation was regenerating vigorously.

Management recommendations

- Monitor seedlings, as dense post-fire regrowth of surrounding trees and shrubs might hinder them.

Figure 16. *Eucalyptus willisii* supsp. *willisii* seedling at Wilsons Promontory, 21/2/2011.



3.27 *Euchiton umbricola* – Cliff Cudweed (r)

Local habitat

This uncommon species is generally found on rocky outcrops and rock ledges near streams (Mueck 1990). It is normally found in areas above around 1000 m, but also occurs disjunctly at lower elevation in Kinglake National Park (Walsh and Entwisle 1999).

An existing FIS quadrat in Kinglake National Park appeared to be located on a steep cliff beside Masons Creek (Figure 17), and it was considered unsafe and impractical to undertake a search. Plants are unlikely to have been burnt by the fire, given their position. An additional known population in this fire area had a quoted accuracy of 5000 m, and cannot be located without much better information.

Mode of regeneration

Not confirmed. May utilise both seed regeneration and resprouting, as this species is stoloniferous (Walsh and Entwisle 1999).

Key threats

None likely, given its relatively protected location.

Management recommendations

- No management actions appear to be required.

Figure 17. Recorded habitat of *Euchiton umbricola*, Kinglake National Park, 17/1/2011



3.28 *Exocarpos syrticola* – Coast Ballart (r)

Local habitat

This is a shrub to around 3.5 m tall, confined to coastal dunes and cliffs at, and west of, Wilsons Promontory (Walsh and Entwisle 1999).

A known population contained mature plants in a small unburnt patch towards the end of Limestone Track, Wilsons Promontory, near the top of shallow old dunes. Similar locations on the surrounding burnt dunes were searched but no juveniles were found. Surrounding vegetation included *Leptospermum laevigatum*, *Leucopogon parviflorus*, *Acacia sophorae*, *Hibbertia* sp., *Senecio pinnatifolius*, *Rhagodia candolleana*, *Corybas* sp. and *Chrysocephalum baxteri*.

Additional populations were found along the eastern side of Wilsons Promontory Road, south of the entrance gate, on sandy soils within shallow dunes. Mature plants were only found in unburnt patches, where they were locally common, while juveniles were found in the unburnt patches and a small, lightly burnt zone within ~2.5 m of the main burn boundary. No juveniles were found in equivalent locations in more severely burnt areas. Surrounding vegetation here included *Leptospermum laevigatum*, *Leucopogon parviflorus*, *Hibbertia sericea*, *Ficinia nodosa*, *Crassula sieberiana*, *Muehlenbeckia adpressa*, *Senecio pinnatifolius*, *Kennedia prostrata* and *Pultenaea mollis*.

Mode of regeneration

Juveniles consisted of root 'suckers' to ~80 cm high (typically 30–40 cm), mostly clustered within 4 m of mature plants (Figure 18). In burnt areas, juveniles were only found in a lightly burnt zone within ~2.5 m of unburnt vegetation. No juveniles were found further into the burn area.

Key threats

Deer rubbing was observed on one mature plant near the end of Limestone Track. Some browsing on juveniles was noted, but it was not possible to determine whether this was by native or introduced animals.

Management recommendations

- Monitor deer populations and undertake control if required.

Figure 18. Resprouting *Exocarpos syrticola*, Wilsons Promontory, 28/10/2010.



3.29 *Gahnia grandis* – Brickmaker's Sedge (v)

Local habitat

Gahnia grandis is a robust, tussock-forming perennial to 3 m high, which grows in damp, shaded sites near streams and swamps in only two areas in Victoria (near Gembrook and at Wilsons Promontory) (Walsh and Entwisle 1994). In the current surveys it was found only in an unburnt area in Bunyip State Park.

Mode of regeneration

Not confirmed, as no plants were found in burnt areas. It would be expected to regenerate by resprouting, consistent with it being rhizomatous, and also by seed (Walsh and Entwisle 1994; DPIW 2011).

Key threats

Not known. No plants were found in burnt areas.

Management recommendations

- Opportunistic future searches to confirm post-fire recovery.

3.30 *Gaultheria hispida* – Snow-berry (e, L)

Local habitat

This is a small shrub to around 1.6 m high (Walsh and Entwisle 1996), recorded only from the Otway Ranges and Lake Mountain (FIS 2007).

The single known population at Lake Mountain was not located. This record possibly involved a taxonomic error, as the species is considered unlikely to be in this area, and is very similar to the alpine *Gaultheria appressa* (Walsh and Entwisle 1996). Another 1994 roadside record from the Otway Ranges may have resulted from an inadvertent importation from Tasmania (Walsh and Entwisle 1996), casting doubts on the natural occurrence of this species in Victoria.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage.

3.31 *Goodia pubescens* – Silky Golden-tip (r)

Local habitat

This species was, until recently, known as *Goodia lotifolia* var. *pubescens* (Thompson 2011). It is a shrub to 4 m high (although Thompson 2011 cites 2 m), and occurs sporadically in dry and wet sclerophyll forests in south-west and central Victoria (Walsh and Entwisle 1996). In the current surveys it was locally abundant post-fire on a range of soils, slopes and aspects, including steep easterly slopes and gentle south-westerly slopes in the Kinglake and Mount Richmond fire areas (Figure 19).

At Kinglake, associated vegetation differed according to location, but commonly included *Eucalyptus cypellocarpa* and *Eucalyptus obliqua* over *Goodenia ovata*, *Coprosma quadrifida*, *Cassinia aculeata* and *Tetrarrhena juncea*. Other common species, depending on location, included *Pteridium esculentum*, *Pomaderris aspera*, *Viola hederacea*, *Pultenaea scabra*, *Acacia melanoxylon* and *Acacia verticillata*.

A known population was also confirmed within the Lower Glenelg National Park in a gully south of Normanby Track. Associated species here included *Eucalyptus obliqua* and *Eucalyptus ovata* over *Acacia melanoxylon*, *Coprosma quadrifida*, *Leptospermum continentale*, *Lomandra longifolia*, *Viola hederacea*, *Geranium potentilloides*, *Pteridium esculentum*, *Gonocarpus teucrioides* and *Acrotriche serrulata*.

Mode of regeneration

Regenerating prolifically from seed over large areas, with one population at Kinglake consisting of more than 20,000 plants spread out over an area approximately 200 m x 130 m. Seedlings at Kinglake had reached 2.5 m in height within two years of the fire, but there was no sign of flowering at that time. Some plants were large and multi-stemmed, but no evidence of resprouting was found and these were also assumed to be seedlings.

In the Lower Glenelg National Park, seedlings in September 2011 (around 2 ½ years post-fire) were up to 2 m high and were flowering. Possible resprouting was observed here, as one shrub had five well-separated stems. This species has been known to resprout after fire from rhizomes (pers. comm., David Cameron, BES).

Key threats

No obvious signs of browsing or other threats: indeed, the number of plants would suggest browser satiation. The proportion of soil-stored seed that germinated post-fire is unknown. Numerous plants near Kinglake were located in a salvage logging coupe, but these were of a similar size to plants outside the coupe, suggesting they were not burnt a second time by the logging operation. We assume that an additional fire before plants accumulate a viable soil seed bank is likely to impact adversely on recovering populations.

Management recommendations

- Ensure populations are protected from fire until such time as a viable seed store is re-established.

Figure 19. *Goodia pubescens*, Kinglake National Park, 10/10/2011



3.32 *Grevillea barklyana* – Gully Grevillea (v, L)

Local habitat

Grevillea barklyana is a large-leaved, tall shrub with a very restricted distribution around the Bunyip area in Victoria (Mueck 1990; DSE 2004). The species may be locally common, and is not restricted to gullies as its name implies (DSE 2004).

Populations found during current surveys were generally confined to well-drained locations in the Bunyip area on hill slopes above drainage lines or along the top of small road embankments, often with a predominantly northerly to westerly aspect (in contrast to the predominantly southerly aspect cited in DSE 2004). Few plants were found in lower or flatter areas that were less well-drained.

Surrounding vegetation generally consisted of *Eucalyptus sieberi* and *Eucalyptus obliqua* (sometimes *Eucalyptus regnans*) over *Goodenia ovata*, *Scaevola aemula*, *Pultenaea forsythiana*, *Lepidosperma laterale*, *Dampiera stricta*, *Acacia falciformis* and *Pteridium esculentum*. *Gahnia radula*, *Tetrarrhena juncea*, *Correa reflexa* and *Spyridium parvifolium* were also common at some sites. Dense *Eucalyptus sieberi* regeneration to ~2.5 m high was present at some sites.

Figure 20. *Grevillea barklyana*, Bunyip State Park, 19/10/2010.



Mode of regeneration

This species is considered to be an obligate seeder, with no canopy storage of seeds, that requires fire to germinate (DSE 2004), although a small proportion of seeds will nonetheless germinate without fire (Edwards and Whelan 1995). Seeds are found only in the soil directly under the canopy of the parent plants (Edwards and Whelan 1995), hence populations have little ability to spread.

As expected, *Grevillea barklyana* was regenerating profusely by seed (Figure 20), with one population exceeding 10,000 plants and extending for around 800 m along a road. There was no obvious sign of resprouting. No buds or flowers were observed on the recruits, consistent with them not yet having reached reproductive maturity. Seedlings had reached a height of up to 2 m within two years post-fire (although typically ~1 m) and ~15 mm diameter at the base.

Key threats

No obvious signs of browsing were observed. In any event, seedlings were in sufficient abundance that this would be unlikely to pose any threat to the populations. Plants were not reproductively mature, and it is not known whether viable seeds still remain in the soil. Another fire before they reach maturity may severely impact on the populations, and they should be protected from such a possibility.

By March 2011, many seedlings were showing signs of stress, with discolouration and drying of leaves, particularly at the tips (Figure 21). The reasons for this are unclear, but could include leaf skeletonising caterpillars or a lack of suitable site conditions (for example, poor drainage) (pers. comm., Peter Olde, Grevillea Study Group, Australian Plants Society, Victoria). In any event, given such dense, post-fire regeneration, a large number of seedlings that germinate are not expected to survive to maturity. *Phytophthora* infection was not tested for but remains a possibility, as some *Grevillea* species are susceptible to this disease (Peters 1994).

Figure 21. *Grevillea barklyana* seedlings under stress, Bunyip State Park, 8/3/2011.



Management recommendations

- Protect populations from additional fire until plants have reached reproductive maturity and have had sufficient time to establish a viable soil seed-bank
- Hygiene protocols for *Phytophthora* infection be observed around all populations in case of possible infestation
- Refer also to the Action Statement (DSE 2004).

3.33 *Grevillea chrysophaea* – Golden Grevillea (r)

Local habitat

This species is a spreading shrub to around 2.5 m high, endemic to Victoria, and usually growing in eucalypt woodland or heath with sandy soils (Walsh and Entwisle 1996).

Known populations of this species had been recorded within the Traralgon South Flora and Fauna Reserve. The first, (and possibly unlikely), previously known location searched was within dense post-fire regrowth on sandy soils in a low-lying area off North South Track, but no plants were found. We checked a more likely area on a ridge 250 m to the north-east, also without success. The vegetation here included *Eucalyptus obliqua* over *Acacia terminalis*, *Pteridium esculentum*, *Leptospermum continentale*, *Gahnia radula*, *Bossiaea cinerea*, *Epacris impressa*, *Banksia serrata*, *Amperea xiphoclada* and *Correa reflexa*. A walking track south-west of Centre Road was also searched without success.

Mode of regeneration

Not confirmed. However, it is known to recruit readily from seed (Peters 1994).

Key threats

This species is highly susceptible to Cinnamon Fungus (*Phytophthora cinnamomi*), most likely because of the suitable conditions for the spread of this pathogen in sandy soils (Peters 1994). Populations of *Grevillea chrysophaea* continued to decline even in old infection sites, suggesting difficulty in recovering post-infection.

Management recommendations

- Hygiene protocols to be observed around all populations, to help protect them from *Phytophthora* infection
- Opportunistic searching to attempt to detect this species.

3.34 *Grevillea monslacana* – Lake Mountain *Grevillea* (r)

Local habitat

This species was once contained within *Grevillea victoriae* (Stajsic and Molyneux 2005). It is a spreading to erect shrub to 3.5 m high, endemic to Victoria, and restricted to montane and sub-alpine areas around Marysville – Lake Mountain (Stajsic and Molyneux 2005).

During the current surveys, two known populations and one new population were found on moderate north to north-westerly slopes at Lake Mountain. Associated species differed substantially between the two known populations. At one site they included *Eucalyptus delegatensis* and *Eucalyptus pauciflora* over *Phyllothea* sp., *Acacia obliquinervia*, *Prostanthera melissifolia*, *Pultenaea muelleri*, *Viola hederacea*, *Poa ensiformis*, *Olearia phlogopappa*, *Dryopoa dives* and *Gonocarpus tetragynus*. At the second site, species included *Eucalyptus pauciflora* over dense *Acacia alpina*, *Phyllothea* sp., *Scaevola hookeri*, *Stylidium graminifolium*, *Prostanthera cuneata* and *Geranium potentilloides*.

Mode of regeneration

Regenerating profusely from seed (Figure 22), with one population of over 1000 plants below Gerraty's carpark extending for ~100 m along the road. Within two years of the fire seedlings were up to 50 cm high, but there was no evidence of budding or flowering yet. At the first site, seedlings will be competing with dense regrowth of *Acacia obliquinervia*. This species is not known to resprout, and parent plants are killed outright by fire (Stajsic and Molyneux 2005).

Key threats

No obvious threats were noted, although populations are likely to suffer should there be another fire before seedlings reach viable maturity and have time to re-establish adequate seed stores. Some sections of the population might also be susceptible to any future road widening or carpark expansion.

Management recommendations

- Protect populations from further fire until such time as they have reached viable reproductive maturity
- Ensure future road widening or carpark expansion do not impact on populations.

Figure 22. *Grevillea monslacana* seedlings, Lake Mountain, 20/1/2011.



3.35 *Grevillea repens* – Creeping Grevillea (r)

Local habitat

This is a prostrate or mat-forming shrub to around 3 m across, endemic to Victoria, and found in shallow, clayey soils in a few areas north-east and north-west of Melbourne (Walsh and Entwisle 1996). During the current surveys, populations were mostly found on and above road embankments in the Kinglake to Toolangi area, with a predominantly easterly to north-westerly aspect. Drainage appears important, as plants found away from embankments were often on raised areas. Generally found in open areas not covered by dense canopy or post-fire regrowth, particularly towards the very edge of the embankment. Soils varied from stony clay to loam.

At a known unburnt population on Captains Creek Rd, near Kinglake, only one plant was found after searching an area ~500 x 25 m. It is not known whether plants have senesced there after being long-unburnt.

Most locations were characterised by an open overstorey and sparse ground layer, although associated species varied. The overstorey was generally *Eucalyptus macrorhyncha* and/or *Eucalyptus dives*, while common understorey species included *Acrotriche prostrata*, *Dampiera stricta*, *Dillwynia phyllicoides*, *Gonocarpus tetragynus*, *Lomandra filiformis*, *Lomatia ilicifolia* and *Pteridium esculentum*. Other understorey species which were locally common, depending on location, included *Rhytidosporum procumbens*, *Lepidosperma laterale* and *Correa reflexa*.

Mode of regeneration

Resprout and seed. Some larger plants (Figure 23) appear to have resprouted from below ground at the base of the stem, while some smaller plants appeared to be seedlings. No plants were observed flowering within two years of the fire, but they were in bud by September 2011.

Figure 23. *Grevillea repens*, Kinglake National Park, 11/1/2011



Key threats

The concentration of plants on and above road embankments suggests that some populations are potentially threatened by road widening. However most roads are minor tracks in areas of forest or park, so that event would be unlikely. There was no obvious browsing of plants, possibly reflecting saturation of browsers by surrounding high levels of post-fire regrowth, or the prostrate nature of the species.

Management recommendations

- Ensure any road widening does not impact on populations.

3.36 *Hakea decurrens* subsp. *platytaenia* – Coast Needlewood (r)

Local habitat

This is a stunted to erect shrub to 2 m high, occurring in coastal heathlands at Wilsons Promontory and Mallacoota (Walsh and Entwisle 1996). In the current survey it was found beside Tongue Point walking track, Wilsons Promontory, on sandy soil with steep WNW aspect. Associated species included *Spyridium parvifolium*, *Allocasuarina stricta*, *Lepidosperma gladiatum*, *Correa reflexa*, *Leptospermum laevigatum*, *Pultenaea daphnoides* and *Kennedia prostrata*.

Mode of regeneration

Eight seedlings were found, to 60 cm high within two years of fire, but with no sign of flowering. Four dead parents to 2.5 m high were found along the track within a distance of ~40 m, suggesting that the pre-fire population here was small.

Key threats

No obvious threats other than repeat fire before viable seed stores are re-established.

Management recommendations

- Protect population from another fire prior to plants reaching viable maturity.

3.37 *Haloragis myriocarpa* – Prickly Raspwort (v)

Local habitat

This is an erect, perennial herb confined to a few wet areas in western Victoria (Walsh and Entwisle 1996).

The recorded location of a known population led to a gully south of Normanby Track, Lower Glenelg National Park. This was not the swampy vegetation suggested by the original quadrat sheet, and the grid reference appears wrong. The population was not found.

Mode of regeneration

Not confirmed, and little is known about its life history or ecology (DPIWE 2003).

Key threats

Not known. It is susceptible to grazing (DPIWE 2003), which in this area should only be by native herbivores.

Management recommendations

None at this stage.

3.38 *Herpolirion novae-zelandiae* – Sky Lily (r)

Local habitat

This is a rhizomatous, mat-forming perennial, found in moist, peaty herbfield and grassland throughout the alpine region (Walsh and Entwisle 1994).

At Lake Mountain the population consisted of a dense 'lawn' of plants in a flat, barely burnt area beside shallow pools west of Echo Flat Track. Associated species included *Poa costiniana*, *Luzula* sp., *Carex blakei*, *Craspedia ?jamesii*, *Prasophyllum alpinum*, *Gonocarpus micranthus*, *Ranunculus* spp. and *Asperula gunnii*.

At Mt Bullfight plants were found on raised areas within bogs or at the edge of pools in wet grassland (Figure 24). Associated species there included *Bossiaea foliosa*, *Scaevola hookeri*, *Poa costiniana* and *Carex blakei*. *Empodisma minus* and fire-killed *Richea continentis* were sometimes present.

Mode of regeneration

Plants are rhizomatous (Walsh and Entwisle 1994), and their location in low, wet areas probably ensured that some survived unburnt. Plants appear to be resprouting from those rhizomes, but it is difficult to determine what proportion, if any, might be regenerating from seed. Individual plants were not flowering at the time of the survey, although photographs in the Lake Mountain visitor centre indicated that this species had already flowered in the year after the fire.

Key threats

No obvious threats noted.

Management recommendations

None at this stage.

Figure 24. *Herpolirion novae-zelandiae*, Mount Bullfight, 25/2/2011.



3.39 *Hibbertia hirticalyx* – Bass Guinea-flower (r)

Local habitat

This species was previously known within *Hibbertia aspera*, and usually grows in sandy soil on wet seepage areas at Wilsons Promontory (Toelken 1998).

Known populations were found on banks and stream flats on sandy soils within a few metres of Barry Creek, Wilsons Promontory, and in a shallow drainage line south of Five Mile Road. An additional population was located on a moderate slope well above a stream, suggesting that it is not a uniquely riparian species.

Associated species varied depending on the location. In riparian locations, common species included *Eucalyptus obliqua* and/or *Eucalyptus baxteri* over *Gahnia radula*, *Leptospermum continentale*, *Allocasuarina* spp., *Xanthosia tridentata*, *Billardiera scandens*, *Pteridium esculentum*, *Gonocarpus teucrioides* and *Banksia serrata*/*Banksia marginata*.

Away from the riparian zone, species included *Eucalyptus obliqua* and *Eucalyptus dives* over *Pteridium esculentum*, *Pultenaea daphnoides*, *Acacia verticillata*, *Gonocarpus teucrioides*, *Tetrarrhena juncea*, *Elaeocarpus reticulatus*, *Lepidosperma elatius*, *Correa reflexa*, *Viola hederacea* and *Goodenia ovata*.

Mode of regeneration

Regenerating by resprout and seed. Clearly identified basal resprouts, resprouting from just below the surface, were up to ~ 120 cm high within two years of fire. Larger individuals were flowering (Figure 25). There was also a mix of smaller seedlings and root resprouts (the majority appeared to be resprouts, but it was difficult to confirm ratios without undue destruction), to 50 cm high, typically 10–20 cm. Some of these were also flowering.

Figure 25. *Hibbertia hirticalyx*, Wilsons Promontory, 28/10/2010.



Key threats

No signs of browsing were observed, and no other threats noted.

Management recommendations

None at this stage.

3.40 *Lastreopsis hispida* – Bristly Shield-fern (r)

Local habitat

This is a rhizomatous fern to around 85 cm tall, restricted to wet forests in the Otway ranges and in mountains east of Melbourne (Mueck 1990; Walsh and Entwisle 1994).

Three known populations were found in a gully beside Tarago River in the Bunyip fire area. Plants were growing on saturated gravelly (almost bare) soil, on moss-covered rocks and as epiphytes on tree fern trunks (Figure 26). The understorey was only lightly burnt, and plants that were fire-killed had been growing above around 0.5 m height on tree fern trunks. Some new plants had established below the scorch line. Two additional known populations were recorded in separate steep, burnt gullies, but dense regeneration and fallen logs prevented searching. Another, unburnt population was also re-located.

Associated species generally included *Eucalyptus regnans* over *Nothofagus cunninghamii*, *Dicksonia antarctica*, *Acacia dealbata*, *Todea barbara*, *Prostanthera lasianthos*, *Australina pusilla* subsp. *muelleri*, *Bedfordia arborescens*, *Atherosperma moschatum*, *Hydrocotyle geraniiifolia* and *Blechnum watsii*.

Mode of regeneration

New growth on tree fern trunk was presumably from spores, consistent with many other epiphytic ferns.

Key threats

No obvious threats observed. The location of the populations ensured that plants were largely protected from being severely burnt.

Management recommendations

None at this stage.

Figure 26. *Lastreopsis hispida* on tree fern, Bunyip State Park, 19/10/2010.



3.41 *Leionema bilobum* subsp. *serrulatum* (subsp. 3, West Gippsland) – Toothed *Leionema* (r)

Local habitat

This species was previously known within *Leionema bilobum* (Duretto *et al.* 2006). It is a dense shrub or small tree to around 4 m high, which grows in wet sclerophyll forest or riparian open forests in the Eastern or Central Highlands, often on steep slopes (Duretto *et al.* 2006).

In the current surveys, the largest population of plants in the burnt area (around 1000 individuals) was centred across an earlier bulldozer cut (of unknown purpose) on a north-west facing slope on gravelly loam in the Bunyip State Park. In this location, plants were generally in the open with little shade from the canopy, and individuals dropped out rapidly as other vegetation thickened. The preference for open, possibly disturbed areas by this species was noted in other research in the Strzelecki Ranges in South Gippsland (Wright *et al.* 2011). Associated vegetation at the burnt Bunyip population included *Eucalyptus obliqua* over *Zieria arborescens*, *Prostanthera lasianthos*, *Acacia dealbata*, *Pomaderris aspera*, *Scaevola aemula*, *Pultenaea forsythiana*, *Acacia falciformis*, *Gonocarpus teucrioides* and *Tetrarrhena juncea*.

Five new populations were also found within this fire area, of which one did not appear to have been burnt. This latter population contained mature, flowering plants to 2 m high, and extended several hundred metres along the road. Associated species here included *Eucalyptus sieberi*, *Eucalyptus obliqua* and *Eucalyptus cypellocarpa* over *Cyathea australis*, *Polyscias sambucifolia*, *Tetrarrhena juncea*, *Lepidosperma elatius*, *Goodenia ovata*, *Prostanthera lasianthos*, *Clematis aristata* and *Pteridium esculentum*. Burnt areas, depending on location, also included *Dampiera stricta*, *Pultenaea mollis*, *Grevillea barklyana*, *Spyridium parvifolium*, *Gonocarpus teucrioides*, *Scaevola aemula* and *Acacia obliquinervia*.

Figure 27. *Leionema bilobum* subsp. *serrulatum*, Bunyip State Park, 10/3/2011.



In the O'Shannassy Catchment to the north of the study area, smaller numbers of plants were found, scattered within dense post-fire regrowth. Species differed substantially in the O'Shannassy Catchment, with the overstorey including *Eucalyptus nitens*, *Eucalyptus obliqua* or *Eucalyptus regnans*, with the understorey commonly including *Acacia frutescens* and *Polyscias sambucifolia*.

Mode of regeneration

Plants found were regenerating by seed (Figure 27). Seedlings were up to ~150 cm high within two years of fire, but typically ~60 cm. No flowers or buds were observed on seedlings by September 2011. Adult plants to 2 m high with flowers were found only in the unburnt area. This species actively reproduces from suckers (Duretto *et al.* 2006), so it is possible that some post-fire resprouting may have occurred.

Key threats

The large population off Forest Rd, Bunyip State Park (~1.8 km south of Tarago Rd) straddles a bulldozer cut that (from the road) has the appearance of a track, and may be susceptible to damage by vehicles attempting to drive up it. We suggest that this dead-end 'track' is blocked to prevent such access. Minor browsing was observed on a few plants, but is unlikely to be a problem given the large number of individuals in the population.

Management recommendations

- Block 'track' off Forest Rd to prevent vehicle access.

3.42 *Leptecophylla juniperina* subsp. *oxycedrus* – Crimson berry (v)

Local habitat

This species was previously contained within *Cyathodes juniperina* (Weiller 1999). It is a densely branched shrub to around 3 m high, restricted to granitic areas around Phillip Island and Wilsons Promontory (Walsh and Entwisle 1996).

A single known population assessed during this survey had been protected from the fires by large boulders on the crest along Vereker walking track, Wilsons Promontory (Figure 28).

Associated plants here included *Eucalyptus baxteri* and *Allocasuarina verticillata* over *Epacris impressa*, *Acrotriche serrulata* and *Kunzea* sp.

Mode of regeneration

Not confirmed as plants were not burnt by the 2009 fire. The population included three mature plants to ~ 1.5 m high with flowers and fruit, and four seedlings 10–15 cm high. On-going recruitment suggests that this species does not need fire for its persistence.

Key threats

No obvious threats observed.

Management recommendations

None at this stage.

3.43 *Lindsaea trichomanoides* – Oval Wedge-fern (e)

Local habitat

This is a rhizomatous fern to around 35 cm high, reported from only a few isolated sites at Wilsons Promontory (Walsh and Entwisle 1994). However, known populations searched for at Wilsons Promontory were not found, as locations were too inaccurate.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

- Opportunistic future searches could be undertaken to confirm post-fire recovery.

Figure 28. *Leptecophylla juniperina* subsp. *oxycedrus* at Wilsons Promontory. Photo by Liz Zetzmann, 21/11/2008.



3.44 *Monotoca glauca* – Currant-wood (r)

Local habitat

Monotoca glauca is a small tree to around 7 m high, that grows on infertile, sandy soils in high-rainfall, near-coastal areas such as the Otway Ranges and around Wilsons Promontory (Albrecht 1987; Walsh and Entwisle 1996). It is more extensive in Tasmania, and the present pattern of distribution may be a remnant of a once more extensive distribution (Albrecht 1987).

A known population was searched for at Wilsons Promontory, but was not found.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

- Opportunistic future searches to confirm post-fire recovery.

3.45 *Olearia asterotricha* – Rough Daisy-bush (r)

Local habitat

This is a sprawling shrub to around 2 m high, occurring in a few disjunct areas of south-western Victoria, the Grampians, and the mountains east of Melbourne (Walsh and Entwisle 1999).

During the current surveys, a single plant was found in damp vegetation in a flat, low-lying area under the transmission line that runs through the Bunyip forest area.

Associated species included *Pultenaea weindorferi*, *Austrostipa muelleri*, *Lepidosperma filiforme*, *Lomandra filiformis*, *Hypolaena fastigiata*, *Empodisma minus*, *Xanthosia dissecta*, *Xyris operculata* and *Gahnia radula*.

Mode of regeneration

The plant was flowering, and was approximately 60 cm high around 20 months post-fire. The overall size and branching nature of the plant suggested that it probably resprouted.

Key threats

May be vulnerable to slashing of vegetation under powerlines.

Management recommendations

- Opportunistic monitoring to determine if numbers increase.

3.46 *Oreobolus oxycarpus* subsp. *oxycarpus* – Tuft-rush (r)

Local habitat

This is a small, mat-forming plant to only around 10 cm high, found in bogs and swampy areas in the alpine region (Walsh and Entwisle 1994).

During the current surveys it was found in drainage lines, pools and seasonally-wet depressions within areas of sub-alpine bog vegetation at Mt Bullfight (Figure 29). The wet location will have largely protected the plants from fire, although plants in shallow ephemeral pools may have been burnt.

Commonly associated species included *Sphagnum cristatum*, *Isolepis* spp., *Gonocarpus micranthus* and *Empodisma minus*. Other locally common species, depending on location, included *Callistemon pityoides*, *Carex blakei*, *Scaevola hookeri*, *Poa costiniana*, *Astelia alpina*, *Epacris paludosa* and *Baeckea gunniana*.

Several known locations were searched at Lake Mountain for this species, but without success. Searches were hampered by a lack of flowering material at the time.

Mode of regeneration

This species is rhizomatous, hence can spread vegetatively. However, plants examined were readily pulled from the ground and away from each other, suggesting that rhizomes that may have existed were thin and weak. This made it difficult to determine whether the plants examined were regenerating from seed or vegetatively. At one site on Mt Bullfight the area appeared severely burnt, and regeneration appeared to be from seed. However, where patches were barely burnt they probably spread vegetatively.

Key threats

Some plants showed sign of browsing by deer or rabbits (scats of both animals were found, and large wallows were present). However, the overall impact of browsing was considered to be low.

Management recommendations

None at this stage.

Figure 29. *Oreobolus oxycarpus* subsp. *oxycarpus*, Mount Bullfight, 25/2/2011.



3.47 *Pellaea nana* – Dwarf Sickle-fern (r)

Local habitat

Pellaea nana is a rhizomatous fern with fronds up to around 75 cm long (Walsh and Entwisle 1994). It is found in a wide variety of habitats, often among rocks. A known population recorded at Kinglake was not found.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage.

3.48 *Persoonia arborea* – Tree Geebung (v)

Local habitat

This is a small tree to around 10 m high, found mostly in wet montane gullies in the forests east of Melbourne (Mueck 1990; Walsh and Entwisle 1996).

During the current surveys it was found at various localities in the O'Shannassy Catchment (Murrindindi fire area) and Bunyip fire area. Soils were generally sandy clay loams, on moderate to steep, easterly to south-westerly slopes. Plants were generally found on the edges of road and snig tracks, and dropped out rapidly as the vegetation density increased away from those edges.

Associated vegetation generally comprised *Eucalyptus regnans* and/or *Eucalyptus obliqua* or *Eucalyptus sieberi* over *Acacia obliquinervia*, *Tetrarrhena juncea* and *Polyscias sambucifolia*. Other locally common species, depending on location, included *Pteridium esculentum*, *Zieria arborescens*, *Pomaderris aspera*, *Correa reflexa*, *Prostanthera lasianthos*, *Spyridium parvifolium*, *Lepidosperma elatius*, *Platylobium formosum* and *Gahnia sieberiana*.

Figure 30. *Persoonia arborea* seedling in Bunyip fire area, 10/3/2011.



Mode of regeneration

Individuals examined during the current surveys were regenerating from seed (Figure 30), with seedlings to around 100 cm height (typically 50–60 cm) two years post-fire. This is consistent with the predominant response after the 1939 fires (Mueck *et al.* 1996). No buds or flowers were observed by September 2011, 2 ½ years post-fire. Seedlings were rarely found in denser vegetation, suggesting that this species may be intolerant of competition during or after establishment. Resprouting was not observed, but cannot be discounted. The species is long-lived, with radiocarbon dating suggesting one particular individual was around 370 years old (Mueck *et al.* 1996), and will most certainly have survived several fires.

Some plants to 3 m high were noted in March 2011 in an unburnt logging coupe below Barklyana Track (Bunyip fire area), which also showed no sign of flowering or fruiting, suggesting that time-to-maturity may be long. This is consistent with previous research that suggested only larger individuals are reproductively mature (Mueck *et al.* 1996).

Key threats

Some plants showed signs of browsing, probably by deer, although the overall impact was deemed low. The location of populations on the edges of tracks makes them vulnerable to any track widening. However, it appears to regenerate well after logging (Mueck 1990), suggesting that it should not be disadvantaged by a single disturbance. However, another fire might impact on the population if it occurs before a viable seed store is re-established.

Management recommendations

- Avoid track work that would impact on populations.
- Protect populations from fire until such time as a viable seed store is re-established.

3.49 *Pimelea drupacea* – Cherry Rice-flower (v)

Local habitat

This is a medium-sized shrub to around 3 m high that grows in shady, moist valleys, and in Victoria has been recorded only at Wilsons Promontory (Walsh and Entwisle 1996). A known population within the fire boundary at Wilsons Promontory was in a remote location that required access by boat. Its preferred habitat suggested that it was unlikely to have been burnt.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage.

3.50 *Pneumatopteris pennigera* – Lime Fern (e)

Local habitat

Pneumatopteris pennigera is rhizomatous fern with fronds up to 110 cm long, restricted in Victoria to a few stream sides near the coast west of Port Campbell (Walsh and Entwisle 1994). It is usually found on calcareous soils, as suggested by its common name, Lime Fern (Walsh and Entwisle 1994; DPIPWE 2011c).

In the current surveys it was found on the steep banks of Moleside Creek, Lower Glenelg National Park, just above stream level (Figure 31). One small population was just outside the burn area, while the other was in the base of a protected gully that had been lightly burnt only on the slope above. Associated species, depending on the location, included *Leptospermum lanigerum*, *Coprosma quadrifida*, *Leucopogon lanceolata*, *Pomaderris aspera*, *Polystichum proliferum*, *Blechnum nudum*, *Adiantum* sp, *Hydrocotyle hirta*, *Sambucus gaudichaudiana*, *Cynoglossum australe*, *Rubus parvifolius*, *Microlaena stipoides* and *Pteris tremula*. This is very typical of its habitat (DPIPWE 2011c).

Mode of regeneration

Not confirmed, as populations found had not been burnt. However, it is reported to recruit primarily from spores, with occasional shooting from the base (DPIPWE 2011c).

Key threats

None observed.

Management recommendations

None at this stage.

3.51 *Pomaderris apetala* subsp. *maritima* – Tasman Pomaderris (v)

Local habitat

This is a medium-sized shrub to around 3 m high, restricted to dry coastal vegetation at a few locations such as Wilsons Promontory and the Ninety Mile Beach in Gippsland (Walsh and Coates 1997; Walsh and Entwisle 1999). Two known populations within the fire boundary at Wilsons Promontory had very inaccurate locations (to 2000 m), and were not located.

Mode of regeneration

Not confirmed but likely to regenerate from soil stored seed.

Key threats

Not known.

Management recommendations

None at this stage.

Figure 31. *Pneumatopteris pennigera*, Moleside Creek, Lower Glenelg National Park, 29/9/2011



3.52 *Pomaderris helianthemifolia* subsp. *minor* – Blunt-leaf Pomaderris (r)

Local habitat

This is a small-medium shrub to around 2 m high, endemic to north-east Victoria (Walsh and Coates 1997; Walsh and Entwisle 1999). It is generally found along stream banks, but also sometimes in dry, open forest (Walsh and Coates 1997; Walsh and Entwisle 1999). Two known populations were found in the Murrindindi fire area, one on flat, low ground beside a stream, and the other along the top of a steep south-westerly facing road embankment.

Associated vegetation commonly included *Eucalyptus radiata* and/or *Eucalyptus viminalis* over *Acacia dealbata*, *Pteridium esculentum*, *Clematis aristata* and *Rubus parvifolius*. Locally common species, depending on location, included *Indigofera australis*, *Coprosma quadrifida*, *Platylobium formosum*, *Polyscias sambucifolia*, *Poa ensiformis* and *Acaena novae-zelandiae*.

Mode of regeneration

Individuals examined were regenerating from seed, with seedlings up to 90 cm high within two years of fire. There was no sign of flowering or fruiting yet in these populations. A previous survey by other researchers found a population on the Buffalo River that had reached reproductive maturity five years after fire and showed evidence of a second age cohort (ABZECO 2011). This suggests that seeds might be stimulated by fire, but can also germinate without it, perhaps taking advantage of more open conditions.

Key threats

No signs of browsing were noted. However, regenerating *Rubus fruticosus* (Blackberry) is scattered amongst the seedlings and is likely to pose a severe threat (Figure 32), as it can expand into dense, impenetrable thickets (Richardson *et al.* 2007) and choke out other vegetation. One of these VROT populations is located ~15 m south of the Eildon-Jamieson Rd and 20 m west of Still Ck (grid reference GDA94 415129/5862799). The other is situated on a steep WSW slope above Big River Rd, approximately 50 m south of the rapids (1.5 km south of Eildon-Jamieson Rd) (grid reference GDA94, 417338/5863265).

Any future widening of the Big River Road would threaten some of the population, as most seedlings were found within 5–10 m of the road embankment. The reader is also directed to the Management Plan produced for this species (ABZECO 2011).

Management recommendations

- Control Blackberry at both locations.
- Ensure any future road widening does not impact on populations.
- Refer to management plan.

Figure 32. *Pomaderris helianthemifolia* subsp. *minor*, Still Creek, potentially threatened by Blackberry, 21/1/2011.



3.53 *Pomaderris oraria* subsp. *oraria* – Bassian Pomaderris (r)

Local habitat

This is a compact shrub to 1 m high, which grows on exposed dunes and in coastal scrub on deep sands between Cape Patterson and the Ninety Mile Beach (Walsh and Entwisle 1999). A known population had been mapped at the end of Tin Pot Track, Wilsons Promontory, on sand dunes overlooking a dry wetland. However, no adult plants or seedlings were found, despite an extensive search.

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

- Opportunistic searches in suitable areas.

3.54 *Pultenaea weindorferi* – Swamp Bush-pea (r)

Local habitat

Pultenaea weindorferi is an erect leguminous shrub to around 2 m high that is endemic to Victoria, and confined to drainage lines and swamps to the west and south-east of Melbourne (Corrick 1980b; Walsh and Entwisle 1996). In some areas it may be a dominant understorey plant (Corrick 1980b), although we suspect that this has much to do with recent fire history.

During the current surveys, large populations were found in the Bunyip fire area, and one near Kinglake, particularly on flat areas and gentle slopes leading into broad drainage lines. This species was also found along the edges of narrow drainage lines at the side of the road, but not generally within the drains. A large known population was found along a broad flat easement under power transmission lines at Bunyip. The highest stem densities were in open areas, and plants reduced markedly in density as surrounding vegetation became taller and thicker, or as *Eucalyptus* canopy increased. This suggested that this species is intolerant of shade or strong competition.

Associated vegetation generally consisted of *Eucalyptus cephalocarpa* over *Austrostipa muelleri*, *Dampiera stricta*, *Gonocarpus micranthus*, *Viminaria juncea*, *Gahnia radula* and *Empodisma minus*.

Depending on location, other species that were locally common included *Lepidosperma filiforme*, *Hypolaena fastigiata*, *Xanthosia dissecta*, *Baumea* sp., *Acacia genistifolia*, *Acacia oxycedrus*, *Melaleuca squarrosa*, *Pultenaea gunnii*, *Leptospermum continentale*, *Schoenus apogon*, *Allocasuarina* sp., *Drosera binata* and *Lindsaea linearis*.

Figure 33. *Pultenaea weindorferi*, Bunyip State Park, 20/10/2010.



Mode of regeneration

Regenerating by seed (Figure 33), with seedlings to 100 cm high within two years of fire (typically 30–60 cm). Populations were sometimes large (one population at Kinglake covered over a hectare) with a stem density in some locations as high as ~200 individuals per m². Less than 10% of seedlings were flowering at the time of the survey (barely 1% at Kinglake), although some flowering individuals were as small as 20 cm high. Adult shrubs that existed prior to the fire were burnt to ground level, and there was no sign of resprouting.

Key threats

Populations along drainage lines to the side of tracks are susceptible to a reduction in size from track widening or drain work, while populations under the main power transmission lines at Bunyip might be affected by regular slashing. However, the sheer number of plants regenerating after the 2009 fires should ensure that the species as a whole is unlikely to be at risk. Signs of browsing were observed on a few shrubs, and some deer prints were seen. However, a low level of browsing is unlikely to threaten the populations, given their size.

Management recommendations

None at this stage.

3.55 *Pultenaea williamsonii* – Highland Bush-pea (r)

Local habitat

This is a semi-prostrate shrub to around 70 cm long, found in the margins of a few swamps between the Strathbogie Ranges and Wonnangatta Station (Corrick 1980a; 1995; Walsh and Entwisle 1996). A known population had been recorded near the creek on the north side of the Eildon-Jamieson Road in the Murrindindi fire area. It was not clear during our assessment in early 2011 whether the area had been burnt only very lightly in 2009, or had been subject to earlier fuel-reduction burning. In any event the population was not found. It is possible that this species requires hotter fire to stimulate regeneration.

Mode of regeneration

Not confirmed, but most likely by seed, consistent with most *Pultenaea*.

Key threats

Not known.

Management recommendations

None at this stage.

3.56 *Richea victoriana* – Serpent Heath (r)

Local habitat

Richea victoriana is a narrow, erect shrub to around 2 m high, endemic to Victoria, and restricted to wet areas in a few montane to sub-alpine locations near the Blue Range and Baw Baw plateau (Walsh 1987; Menadue and Crowden 1995; Walsh and Entwisle 1996; Shannon and Morgan 2007). It co-exists with *Richea continentis* at Mt Bullfight, the only location in Victoria where this co-occurrence has been observed (Tolsma and Shannon 2009). However, *R. victoriana* does not form the same dense swards as *R. continentis* (Walsh 1987).

During the current surveys, a known population was found in a flat, partially burnt montane bog area below Tom Burns Track within the Murrindindi fire area. Associated species included *Sphagnum cristatum*, other mosses, *Isolepis* sp., *Carex appressa*, *Epacris ?gunnii*, *Juncus* sp., *Luzula* sp., *Euchiton* sp., *Leptospermum grandifolium*, *Deyeuxia* sp., *Poa* sp., *Carex gaudichaudiana* and *Gonocarpus micranthus*.

Mode of regeneration

Regenerating by seed, with seedlings mostly concentrated in open areas on shallow, damp, burnt *Sphagnum* moss (Figure 34). Seedling emergence appears to be delayed in this genus, with seedlings of the more common *R. continentis* generally not seen for 14–15 months post-fire (personal observation). The small size of seedlings of *R. victoriana* (barely 3 cm high two years after the fire) suggests that it too has delayed emergence, and might take many years to reach reproductive maturity. Part of the adult population survived the patchy burn, and some living plants were producing sprouts from buds below the surface.

Key threats

No direct threats to the regenerating population were observed, although another fire prior to seedlings reaching reproductive maturity would impact severely. Species of *Richea* are known to be fire-sensitive (Wahren and Walsh 2000), and were notably absent at many montane research sites suspected to have had a high frequency of fire in the past (Shannon and Morgan 2007).

Management recommendations

- Monitor seedling growth and survival, and time-to-maturity
- Protect the population from any fire that may occur before seedlings reach reproductive maturity and establish a viable seed bank.

Figure 34. *Richea victoriana* seedlings, Tom Burns Creek, 21/1/2011.



3.57 *Schoenus carsei* – Wiry Bog-sedge (r)

Local habitat

Schoenus carsei is a rhizomatous, perennial sedge to around 80 cm high, scattered in damp heathland between Portland and Wilsons Promontory (Walsh and Entwisle 1994).

During the current surveys, three known populations of this species were searched for in swamps in the vicinity of Five Mile Road, Wilsons Promontory. However, despite the cover-abundance of one population being recorded as 25–50% when the quadrat was surveyed in 1987, no adult or juvenile plants were found.

Mode of regeneration

Not confirmed, but likely to be via both seeds and rhizome resprouting.

Key threats

Not known.

Management recommendations

- Suggest opportunistic searching in summer with an expert in the species.

3.58 *Sowerbaea juncea* – Rush Lily (r)

Local habitat

Sowerbaea juncea is a tufted, rhizomatous, perennial herb to 60 cm high, which may be locally common in damp, near-coastal vegetation around and east of Wilsons Promontory (Walsh and Entwisle 1994). It is most commonly associated with heathland and open woodland on low-lying, poorly drained sandy to peaty soils (DPIPWE 2011d).

During the current surveys, known and newly recorded populations were located off Five Mile Rd, Wilsons Promontory, on gentle northerly slopes grading towards damp heathlands on sandy loam soil. Numerous other individuals were scattered around the area. Plants were generally found in open areas away from canopy cover or dense post-fire regeneration.

Surrounding vegetation generally consisted of *Banksia serrata* (sometimes with *Banksia marginata* or *Eucalyptus baxteri*) over *Leptospermum continentale* or *L. myrsinoides*, *Allocasuarina* sp., *Hypolaena fastigiata*, *Lepidosperma concavum*, *Burchardia umbellata*, *Melaleuca squarrosa*, *Xanthorrhoea* sp., *Dillwynia glaberrima* and *Xanthosia tasmanica*.

Other species present depending on location included *Helichrysum baxteri*, *Tetratheca pilosa*, *Laxmannia* sp., *Lindsaea linearis*, *Empodisma minus*, *Selaginella uliginosa*, *Acrotiche serrulata*, *Lepidosperma laterale*, *Gonocarpus tetragynus*, *Leucopogon virgatus*, *Xanthosia tridentata* and *Comesperma ericinum*.

Figure 35. *Sowerbaea juncea* at Wilsons Promontory, 27/10/2010.



Mode of regeneration

This species is shortly rhizomatous (Walsh and Entwisle 1994), and plants tended to have a hard, “clumpy” base, making it difficult to tell if they were well-advanced post-fire seedlings or resprouts. This species is likely to employ a combination of both regenerative mechanisms. Plants were up to 40 cm high within 20 months of the fire, and many were flowering (Figure 35).

Sowerbaea juncea tends to occur in habitats that are maintained through relatively frequent disturbance events such as fire, which create the open areas suitable for seedling germination and flowering (DPIPWE 2011d). The optimum frequency of such events (in years) has not been articulated, but is likely to be similar to that for coastal heathlands in general.

Key threats

No obvious threats to populations were observed. However, this species is known to respond to disturbance that opens up the vegetation (DPIPWE 2011d), suggesting that long inter-fire periods could eventually lead to their decline.

Management recommendations

- Manage populations in accordance with accepted management protocols for coastal heathlands.

3.59 *Tetratheca stenocarpa* – Long Pink-bells (r)

Local habitat

This is a slender shrub with ascending to trailing branches up to around 1.5 m long, endemic to Victoria, and growing in open or tall mountain forests (Walsh and Entwisle 1999).

Three known and six new populations were found within the Bunyip fire area. Most were in open vegetation along the top of shallow road embankments with a south-westerly to north-westerly aspect. Soils were generally sandy clay.

Associated species generally included *Eucalyptus obliqua* or *Eucalyptus sieberi* over *Spyridium parvifolium*, *Dampiera stricta*, *Pultenaea mollis*, *Tetrarrhena juncea*, *Acacia myrtifolia* and *Gonocarpus teucroides*. Other species, depending on location, included *Pteridium esculentum*, *Lepidosperma laterale*, *Scaevola aemula*, *Platylobium formosum* and *Correa reflexa*.

Mode of regeneration

Seedlings to 1 m high, with around 1/3rd of individuals in flower in September 2011 (Figure 36). One population extended for around 200 m along the road, and was estimated to contain more than 1000 plants.

Key threats

The preferred location of this species along roadsides would leave populations susceptible to the effects of track widening.

Management recommendations

- Ensure populations are not impacted by future road widening works.

Figure 36. *Tetratheca stenocarpa* in flower, Bunyip fire area, 15/9/2011.



3.60 *Thismia rodwayi* – Fairy Lanterns (v, L)

Local habitat

This species is a small herb to only 3 cm high, found in deeply shaded forests and fern gullies (Walsh and Entwisle 1994). Plants lack chlorophyll and derive their energy from a fungus rather than through photosynthesis (Wapstra *et al.* 2005; DPIW 2007). Little is known about their life history, but they are possibly pollinated by insects, with seeds dispersed by water (Wapstra *et al.* 2005).

Three known locations were checked in the Kinglake area. The vegetation consisted of dense, regenerating *Eucalyptus regnans* and *Acacia dealbata* to around 4 m high over understorey species including *Goodenia ovata* and *Solanum aviculare*. The presence of dense post-fire regeneration (Figure 37) precluded finding this species, which has a mostly subterranean habit and is rarely seen. *Thismia* is restricted to damp humus and litter (Walsh and Entwisle 1994), and conditions are unlikely to be suitable for this species until the vegetation matures and the leaf litter accumulates.

Mode of regeneration

The spatial distribution of some plants examined in Tasmania by Wapstra *et al.* (2005) suggests that they normally regenerate from their tiny seeds following dispersal by water splashing or flowing, or possibly by wind (Wapstra *et al.* 2005). However, it is not known whether post-fire regeneration occurs vegetatively from plants that survive the fire, or by recolonisation from unburnt areas (DPIW 2007).

This species is generally found in shady tall forest with leaf litter 1–3 cm thick (DPIW 2007), hence it may be many years before regeneration occurs. In any event, detection of this plant is serendipitous, and targeted surveys in the coming years could be largely futile.

Key threats

A long period without fire may be required to allow suitable conditions for re-establishment to occur.

Management recommendations

- Protect populations from wildfire
- Protect the locations of populations from salvage logging that could prevent suitable conditions from being re-established (DPIW 2007).

Figure 37. *Thismia rodwayi* location, Wallaby Creek Catchment, Kinglake, 10/1/2011.



3.61 *Tmesipteris elongata* – Slender Fork-fern (v)

Local habitat

This is a small fern to around 60 cm long, known from only a few locations in Victoria, and usually epiphytic on the trunks of *Dicksonia antarctica* (Walsh and Entwisle 1994).

A known population at Wilsons Promontory was searched for, but not found.

Mode of regeneration

Not confirmed but probably via spores. Likely to be fire sensitive.

Key threats

Not known.

Management recommendations

None at this stage.

3.62 *Tmesipteris ovata* – Oval Fork-fern (r)

Local habitat

This is a small fern with fronds to around 20 cm long, epiphytic on tree fern trunks in wet forest east of Melbourne, and in the far east of Victoria (Walsh and Entwisle 1994). Known populations at Bunyip and Wilsons Promontory were not found. In the Bunyip fire area the recorded locations were difficult to access because of dense, post-fire regrowth in steep gullies, and one gully on Bunyip Road was choked by Blackberry. Tree fern trunks that were inspected were scorched, with no epiphytic ferns of any description. The canopy is open at present, hence suitable shady and moist conditions may require some years.

At Wilsons Promontory, the given location of the site was inaccurate (to 2000 m), and an extensive search in likely areas failed to find the population.

Mode of regeneration

Not confirmed but probably via spores. Likely to be fire sensitive.

Key threats

Not known.

Management recommendations

- Blackberry control in gullies along Bunyip Road.

3.63 *Tmesipteris parva* – Small Fork-fern (r)

Local habitat

Tmesipteris parva is a small, epiphytic fern to around 15 cm long, that lives on the trunks of *Cyathea australis* or *Dicksonia antarctica* in fern gullies (Walsh and Entwisle 1994; DPIPWE 2010). The rhizomes are buried deeply within the fibrous material of the trunk.

Around 70 plants were found on the trunk of *Dicksonia antarctica* in an unburnt shady gully with sparse ground layer, 20 m west of Chinaman Creek and 100 m south of Five Mile Rd, Wilsons Promontory (Figure 38). A few others were scattered on surrounding *Dicksonia* and *Cyathea australis*. Associated vegetation included *Syzygium smithii* over *Dicksonia antarctica*, *Cyathea australis*, *Coprosma quadrifida*, *Microsorium* sp and *Crepidomanes venosum*.

A second epiphytic population of 10 plants was found nearby on *Cyathea australis*. Vegetation here included *Syzygium smithii* and *Acacia melanoxydon* over *Dicksonia antarctica*, *Cyathea australis*, *Fieldia australis*, *Blechnum wattsi*, *Microsorium* sp, *Olearia argophylla* and *Bedfordia arborescens*.

Figure 38. *Tmesipteris parva*, Chinamans Creek, Wilsons Promontory, 22/2/2011.



Mode of regeneration

Not confirmed as population was not burnt, but it is known to regenerate both from spores and rhizomes (DPIPWE 2010).

Key threats

Inappropriate (high frequency) fire regimes could open up the surrounding canopy and render the habitat unsuitable.

Management recommendations

- Avoid burning of fern gullies.

3.64 *Trochocarpa clarkei* – Lilac Berry (r)

Local habitat

This is a dense, often decumbent shrub, endemic to Victoria, and restricted to alpine and sub-alpine areas from Lake Mountain to Mount Wellington (Walsh and Entwisle 1996). During the current surveys, a population was found in open, snow gum woodland on a gentle northerly slope at Mt Bullfight. Associated vegetation included *Eucalyptus pauciflora* over *Poa ensiformis*, *Stellaria pungens*, *Bossiaea foliosa*, *Stylidium* sp., *Asperula gunnii*, *Leionema phyllicifolium*, *Prostanthera cuneata* and *Hydrocotyle* sp.

Mode of regeneration

Resprouting from roots and stem bases below ground (Figure 39), with resprouts to 8 cm high two years post-fire. No sign of flowering yet.

Key threats

No direct threats observed.

Management recommendations

None at this stage.

Figure 39. *Trochocarpa clarkei* resprouting, Mt Bullfight, 25/2/2011.



3.65 *Wittsteinia vacciniacea* – Baw Baw Berry (r)

Local habitat

Wittsteinia vacciniacea is a sprawling sub-shrub to around 40 cm, endemic to Victoria and with a very restricted distribution (Mueck 1990; Walsh and Entwisle 1996). It is mostly found between Lake Mountain, Mt Donna Buang and the Baw Baw plateau, where it may be locally common at the margins of rainforest, and against tree trunks and boulders in snow gum woodland (Walsh and Entwisle 1996).

During the current surveys it was found on flat to moderate slopes on the edge of bogs (or on the edge of snow gum woodland or drainage lines close to bogs) at Lake Mountain and Mt Bullfight.

At Lake Mountain the associated vegetation generally consisted of *Eucalyptus pauciflora* over *Baeckea latifolia*, *Derwentia nivea*, *Scaevola hookeri* and *Blechnum penna-marina*. Other locally-common species, depending on location, included *Callistemon ptyoides*, *Epacris paludosa*, *Leptospermum grandifolium*, *Tasmannia xerophila* and *Poa ensiformis*.

The Mt Bullfight population was associated with *Nothofagus cunninghamii* over *Leptospermum grandifolium*, *Blechnum penna-marina*, *Hydrocotyle* sp., *Poa ensiformis*, *Coprosma nitida*, *Cassinia aculeata*, *Carex appressa* and *Polystichum proliferum*.

Mode of regeneration

Individuals examined were resprouting from rhizomes (Figure 40). Two years post-fire, resprouts were no higher than 15 cm, and showed no sign of flowering.

Figure 40. *Wittsteinia vacciniacea* sprouting at Lake Mountain, 19/1/2011.



Key threats

No direct threats observed. However, this species was browsed by deer after the 2006 fires in the Mt Speculation/Cobbler area, and opportunistic monitoring is advised.

Management recommendations

- Opportunistic monitoring of deer browsing/activity.

3.66 *Xanthosia tasmanica* – Southern Xanthosia (r)

Local habitat

This is a weak erect or ascending herb to around 20 cm high, which occurs mostly in coastal heathland on sandy soils (Walsh and Entwisle 1999).

During the current surveys it was found on gentle slopes with sandy loamy soils on various aspects at Wilsons Promontory, with the vegetation often grading into wet heathland.

Associated species generally consisted of *Banksia serrata* (occasionally *Banksia marginata* or *Eucalyptus baxteri*) over *Pteridium esculentum*, *Lepidosperma laterale*, *Hypolaena fastigiata*, *Leptospermum continentale* (sometimes *L. myrsinoides*), and *Allocasuarina* sp.

Other species present depending on location included *Rhytidosporum procumbens*, *Xanthorrhoea australis*, *Bossiaea cinerea*, *Burchardia umbellata*, *Acacia suaveolens*, *Lepidosperma ?concavum*, *Leucopogon parviflorus*, *Drosera peltata*, *Acrotriche serrulata*, *Leucopogon virgatus*, *Acacia verticillata*, and *Tetratheca pilosa*.

Mode of regeneration

Regenerating by seed. Seedlings were up to 15 cm high at 20 months post-fire, typically 5–10 cm, and were flowering and fruiting (Figure 41).

Key threats

No obvious threats noted. The population might be sensitive to kangaroo grazing, although plants are in relatively large number.

Management recommendations

None at this stage.

Figure 41. *Xanthosia tasmanica* at Wilsons Promontory, 26/10/2010.



3.67 *Xerochrysum papillosum* – Island Everlasting (r)

Local habitat

Xerochrysum papillosum (previously known as *Bracteantha papillosa*) is a perennial herb to around 80 cm high, which in Victoria has been recorded only from a few islands around Wilsons Promontory (Walsh and Entwisle 1999).

A single, early record from Wilsons Promontory had a very inaccurate location (to 5000 m), hence a search was not undertaken. This species is better known from Bass Strait islands (Figure 42).

Mode of regeneration

Not confirmed.

Key threats

Not known.

Management recommendations

None at this stage. The presence of this species at Wilsons Promontory is doubtful.

Figure 42. Photograph of *Xerochrysum papillosum* at Flinders Island – not this study (photo: David Cheal, 24/10/2007)



4 Discussion

Many species were regenerating from seed in large number. For example, one population of *Pultenaea weindorferi* was estimated to contain more than 250 000 plants along a narrow strip 700 m long. These numbers are expected to decline markedly in coming years through competition and habitat change.

The large number of regenerating plants present suggested that few populations assessed were likely to be at threat from post-fire factors. However, while few obvious threats were observed, four are worthy of mention.

4.1 Weeds

Weeds were not yet a major component of the flora at any sites. Most weeds observed were common, low-impact species such as *Hypochaeris radicata* (Flatweed). However, two populations of *Pomaderris helianthemifolia* subsp. *minor* (Blunt-leaf Pomaderris) are potentially threatened by *Rubus fruticosus* (Blackberry) which was regenerating alongside the *Pomaderris* seedlings. This species can form a dense, impenetrable thicket (Richardson *et al.* 2007), and smother other vegetation. Indeed, some gullies along Bunyip Rd in the Bunyip fire area contain substantial infestations. Urgent removal of Blackberry plants around the *Pomaderris* is recommended while the infestations are still manageable.

Several *Salix cinerea* (Grey Sallow Willow) plants were observed in wetlands at Blue Range Rd, Mt Bullfight and Lake Mountain. High-altitude wetlands are highly susceptible to invasion for prolonged periods after disturbance (McDougall 2007), and willows are of greatest concern. Willow seeds are small, and have a halo of hairs that enables them to be blown many kilometres with winds of sufficient turbulence (Cremer 1999). They established in large numbers at Mt Buffalo and the Bogong High Plains after the 2003 and 2006/2007 fires (McMahon *et al.* 2009; Tolsma 2009), and have the capacity to fundamentally alter the hydrological functioning of wetlands. Willow seedlings found during this project were removed by the authors, but monitoring of wetlands across these higher-altitude areas should continue for the next two or three years until such time as bare, damp ground for seed germination is minimal. Autumn is considered to be the best time for Willow surveys, as the leaves turn yellow and the plants stand out more readily from other vegetation.

4.2 Browsing and grazing

Four species of deer have established wild populations in Victoria (Menkhorst 2001; Victorian Fauna Database 2007), with two species (Sambar and Hog Deer) being of concern in the study areas.

Sambar (*Cervus unicolor*), is considered to be the most successful deer in Australia (Menkhorst 2001), after being introduced into Victoria during the 1860s (Peel *et al.* 2005). It now has a large, well-established population throughout the mountain ranges of central to eastern Victoria (Victorian Fauna Database 2007), including the Yarra Ranges National Park (Parks Victoria 2002). Sambar impact on native ecosystems, particularly rainforests and riparian zones, because stags thrash shrubs and small trees with their antlers, create gaps through browsing and trampling, interfere with vegetation regeneration and create muddy wallows (Menkhorst 2001; Peel *et al.* 2005). Consequently, "reduction in biodiversity of native vegetation by Sambar (*Cervus unicolor*)" is now listed as a threatening process under Victoria's *Flora and Fauna Guarantee Act 1988*.

The effects of browsing, presumably by Sambar but possibly also by rabbits and hares, were observed at several locations. *Carex blakei* and *Oreobolus oxycarpus* subsp. *oxycarpus* were being browsed at Mt Bullfight; *Pultenaea weindorferi*, *Persoonia arborea* and *Leionema bilobum* subsp. *serrulatum* were being browsed in the Bunyip fire area; and some *Acacia leprosa* var. *graveolens* showed signs of stem damage in Kinglake National Park Muddy wallows from deer activity were found at Mt Bullfight (Figure 43), and these were somewhat larger than generally encountered by the authors in high-altitude wetlands. Water bodies are important to Sambar (Flynn *et al.* 1990), and the concentrated deer activity observed at Mt Bullfight is probably due to a combination of high deer numbers and the low number of wetlands there.

Figure 43. Sambar wallow in burnt sub-alpine bog at Mt Bullfight.



Hog Deer (*Axis porcinus*) is the smallest deer species in Australia, and was also introduced into Victoria during the 1860s (Van Dyck and Strahan 2008). They are most common along the south-east Victorian coast (Victorian Fauna Database 2007), where they browse numerous shrub and tree species (Van Dyck and Strahan 2008).

Hog deer activity was commonly observed in shrubby dune vegetation at Wilsons Promontory, with numerous tracks seen throughout the sand dunes and the presence of a perceptible odour. Evidence of browsing was observed on *Acacia uncifolia*, *Allocasuarina media* and *Exocarpos syrticola*. A mature *Exocarpos* showed signs of antler rubbing.

Deer have the potential to interfere with post-fire regeneration, although the sheer amount of regenerating plant material in the study areas is likely to limit the damage to species of concern. Nonetheless, monitoring and management (if practical) of deer numbers is recommended, particularly at Mt Bullfight and Wilsons Promontory.

4.3 Tracks and infrastructure

Populations of *Grevillea repens* in the Kinglake fire area were found mostly on and above road embankments, particularly towards the very edge of the embankment. This suggests a preference for an open, well drained position. Similarly, *Persoonia arborea* plants were generally found on the edges of road and snig tracks, and dropped out rapidly as vegetation density increased away from those edges, and *Tetratheca stenocarpa* was most prevalent in narrow strips along roadsides. This suggests an inability by these species to germinate or persist in the presence of strong inter-specific competition. These populations would be vulnerable to track widening or forestry activities.

A large population of *Leionema bilobum* subsp. *serrulatum* in the Bunyip fire area straddles a bulldozer cut which, from Forest Road (~ 1.8 km south of Tarago Rd), has the appearance of a vehicle track. Populations may be susceptible to damage by vehicles, and we suggest that this dead-end 'track' is blocked to prevent access.

4.4 Fire frequency

Fire regime, particularly the time between successive fires, has a major influence on individual plants or plant populations (Gill 1981). A species may become locally extinct if burnt again before sufficient time has elapsed for that species to reach viable reproductive maturity and re-establish seed stores. However, the time to viable reproductive maturity for many seed-regenerators, especially rarer species such as those which are priorities for this research, remains unconfirmed. For higher-altitude shrub species such as *Acacia alpina* (which had reached only 25 cm in height within two years of the fire), and *Richea*

victoriana (barely 3 cm in height within two years of the fire), which are unlikely to flower for several more years, the minimum tolerable fire interval is likely to be substantially greater than for lower-altitude shrub species such as *Pultenaea weindorferi* that are already flowering and presumably setting seed. Future opportunistic monitoring of priority shrub and tree species is therefore recommended to ensure that time-to-reproductive-maturity is determined. These data should then be included in DSE's Vital Attributes database, as they help underpin the timing of prescribed burning in Victoria.

Another fire prior to the re-establishment of a viable seed store is likely to have a severe impact on local populations of many woody, seed-regenerating species. Areas affected by the 2009 fires should be protected from such an event until all individual species have reached a life stage that will allow subsequent survival or regeneration.

4.5 Suggestions for future studies

The major difficulty with this project was obtaining data in a suitable, spatial format. Location data are readily available in the Flora Information System (which currently contains the most comprehensive VROT population data), but they cannot be accurately restricted by the fire area to generate a short-list of fire-affected plant populations. In contrast, data from DSE's Spatial Datamart can be incorporated into GIS to allow short-listing of fire-affected populations, but the information is incomplete for VROT populations. Further, the resulting shapefile does not contain location information; it is comprised simply of points on a map. As a result, an enormous amount of effort was expended in manually generating GIS layers, grid references and maps for the various fire areas. It is vital that the new Victorian Biodiversity Atlas can be searched using a GIS shapefile, and produce comprehensive maps and location data for populations of interest.

Finally, future (similar) surveys should concentrate on known populations with accurate location data. In many instances, particularly because there were very few FIS records, we attempted to find older populations of dubious accuracy. This was usually futile.

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Appendix 1

List of 163 provisional VROT species ordered by priority and species name, showing total number of records in Victoria as at 2007, total records burnt and records burnt per fire area. VROT (Victorian Rare or Threatened): e = endangered, k = status poorly known, r = rare, v = vulnerable. EPBC (Environment Protection and Biodiversity Act): E = Endangered, V = Vulnerable. Endemic: x = restricted to Victoria. FFG (Flora and Fauna Guarantee Act): L = Listed.

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Adiantum diaphanum</i>		e			L	1	29	4	13.8	4					
<i>Allocasuarina media</i>		k	x			1	22	9	40.9						9
<i>Asplenium obtusatum</i> subsp. <i>north.</i>		v				1	28	1	3.6						1
<i>Baeckea latifolia</i>		r	x			1	79	8	10.1		8				
<i>Banksia saxicola</i>	Possible confusion regarding taxonomy	r	x			1	117	1	0.9						1
<i>Correa reflexa</i> var. <i>lobata</i>		r	x			1	18	2	11.1	2					
<i>Cyathea cunninghamii</i>	Delayed recovery. May not see yet.	v			L	1	316	13	4.1		5				8
<i>Cyathea X marcescens</i>		v				1	92	6	6.5		6				
<i>Eucalyptus allgatrix</i> subsp. <i>allig.</i>	Looked at after 2003 fires	r		x		1	19	2	10.5		2				
<i>Eucalyptus fulgens</i>		r		x		1	202	17	8.4	1	4		12		
<i>Eucalyptus kitsoniana</i>		r		x		1	161	7	4.3						7
<i>Eucalyptus strzeleckii</i>		v		x	L	1	87	1	1.1	1					
<i>Gaultheria hispida</i>		e			L	1	5	1	20.0			1			9
<i>Grevillea barklyana</i>	Looked at after 2003 fires?	v		x	L	1	51	51	100.0	51					
<i>Grevillea monslacana</i>		r		x		1	40	40	100.0		40				
<i>Grevillea repens</i>		r		x		1	125	88	70.4		1	86			
<i>Grevillea victoriae</i> subsp. <i>victoriae</i>	Possible confusion regarding taxonomy	r		x		1	274	12	4.4		12				
<i>Haloragis myriocarpa</i>		v				1	11	1	9.1					1	
<i>Persoonia arborea</i>		v		x		1	236	68	28.8	27		5	36		
<i>Pimelea hewardiana</i>		r		x		1	43	2	4.7					2	
<i>Pomaderris apetala</i> subsp. <i>maritima</i>		v				1	7	2	28.6						2
<i>Pomaderris helianth.</i> subsp. <i>min.</i>		r		x		1	15	1	6.7			1			
<i>Pultenaea weindorferi</i>	Possible confusion regarding taxonomy	r		x		1	101	34	33.7	5			29		
<i>Richea victoriana</i>		r		x		1	24	11	45.8		11				

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Wittsteinia vacciniacea</i>		r		x		1	237	33	13.9			33			
<i>Acacia nano-dealbata</i>	Possible confusion regarding taxonomy	r		x		2	104	3	2.9			1	2		
<i>Acacia verniciflua</i> (Bacchus Mar.)	Possible confusion regarding taxonomy	v		x		2	7	1	14.3				1		
<i>Acacia verniciflua</i> (southern)	Possible confusion regarding taxonomy	k				2	15	2	13.3				2		
<i>Chorizandra australis</i>	Will be difficult to find	k				2	44	1	2.3						1
<i>Huperzia varia</i>	If accurate records only	v				2	49	1	2.0						1
<i>Leptecophylla junip.</i> subsp. oxy.	If accurate records only	v				2	38	8	21.1						8
<i>Lindsaea trichomanoides</i>		e				2	5	3	60.0						3
<i>Olearia stellulata</i>	Possible confusion regarding taxonomy	k				2	22	1	4.5						1
<i>Pimelea drupacea</i>	Will be difficult to find	v				2	7	1	14.3						1
<i>Pneumatopteris pennigera</i>	If accurate records only	e				2	28	4	14.3					4	
<i>Pultenaea williamsonii</i>	If accurate records only	r		x		2	20	2	10.0			2			
<i>Tetratheca stenocarpa</i>	If accurate records only	r		x		2	159	34	21.4	33			1		
<i>Acacia leprosa</i> (large phyllode)	Possible confusion regarding taxonomy	r				3	34	31	91.2				31		
<i>Acacia uncifolia</i>		r				3	107	3	2.8						3
<i>Acacia verticillata</i> subsp. <i>ruscifolia</i>		r				3	33	7	21.2						7
<i>Adriana quadripartita</i>	Will be difficult to find	v				3	61	1	1.6						1
<i>Argentipallium dealbatum</i>		r				3	14	1	7.1					1	
<i>Australina pusilla</i> subsp. <i>pusilla</i>		r				3	13	10	76.9						10
<i>Baumea laxa</i>	If accurate records only	r				3	23	2	8.7						2
<i>Botrychium australe</i>	Will be difficult to find	v			L	3	52	1	1.9			1			
<i>Brachyscome obovata</i>		r				3	56	16	28.6			16			
<i>Callitriche brachycarpa</i>	Will be difficult to find	v			L	3	9	1	11.1			1			
<i>Cardamine liliacina</i> s.s.	Possible confusion regarding taxonomy	v				3	2	1	50.0			1			

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Cardamine tenuifolia</i>	Only small proportion burnt	k				3	84	3	3.6	3					
<i>Derwentia nivea</i>		r				3	22	6	27.3			6			
<i>Epacris microphylla</i> var. <i>rhombo.</i>	Possible confusion regarding taxonomy	r				3	32	7	21.9			7			
<i>Epacris petrophila</i>		r				3	75	7	9.3			7			
<i>Eucalyptus alligatrix</i>		r				3	17	6	35.3			6			
<i>Euchiton umbricola</i>		r				3	77	3	3.9			3			
<i>Exocarpos syrticola</i>		r				3	66	5	7.6					5	
<i>Gahnia grandis</i>	Will be difficult to identify as resprout	v				3	27	13	48.1	6				7	
<i>Goodenia lineata</i>	Will be difficult to find	r		x		3	22	1	4.5					1	
<i>Goodia pubescens</i>	Fire ephemeral	r				3	36	19	52.8			14	4	1	
<i>Grammitis magell.</i> subsp. <i>noth.</i>	Will be difficult to identify	v				3	25	2	8.0		2				
<i>Grevillea chrysophaea</i>	Only small proportion burnt	r		x		3	155	6	3.9		6				
<i>Hakea decurrens</i> subsp. <i>platy.</i>		r				3	5	2	40.0						2
<i>Hibbertia hirticalyx</i>	Possible confusion regarding taxonomy	r				3	27	20	74.1						20
<i>Huperzia australiana</i>	Check locations	r				3	71	1	1.4			1			
<i>Lastreopsis hispida</i>		r				3	96	15	15.6	13			2		
<i>Leionema bilobum</i> subsp. <i>3 (W G)</i>		r				3	154	49	31.8	37		1	11		
<i>Monotoca glauca</i>		r				3	139	11	7.9						11
<i>Oreobolus oxycarpus</i> subsp. <i>oxy.</i>	Only small proportion burnt	r				3	58	7	12.1			7			
<i>Pellaea calidrupium</i>	Possible confusion regarding taxonomy	k				3	16	1	6.3			1			
<i>Pellaea nana</i>	Possible confusion regarding taxonomy	r				3	9	3	33.3			1	2		
<i>Pomaderris oraria</i> subsp. <i>oraria</i>		r				3	50	3	6.0						3
<i>Schoenus carsei</i>	If accurate records only. Hard to find.	r				3	27	9	33.3	1					8
<i>Sowerbaea juncea</i>		r				3	86	7	8.1						7

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Thismia rodwayi</i>	Will be difficult to find	v			L	3	11	4	36.4			4			
<i>Thomasia petalocalyx</i>		r				3	44	2	4.5						2
<i>Tmesipteris elongata</i>	If accurate records only	v				3	22	1	4.5						1
<i>Tmesipteris ovata</i>		r				3	75	6	8.0	3					3
<i>Tmesipteris parva</i>		r				3	124	23	18.5	11					12
<i>Uncinia nemoralis</i>	Check records	r				3	142	6	4.2						6
<i>Xanthosia leiophylla</i>	Will be difficult to find	r				3	37	4	10.8			2	1		1
<i>Xanthosia tasmanica</i>		r				3	20	3	15.0						3
<i>Xerochrysum papillosum</i>	If accurate records only	r				3	8	1	12.5						1
<i>Asplenium trichomanes</i>	If accurate records only. Difficult to find.	r				4	69	2	2.9					2	
<i>Austrostipa mundula</i>	If accurate records only. Difficult to find.	r				4	11	1	9.1					1	
<i>Cephalomanes caudatum</i>	If accurate records only	r				4	65	8	12.3	1					7
<i>Cladium procerum</i>	If accurate records only. Difficult to find.	r				4	52	3	5.8						3
<i>Herpolorion novae-zelandiae</i>	If accurate records only	r				4	52	3	5.8			3			
<i>Lindsaea microphylla</i>	Fire ephemeral. If accurate records only	r				4	103	2	1.9	2					
<i>Lycopodium scariosum</i>	If accurate records only	r				4	49	1	2.0			1			
<i>Pteris comans</i>	If accurate records only	r				4	42	2	4.8			1			1
<i>Acacia alpina</i>	Only small proportion burnt. Not at risk.	r				5	175	8	4.6			8			
<i>Agrostis betyae</i>	Very difficult to find. Not at risk.	k				5	3	1	33.3				1		
<i>Argyrotegium fordianum</i>	Only small proportion burnt. Not at risk.	r				5	240	8	3.3			8			
<i>Astelia australiana</i>	Looked at after 2003 fires. Not at risk.	v	V	x	L	5	123	62	50.4	62					
<i>Baumea planifolia</i>	Not considered at risk.	k				5	36	1	2.8						
<i>Berula erecta</i>	Only small proportion burnt	k				5	55	3	5.5						3
<i>Boronia pilosa</i> subsp. <i>torquata</i>	Only small proportion burnt. Not at risk.	r				5	48	1	2.1					1	

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Bossiæa cordigera</i>	Only small proportion burnt. Not at risk.	r				5	69	2	2.9			2			
<i>Bossiæa heterophylla</i>	Only small proportion burnt. Not at risk.	r				5	213	2	0.9						2
<i>Burnettia cuneata</i>	Orchid – to be looked at separately	r				5	56	3	5.4	1			1		1
<i>Caladenia aurantiaca</i>	Orchid – to be looked at separately	r				5	41	6	14.6		4				2
<i>Caladenia australis</i>	Orchid – to be looked at separately	k				5	42	2	4.8						2
<i>Caladenia concolor</i>	Orchid – to be looked at separately	e	V		L	5	56	2	3.6						
<i>Caladenia flavovirens</i>	Orchid – to be looked at separately	r		x		5	35	1	2.9				1		
<i>Caladenia orientalis</i>	Orchid – to be looked at separately	e	E	x	L	5	11	3	27.3						3
<i>Caladenia tessellata</i>	Orchid – to be looked at separately		V			5	22	3	13.6						3
<i>Callistemon subulatus</i>	Minor record in separate fire	r				5	41	1	2.4						
<i>Calochilus therophilus</i>	Orchid – to be looked at separately	k				5	14	1	7.1				1		
<i>Carex alsophila</i>	Considered not at risk from fire	r		x		5	92	25	27.2	4		16	5		
<i>Carex blakei</i>	Only small proportion burnt. Not at risk.	r				5	130	10	7.7			10			
<i>Carex chlorantha</i>	Only small proportion burnt. Not at risk.	k				5	75	1	1.3				1		
<i>Celmisia tomentella</i>	Minor record in separate fire	r				5	111	1	0.9						
<i>Corunastylis nuda</i>	Orchid – to be looked at separately	r				5	4	2	50.0						2
<i>Corunastylis pumila</i>	Orchid – to be looked at separately	r				5	13	3	23.1						3
<i>Corybas aconitiflorus</i>	Orchid – to be looked at separately	r				5	41	1	2.4						1
<i>Corybas fimbriatus</i>	Orchid – to be looked at separately	r				5	41	1	2.4						1
<i>Cymbonotus lawsonianus</i>	Only small proportion burnt. Not at risk.	r				5	54	2	3.7		2				
<i>Desmodium varians</i>	Only small proportion burnt. Not at risk.	k				5	276	12	4.3		7	2	2		
<i>Diuris punctata</i> var. <i>punctata</i>	Orchid – to be looked at separately	v			L	5	321	1	0.3				1		
<i>Entolasia stricta</i>	Will be difficult to find. Not at risk.	k				5	41	1	2.4						1
<i>Epacris microphylla</i> s.s.	Only small proportion burnt. Not at risk.	r				5	24	1	4.2						1

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Eucalyptus crenulata</i>	Already subject to post-fire activities	e	E	x	L	5	46	27	58.7			26	1		
<i>Eucalyptus globulus</i> subsp. <i>globulus</i>	Only small proportion burnt. Not at risk.	r				5	70	2	2.9						2
<i>Eucalyptus neglecta</i>	Minor record in separate fire	r				5	73	1	1.4						
<i>Eucalyptus perniana</i>	Only small proportion burnt. Not at risk.	r				5	70	6	8.6			6			
<i>Eucalyptus willisii</i> subsp. <i>willisii</i>	Taxonomic confusion? Not at risk.	r		x		5	49	21	42.9						21
<i>Eucalyptus yarraensis</i>	Considered not at risk from fire	r		x		5	376	2	0.5				2		
<i>Grevillea victoriae</i> s.s.	Taxonomic confusion? Not at risk.	r				5	1	1	100.0			1			
<i>Hydrochis orbicularis</i>	Orchid – to be looked at separately	v				5	77	3	3.9						3
<i>Juncus falcatus</i>	Minor record in separate fire	r				5	136	1	0.7						
<i>Juncus revolutus</i>	Only small proportion burnt. Not at risk.	r				5	73	1	1.4						1
<i>Lachnagrostis scabra</i>	Only small proportion burnt. Not at risk.	r				5	36	4	11.1				1		3
<i>Leionema bilobum</i>	Only small proportion burnt. Not at risk.	r				5	100	8	8.0	6			2		
<i>Lepidium desvauxii</i>	Will be difficult to find. Not at risk.	r				5	8	1	12.5						1
<i>Lomandra glauca</i> s.s.	Only small proportion burnt. Not at risk.	k				5	44	1	2.3						1
<i>Nematolepis wilsonii</i>	Already subject to post-fire activities	v	V	x	L	5	14	13	92.9			13			
<i>Olearia asterotricha</i>	Only small proportion burnt. Not at risk.	r		x		5	60	2	3.3	1		1			
<i>Olearia speciosa</i>	Only small proportion burnt. Not at risk.	k		x		5	96	5	5.2			2	1	1	
<i>Oxalis magellanica</i>	Only small proportion burnt. Not at risk.	r				5	103	1	1.0			1			
<i>Phebalium squam.</i> subsp. <i>ozo.</i>	Only small proportion burnt. Not at risk.	r				5	23	1	4.3			1			
<i>Phebalium squam.</i> subsp. <i>squam.</i>	Only small proportion burnt. Not at risk.	r				5	24	1	4.2	1					
<i>Platylobium triangulare</i>	Only small proportion burnt. Not at risk.	k				5	32	1	3.1						1
<i>Poa hothamensis</i> var. <i>parviflora</i>	Minor record in separate fire	r		x		5	37	2	5.4						
<i>Poa sieberiana</i> var. <i>cyanophylla</i>	Only small proportion burnt. Not at risk.	k				5	144	8	5.6			8			
<i>Podolepis hieracioides</i>	Minor record in separate fire	r				5	31	1	3.2						

Species name	Comments	VROT	EPBC	Endemic	FFG	Priority	Total records	Records burnt	% records burnt	Bunyip	Churchill	Kilmore Nth	Kilmore Sth	Mt Richmond	WPNP
<i>Pomaderris vacciniifolia</i>	Already subject to post-fire activities	v				5	38	22	57.9			3	19		
<i>Potamogeton australiensis</i>	Will be difficult to find. Not at risk.	k				5	3	1	33.3						1
<i>Prasophyllum pyriforme</i> s.s.	Orchid – to be looked at separately	e		x		5	67	1	1.5				1		
<i>Pterostylis alveata</i>	Orchid – to be looked at separately	v				5	18	1	5.6						1
<i>Pterostylis cucullata</i>	Orchid – to be looked at separately	v	V		L	5	122	2	1.6						2
<i>Pterostylis fischii</i>	Orchid – to be looked at separately	r				5	48	2	4.2						
<i>Pterostylis pedoglossa</i>	Orchid – to be looked at separately	v				5	27	3	11.1						3
<i>Pterostylis tunstallii</i>	Orchid – to be looked at separately	v				5	6	4	66.7						4
<i>Pterostylis X ingens</i>	Orchid – to be looked at separately	r				5	20	2	10.0		1			1	
<i>Pultenaea fasciculata</i>	Only small proportion burnt. Not at risk.	r				5	49	3	6.1			3			
<i>Pultenaea reflexifolia</i>	Minor record in separate fire	r		x		5	73	3	4.1						
<i>Ranunculus collinus</i>	Only small proportion burnt. Not at risk.	r				5	82	4	4.9			4			
<i>Scaevola calendulaea</i>	Will be difficult to find. Not at risk.	v				5	29	1	3.4						1
<i>Tasmannia vickeriana</i>	Only small proportion burnt. Not at risk.	r		x		5	36	1	2.8			1			
<i>Tetrarrhena turfosa</i>	Only small proportion burnt. Not at risk.	r				5	81	1	1.2			1			
<i>Thelymitra benthamiana</i>	Orchid – to be looked at separately	v				5	56	2	3.6					1	1
<i>Thelymitra mucida</i>	Orchid – to be looked at separately	v				5	41	1	2.4						1
<i>Triglochin minutissima</i>	Only small proportion burnt. Not at risk.	r				5	35	1	2.9						1
<i>Trochocarpa clarkei</i>	Only small proportion burnt. Not at risk.	r		x		5	127	16	12.6			16			



