Department of
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Determination of sustainable fire regimes in the Victorian Alps

using plant vital attributes

Research report no. 54

Victoria
The Place To Be

Determination of sustainable fire regimes in the Victorian Alps using plant vital attributes

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Summary

The Caledonia River wildfire in January 1998 burned 35 000 ha of foothill, sub-alpine and alpine vegetation in the Victorian Alps. At the time, this was the most extensive fire in Victorian alpine vegetation since 1939. It provided an opportunity to investigate the fire response of many alpine plant species.

For each major alpine vegetation community within the fire area, the fire responses of as many species as could be found were collated into a database. The database was then sorted using a plant Vital Attributes methodology (Noble & Slatyer 1980; NRE 1996) which allows identification of Key Fire Response Species. From the Key Fire Response Species can be derived the particular minimum and maximum inter-fire period for each community that ensures that each species extant in the community persists. The period between the minimum and maximum inter-fire periods then defines the range of ecologically sustainable fire frequencies for each vegetation community. This range enables evaluation of current or proposed fire regimes in terms of their ecological sustainability.

The study found that about 75% of alpine species respond very rapidly to fire and are able to regenerate either by seed or vegetatively within two years. It is proposed that this is an evolutionary attribute acquired in response to rapid seasonal changes in the harsh environment.

Although many species appear robust, a few are apparently quite vulnerable to fire. Significant amongst these are the Sphagnum Bogland species - *Sphagnum cristatum, S. subsecundum* and *Richea continentis*. Areas of Bogland were substantially burned in the fire and, while small numbers of each species survived, re-establishment of their cover toward pre-fire levels has been very slow. By 18 months post-fire, *Richea* had shown no signs of regeneration either from seed or vegetatively.

The minimum and maximum inter-fire periods derived in this study suggest that no ecological reasons exist to apply prescribed fire in most of the alpine vegetation communities studied (the only exception being for regeneration of Alpine Ash stands following timber harvesting). Information about weather and fire history indicates that the type of fire experienced in 1998 occurred only once or twice every century. This frequency of fire is considered adequate for providing regeneration opportunities for those intolerant species which otherwise rely on other disturbance events, such as insect attack or senescence of grassland, for their regeneration.

Evaluation of fuel hazard levels indicates no particular imperatives exist to apply prescribed fire for protection reasons.

The potential for soil erosion in alpine environments was seen to be an important reason for not applying frequent prescribed fire. That is, although fire more frequent than once or twice a century may have no significant ecological implications, the reduction of vegetative cover as a result of frequent fires in these vegetation communities may cause significantly increased soil loss.

Introduction

Despite the occurrence of wildfires in Victoria's alpine vegetation in the past, there is little obvious evidence of their impact. The physical damage caused by cattle and vehicles, on the other hand, is often evident and longer-lasting. Grazing licences were first taken out in Victoria's alpine area in 1851 (LCC 1977) and, since then, virtually every area has been subjected to grazing at some stage. Burning by the graziers and overgrazing contributed to the opening up of the previously continuous ground cover of grass and herbs on the High Plains, and wind and water erosion resulted. The seriousness of the resulting physical damage and perceived biological damage led Victoria's legislators in the 1940s to ban burning and sheep grazing in the High Plains. They also introduced controls on the numbers of cattle grazed, and the dates of their entry and removal in accordance with the growth conditions of each season (ibid). Although some of the more sensitive mountain summits are now excluded from grazing, and most of Victoria's Alps are reserved in an Alpine National Park, grazing continues across much of the area.

The evidence of the long-lasting scars from the physical damage and the slow recovery of the vegetation due to the harshness of the alpine environment led to the perception that the alpine areas are inherently fragile. This also led to the view that alpine areas needed protection from fire generally, and particularly from the impacts of major wildfires.

Just such a major bushfire occurred in the Snowy Range–Mt Wellington area in January 1998 and is suspected to have started from a deserted campfire beside the Caledonia River. With rugged topography hampering suppression efforts and two days of strong winds, approximately 35 000 hectares of State forest and national park burned. The area of snow grass plain and snow gum woodland burned was well in excess of that burned in the past four decades. Substantial areas of Alpine Ash (*Eucalyptus delegatensis*) and Mountain Gum (*E. dalrympleana*) damp montane forest were also burned; this has only occurred about once or twice each century.

The nature and extent of the fire provided an opportunity to investigate the fire responses of a large number of alpine plants. Such studies are required to determine whether alpine areas are relatively fragile from a floristic point of view, or whether past fire events or other factors have endowed the local flora with an inherent robustness to fire. An opportunity was also provided to investigate the factors which limited the extent of the fire in the alpine vegetation types, with a view to predicting the probable extent of future fires in alpine environments.

The Code of Practice for Fire Management on Public Land (CNR 1995) provided some of the impetus for the former Department of Natural Resources and Environment (NRE) to conduct this investigation. The environmental care principles of the Code (Section 1.10.4) include the requirements for:

> **Paragraph 50:** fire regimes and fire management activities to be appropriate for maintaining the vigour and diversity in populations of species and communities of the State's indigenous flora and fauna.
>
> **Paragraph 54:** indigenous flora and fauna to be protected following fire suppression by measures which promote the re-establishment of ecological processes existing prior to the wildfire.

The Code thereby clearly indicates that ecological processes should be investigated after a major fire event. Accordingly, the aims of this study were to:

- investigate the fire response of as many individual flora species from within the alpine and sub-alpine communities in the fire area as possible
- determine fire regimes for alpine vegetation communities which would be ecologically sustainable
- investigate the extent to which fire affected each vegetation community generally, including the factors which may have limited the extent of areas burned.

Climate, weather and fire history, soil types, fuel hazard and fauna of the alpine environment were also examined because of their significance in determining fire regimes and because of the way they may affect interpretations of species' fire responses.

Method

Study area

The principal area studied was the Snowy Range–Mt Wellington region (Figure 1) which suffered the greatest impact from the January 1998 Caledonia Fire. As well as including extensive areas of burnt alpine vegetation, this area also includes sites which burned with the highest fire intensities.

Some data were also collected from the Bogong and Mt Buffalo areas where relatively recent fire events had produced regeneration of alpine plants.

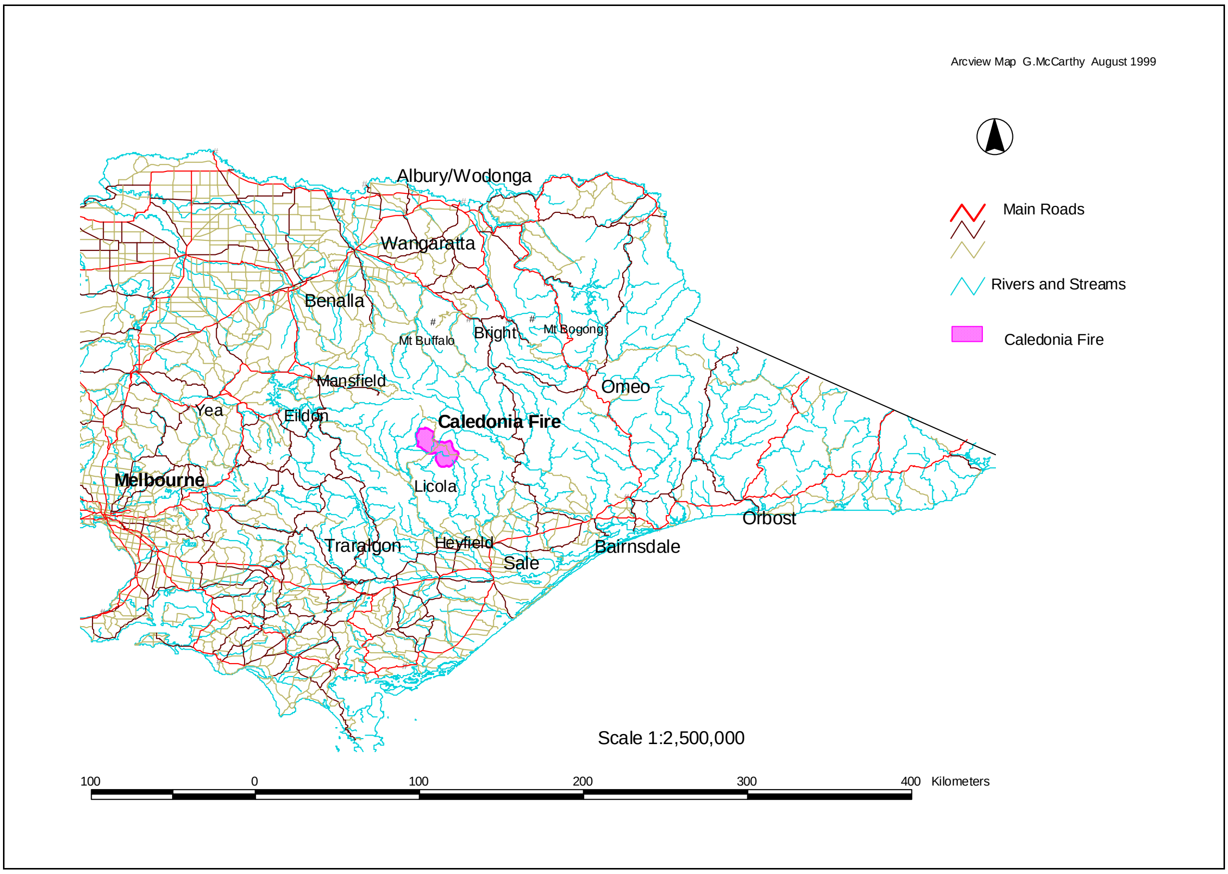
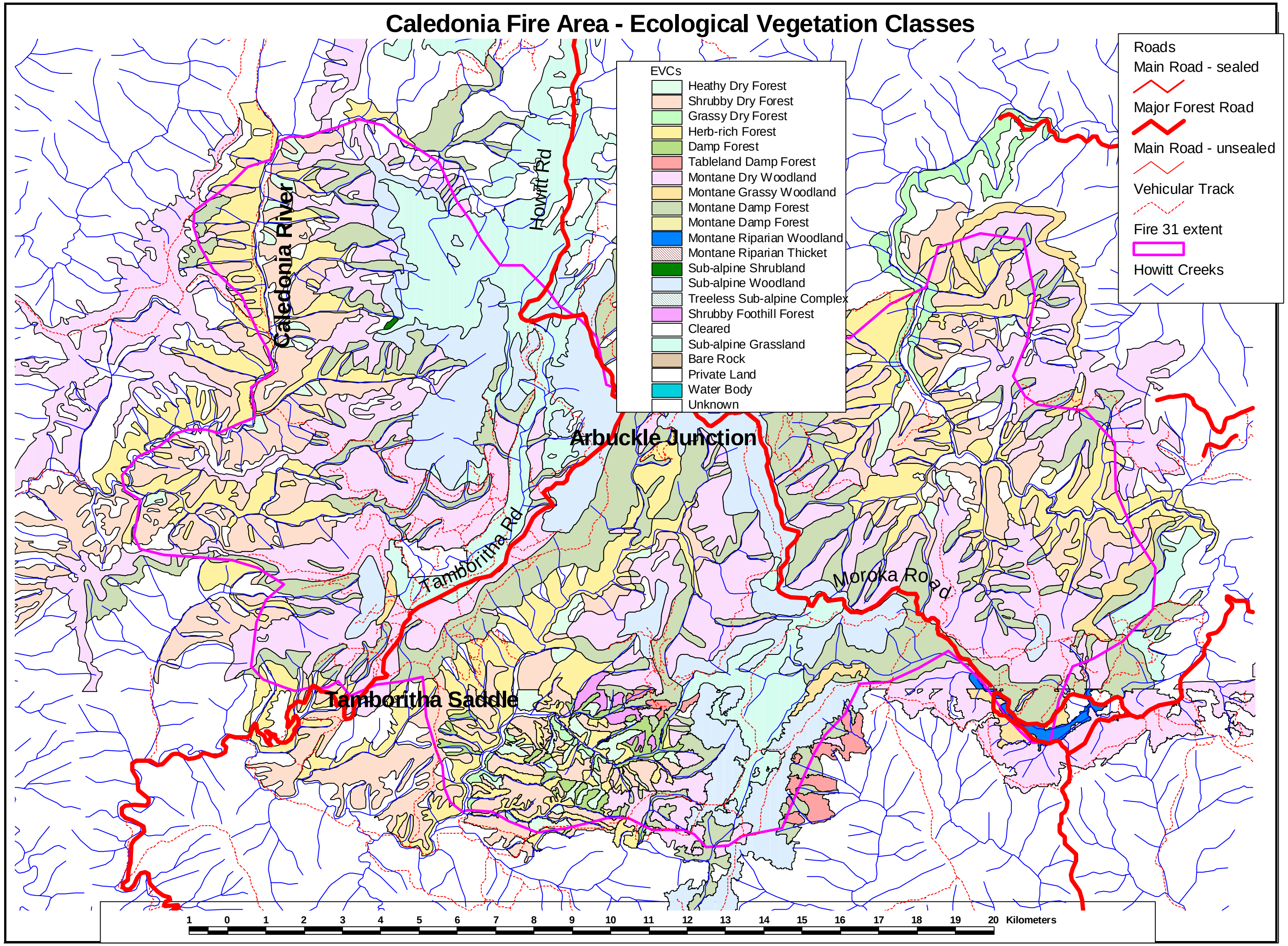


Figure 1 Location of the Caledonia fire area, Mt Buffalo and Mt Bogong

Vegetation classification

Figure 2 displays the vegetation communities in the area of the Caledonia fire classified according to Ecological Vegetation Classes.



(Arcview Map G. McCarthy Nov 1999)

Figure 2 Ecological Vegetation Classes in the Caledonia fire area

Fire response data

Fire response data for as many individual species as possible was collected using the plant Vital Attributes methodology (Noble & Slatyer 1980; NRE 1996) described in detail in Appendix A. The bulk of the field investigation was conducted by a botanist who specialises in alpine ecology.

The Vital Attributes methodology is essentially about identifying the minimum number of species for each vegetation community which will determine the minimum and maximum inter-fire periods. Where a vegetation community contains, say, a total of 100 to 200 species, it is usual to find perhaps 10 to 15 species which are the most sensitive to either:

- being burned too often (these will set the minimum inter-fire period)
- not being burned for a long period (these will set the maximum inter-fire period).

These are termed *key fire response species* and would be those monitored to evaluate and manage fire regimes.

The inter-fire periods become the recommended lower and upper limits for the application of fire in the respective plant communities, with the aim of retaining all extant species on the site.

This methodology does not indicate whether substantial changes will occur in the abundance of species under particular fire regimes. It is likely that either very short or very long inter-fire periods will lead to substantial changes in species abundance. Accordingly, the range of post-fire age classes within each vegetation community should be noted, with a view to ensuring that any introduced fire regime will produce a range of age classes, and so maximise the probability that variation in species abundance is achieved (for example Avis 1993; Tolhurst 1996).

The sorting process to identify the key fire response species uses three aspects of the *vital attributes* or lifeform characteristics of plant species:

> **Method of persistence**: *the principal method of regeneration after fire*
>
> Whether it is a seeder or sprouter or both. Where the seed is stored. How much seed will germinate after a fire and how much will be left for some future disturbance event. How long after a fire before it is able to resprout.
>
> **Conditions for establishment**: *the conditions the species requires for it to establish on a site*
>
> Whether it can establish in the presence of adult competition (producing an uneven-aged population) or it requires all the adults to be removed from the site before it can establish (producing an even-aged population). If it requires some other essential pre-condition (such as a cold period to break primary seed dormancy) before it can establish.
>
> **Timing of life stages**: *the period of each important life stage*
>
> The time taken for the species to either set viable amounts of seed or become vegetatively viable. The time taken for the species to reach maturity (full size and full seed production). The time before it starts to become locally extinct.

The key fire response species for the range of inter-fire periods can be characterised as follows:

for a minimum inter-fire period

These species will most often be obligate seeders (seed being the only regeneration mechanism) that have a single germination event following a fire. Typically all the seed will be used up in this one germination event. Such species require time in which to establish, grow and set viable amounts of seed before the next disturbance. If a second fire occurs before this time, the species may become locally extinct.

for a maximum inter-fire period

These are most commonly intolerant species (they do not establish in the presence of adults) which require a fire or other disturbance to re-establish. They will tend to become locally extinct if a fire or other disturbance does not occur within a certain time.

Timing of the survey

Fire response data for alpine plant species were collected in the Snowy Range study area during an extensive survey spanning the period from February through May 1999. This included 20 days of fieldwork directly related to this study and a number of days where information was collected opportunistically during other work.

The period of the survey meant that a high proportion of extant species were sampled and the timing of sampling, 12 to 16 months after the fire event, meant that there was opportunity to sample various post-fire developmental life stages.

Extent of area burned

About two months after the Caledonia fire a series of 1:5000 colour aerial photos was taken of the Holmes and Wellington Plains to provide a record of the burnt areas and to enable assessment of the damage to vegetation and soils.

Fuel hazard

Fuel hazards, both component and overall, were assessed using the Overall Fuel Hazard Guide (McCarthy et al. 1998-2) to determine the equilibrium levels of fuel hazard likely to be reached within each vegetation community (Table 7).

Soils

Information on soil types in alpine areas was obtained from the literature.

Fauna

Information on alpine fauna was obtained from the literature and a NSW National Parks and Wildlife Service (Kosciusko) generalised database of fauna fire responses which was at an early stage of development.

Historical information

Where applicable, fire history records at the Department’s Heyfield office were consulted to determine the pre-fire age of the vegetation and rainfall records from the Heyfield and Maffra offices were used to indicate trends in long-term drought which may lead to fires in alpine areas.

Results

Table 1 lists the *key fire response species* for each vegetation community and was developed by applying the Vital Attributes methodology (Appendix A). The fire responses of individual species, listed by community, are provided in Appendix B.

The nomenclature for plants follows that of the Victorian Herbarium's *List of Victorian Plants.*

Table 1 Key fire response species and the minimum and maximum inter-fire periods required to maintain all plant species within each of the fire-prone vegetation communities

Vegetation community (key fire-response species) Scientific name	Common name	Minimum inter-fire period (years)	Maximum inter-fire period (years)
Snow-grass Plains		**2–3**	**50–100**
Agrostis venusta		✓	
Agrostis parviflora		✓	
Asterolasia trymaloides		✓	
Brachyscome decipiens	Field Daisy	✓	
Brachyscome tenuiscapa		✓	
Cardamine lilascina	Bitter Cress	✓	
Euphrasia collina ssp. *paludosa*			
Leucopogon montanus	Snow Beard-heath		✓
Poa costiniana	Bog Snow-grass		✓
Poa hiemata	Soft Snow-grass		✓
Poa fawcettiae	Horny Snow-grass		✓
Snow Gum Woodland		**10**	**50–100**
Dianella tasmanica	Tasman Flax-lily	✓	
Grevillea australis	Alpine Grevillea	✓	✓
Leucopogon montanus	Snow Beard-heath	✓	✓
Sphagnum Bogland		**20**	**100+**
Richea continentis	Candle Heath	✓	
Poa costiniana	Bog Snow-grass		✓
Poa fawcettiae	Horny Snow-grass		✓
Alpine Heathland		**10**	**50–100**
Ajuga australis	Austral Bugle		✓
Hymenanthera dentata	Tree Violet		✓
Grevillea australis	Alpine Grevillea	✓	
Leucopogon montanus	Snow Beard-heath	✓	
Orites lancifolia	Alpine Orites		✓
Prostanthera cuneata	Alpine Mint-bush		✓
Phebalium phylicifolium	Alpine Phebalium		✓
Phebalium squamulosum	Forest Phebalium		✓
Pultenaea tenella	Delicate Bush-pea		✓

✓ indicates key criteria for the species

Table 1 continued

Vegetation community (key fire-response species) Scientific name	Common name	Minimum inter-fire period (years)	Maximum inter-fire period (years)
Alpine Ash Forest		**20–25**	**300**
Dianella tasmanica	Tasman Flax-lily	✓	
Eucalyptus delegatensis	Alpine Ash	✓	✓
Hakea lissosperma		✓	
Kunzea ericoides	Burgan		
Leucopogon montanus	Snow Beard-heath	✓	
Tasmannia xerophila	Alpine Pepper		

✓ indicates key criteria for the species

Table 2 Recommended fire regimes for each vegetation community and the minimum possible inter-fire period

Vegetation community	Broad scale fire regime – minimum inter-fire period (years)	Broad scale fire regime – maximum inter-fire period (years)	Period required to establish adequate vegetative cover for soil protection (years)	Minimum possible inter-fire period (years)
Snow-grass Plains	2–3	50–100	10–15	3–4
Snow Gum Woodland	10	50–100	10	4
Sphagnum Bogland	20	100+	25+	8–10
Alpine Heathland	10	50-100	10	5–10
Alpine Ash Forest	20–25	300	5-7	5

Table 3 Limitations to the spread of the Caledonia fire in alpine vegetation communities

Vegetation community	Observed limitations to fire spread
Snow-grass Plains	• Diurnal increase in humidity and fuel moisture content. • Fuel discontinuities such as fence-lines and animal tracks, particularly on southern and south-eastern aspects.
Snow Gum Woodland	• Diurnal increase in fuel moisture content. • Combination of diurnal increase in fuel moisture content and a high proportion of green material in the fuel complex in some locations, for example where understorey comprised greener forbs, short green grasses and sedges. • Fuel discontinuities such as fence-lines and animal tracks, particularly on southern and south-eastern aspects where the fire was running down toward treeless areas.
Sphagnum Bogland	• Diurnal increase in humidity and fuel moisture content • Proximity of streamlines containing moisture. • Within the Sphagnum stands there were variations in moisture through the vegetation/peat/soil profile which limited fire spread both horizontally and vertically.
Alpine Heathland	• Very severely burnt, with very little contiguous heathland surviving anywhere in the fire area. The presence of significant elevated dead material made this community highly flammable
Alpine Ash Forest	• Fuel moisture content differential on southern and eastern aspects. Some gullies in these locations unburnt. • Some smaller areas where understorey only was burned. • Some mature trees survived near fuel discontinuities such as the edges of roads and tracks. • The fire also stopped when it encountered various areas of mixed eucalypt/wattle regrowth which had a high proportion of green material and moister surface fuels. • Approximate proportions within overall fire area were: crown burnt/killed 75% understorey burnt (partial crown survival) 20% gully area unburnt 5%

Table 4 Proportion of each main vegetation community burned in the Holmes Plain and Wellington Plain areas

Vegetation community	Proportion burned (percent)	
	Holmes Plain	Wellington Plain
Snow-grass Plains	90	98
Snow Gum Woodland	90	90
Sphagnum Bogland	80	95
Alpine Heathland	98	99

Note: Data derives from preliminary analysis of 1:5000 colour aerial photographs.

Table 5 Post-fire recovery of alpine vegetation communities in the Caledonia area

Vegetation community	Observed recovery of vegetation
Snow-grass Plains	Recovered vegetatively very rapidly, particularly following spring rains.
Snow Gum Woodland	Substantial evidence of reshooting from both lignotubers and epicormics. Significant regrowth in the understorey by both seedlings and resprouts.
Sphagnum Bogland	The least signs of recovery 12 to 18 months after the fire. Very slow vegetative recovery of *Sphagnum* spp. and no signs of any regeneration of Candle Heath (*Richea*).
Alpine Heathland	Signs of slow recovery with most species regenerating from seed.
Alpine Ash Forest	Regeneration from seedlings apparent in virtually all areas where there was a mature seed crop prior to the fire. This was not apparent in areas of regrowth from previous wildfire or logging which was less than 20 years old.

Note: Observations by survey botanist and Departmental research staff.

Proportion of alpine species with rapid fire responses

Analysis of Appendix B indicates that approximately 75% of the species surveyed across all vegetation communities were able to respond either by seed or vegetatively within 12 months after the fire event.

Table 6 Fuel hazard of each vegetation community prior to the fire

Vegetation community	Fuel			
	Bark	Elevated	Surface	Overall
Snow-grass Plains	Low	*Mod–High*	*Low–High*	*Mod–High*
Snow Gum Woodland	*Mod*	Mod–High	*Mod–High*	*Mod–High*
Sphagnum Bogland	Low	*Mod–High*	*Low–Mod*	*Mod–High*
Alpine Heathland	Low	*Mod–V High*	*Mod–High*	*Mod–V High*
Alpine Ash Forest	*High–Extreme*	*Mod–V High*	*High–Extreme*	*High–Extreme*

Fuel hazard ranking follows McCarthy et al. 1998-2

Rainfall records and drought trends

With records dating back to 1899, the Departmental office at Maffra provided the best long-term record of rainfall for a station close to the Caledonia fire area.

Figure 3 plots the rainfall for Maffra over the last 100 years. Those years with rainfalls below 400 mm correlate well with years of high fire activity in the State. The figure shows that there have been four or five sufficiently dry periods in which fires could have sustained in the nearby alpine areas. However, taking into account the relative lack of ignition potential of the alpine areas (compared with that for the closer-settled foothill country), a frequency of one or two major fires each century would be a reasonable prediction.

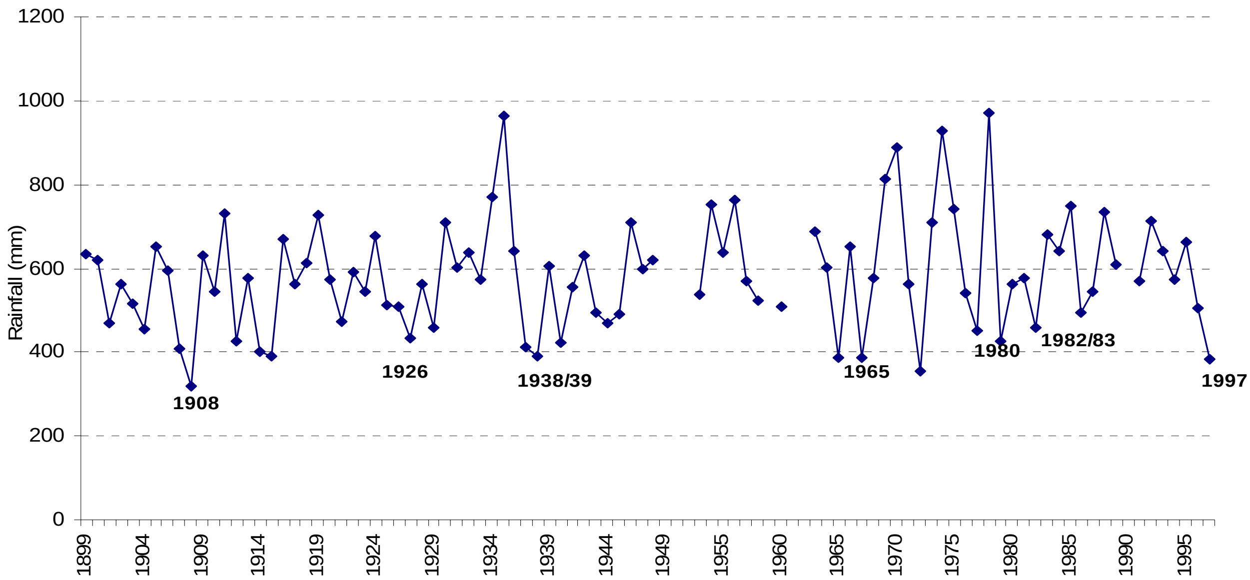


Figure 3 Annual rainfall for Maffra, 1899–1997

Discussion

Species fire response and fire regimes

A common characteristic of many of the alpine species studied was the rapidity with which they were able to set viable seed or become vegetatively viable, with 75% of species being able to do so within one year of the fire (Appendix B). This result is not unexpected, given the short growing season available. That is, it could be expected that plants in this locality would be adapted to responding quickly to the short period in spring and summer when temperatures are high enough to support growth and to set seed before being covered by winter snowfall.

The mechanisms for responding quickly to climatic imperatives should mean that many of these species would be relatively robust to disturbance by fire. That is, those same characteristics of being able to respond quickly to climate should provide many of these species with an ability to regenerate quickly after a fire event. Perhaps more importantly, it should mean that they are able to survive a number of disturbances, such as fire, over a relatively short period.

The community apparently most affected by the fire was Sphagnum Bogland. In particular the mosses - *Sphagnum cristatum* and *S. subsecundum* - and Candle Heath (*Richea continentis*) appeared to suffer heavily from the initial impact of the fire. While Sphagnum is recovering slowly by vegetative means, no regeneration of Candle Heath, either by vegetative means or by seed, was seen after 18 months post-fire.

This situation with Candle Heath is significant from a fire response point of view as very few other species show no evidence of a regenerative mechanism after 18 months post-fire (McCarthy & Tolhurst 1997; McCarthy et al. 1998-1). The same situation was noted by van Rees and Walsh (1985) in a study of vegetation recovery following a wildfire on Mt Buffalo in 1985. While it would be expected that Candle Heath would eventually recover by some method, it could only be assumed that recovery to pre-fire abundance levels will be very slow. The Sphagnum Bogland community must therefore be regarded as being very sensitive to fire and proposals for prescribed burning from an ecological point of view should be treated very cautiously. Fires any more frequent than every ten years could have profound effects on the floristic composition of this community, let alone the physical damage which may result in these sites from being burned at short intervals.

The fact that this community burned at all during the Caledonia fire event is indicative of the severe drought that prevailed at the time. It is probable that this fire represented a 1-in-50 or 1-in-100 year event. The only previous record of extensive fire in many of these vegetation communities is from 1939 (Turner & Fawcett 1948; Costin et al. 1959; Williams 1987).

The relative abundance of species which are both intolerant of adult competition and with lifespans of less than 10 to 20 years indicates that there have been enough local disturbance from factors other than fire to support their regeneration. These other factors are likely to include insect attack, grass sward senescence, frost heave and grazing (Williams 1987).

With the maximum inter-fire periods of the alpine communities being between 50 and 100 years, there seems to be no good ecological reason for burning them at anything less than 50- to 100-year intervals. In practical terms this would mean that they would never be scheduled for prescribed burning.

These long intervals represent the frequency of occurrence of wildfires in the alps and, taking into account the probability that disturbance from factors other than fire will occur, there may never be a particular need to deliberately burn these areas for ecological reasons. The only possible exception would be in circumstances where the 1-in-50 or 1-in-100 year wildfire event did not occur and one of the intolerant key fire response species was declining due to a lack of other disturbing factors. Monitoring of the key fire response species would show if this were likely to occur.

Influence of other environmental factors on setting fire regimes

Soils

Although, as discussed, many of the species studied were found to be highly robust in regard to fire frequency, other factors of the alpine environment, such as climate, soil type, grazing pressure, natural disturbances (particularly insects), timber harvesting and drought must influence any decision to apply prescribed fire. The most important outcome of the interaction of these factors, together with the influence of fire, is the potential for soil erosion.

Accelerated soil erosion was cited as one of the main reasons for the removal of all cattle grazing from the Kosciusko National Park in 1967 (Williams 1987). Similar concerns prompted the Victorian Government to restrict grazing in many parts of Victoria's Alps.

While fire is likely to have less impact on alpine soils than cattle grazing, disturbance by fire can nevertheless expose alpine soils to the rigours of the harsh climate with a very short growing season. Fire and grazing in combination could be expected to have an even more severe influence on soil erosion rates. Any decision to deliberately introduce a burning regime into areas which are subject to grazing would therefore have to be very well considered before implementation.

Land mangers should also recognise that the minimum inter-fire periods derived in this study relate only to the requirement to *retain all current species on the site* and do not represent an inter-fire period which will guarantee the maintenance of all other site attributes - particularly soil cover.

Impact of different fire intensities and unburnt areas

The observations on the limitations to the spread of the Caledonia fire in alpine vegetation communities (Table 3) and the proportion of each community on Holmes and Wellington Plains that was not burned (Table 4) indicate that even a very severe fire event is likely to leave enough of each community unburned to provide seed or vegetative material to recolonise the burnt areas. This assumes that the unburnt areas are not burned within the next 5 to 10 years. Prevention of subsequent fires in Alpine Heathland will be very important, given the very small area of this community which survived the fire and the fact that it contains a number of key fire response species which are obligate seeders.

The exception to the pattern of remnants surviving was found in some areas of Alpine Ash regrowth (which developed following harvesting or previous fires) which did not have a sufficient crop of seed to assure regeneration. An opportunity to compare regrowth of this species has been provided, as most burnt areas in the Carey State Forest were supplementary seeded while those in the Alpine National Park were not treated. This may lead to some local extinctions of Alpine Ash within the Alpine National Park.

Modification to fuel hazard

Another consideration would be whether fire could be used to modify current fuel hazard levels to better protect alpine communities from wildfire occurring within or outside them.

The Gippsland Fire Protection Plan (NRE 1999) does not include alpine vegetation communities within areas to be actively managed for fuel hazard reduction. Virtually all alpine areas are within Fuel Management Zones (FMZ) 4 or 5. Burning within FMZ 4 is driven only by ecological considerations while there is deemed to be no need to ever deliberately burn within FMZ 5 for either protection or ecological reasons.

The robustness of most of the alpine vegetation to fire (Appendix B) would indicate that there may be some scope ecologically to manage hazard levels within some alpine and sub-alpine communities. However, the Overall Fuel Hazard levels (McCarthy et al. 1998) in most mature alpine vegetation communities were found to be generally ***High*** or less. Overall Fuel Hazard levels of ***Very High*** or ***Extreme***, which give rise to significant fire-control problems (McCarthy & Tolhurst 1998), were not common except in some Alpine Ash Forests and occasionally in Alpine Heathland. However, Alpine Ash is sensitive to fire (it is readily damaged or even killed by fire) and is generally not prescribed burned. Prescribed burning would thereby be of limited value in terms of significantly reducing existing fuel hazard levels.

Fire response of fauna

Previous studies found the effects of fire on faunal populations to be related significantly to the survival or recovery time of their vegetative habitat. Tolhurst and Flinn (1992) reproduce the results from a number of studies into various types of fauna (birds, mammals, bats, invertebrates) in dry sclerophyll forest. They reported relatively consistent findings that the post-fire recovery of faunal populations related to both the amount of unburnt vegetative habitat remaining and the rate of recovery of the burnt areas.

Immediate post-fire increases and subsequent decreases in some species of fauna have been observed. Green and Osborne (1994) noted that post-fire seral Snow Gum Woodland supported one of the highest diversities of fauna, but that this diversity gradually declined as the structure changed with time. The reduction of shrubby understorey in older woodland caused a severe decline in the abundance of the smaller mammals.

While it was not possible to draw firm conclusions about faunal population dynamics following fire events in alpine vegetation, a general observation was that, because many alpine plant species are able to recover rapidly after a fire, a concurrent rapid recovery of associated faunal species could be expected. The survival of fauna in unburnt areas, of which there were some in each major vegetation type, could be expected to assist this recovery (Humphries & Tolhurst 1992). Notable exceptions may be those fauna that depend on either tree canopies or shrub strata, which take longer to re-establish.

Both Tolhurst (1992) and Friend (1994) noted that climatic factors had the capacity to override any effect of fire on the dynamics of faunal populations (particularly invertebrate). The severe climate may mean that it is a stronger determinant in alpine areas than fire, particularly given the rapid regrowth of snowgrass, one of the major components of alpine vegetation, in the first season following fire. Green and Osborne (1994) noted that grasshopper populations increased in response to the level of snow cover in a particular year, with years of lighter snow exposing the eggs to destructive freezing conditions. They also noted that sub-nivean spaces were important to the capacity of many species to over-winter in alpine areas.

The NSW National Parks and Wildlife Service is compiling a database of faunal fire responses for alpine areas (NPWS/NSW 1999) which should provide useful information on whether any fire regime, resulting from either prescribed burning or wildfire, will pose a significant threat to alpine faunal populations.

Conclusions

Deliberate prescribed fire is not required for the conservation of species in most alpine areas. The natural occurrence of one or two large landscape-scale wildfires per century is sufficient to provide regeneration opportunities for any species which has not otherwise been able to regenerate from other natural disturbance events. Smaller fires, particularly in grasslands, may occur more often than this with little impact in terms of loss of species or changes in structure.

The physical effects of fire in alpine environments, particularly the increased potential for soil erosion, are more severe than the ecological effects. Any increased frequency of fire in alpine areas will increase the potential for soil erosion.

Many alpine plant species are quite robust to fire events, with 75% of species being able to become regeneratively viable, either from seed or vegetatively, within the first two years after fire.

Sphagnum Bogland appears to have the poorest capacity to recover quickly to pre-disturbance cover values after fire or other disturbance, with the regeneration of both Sphagnum and Candle Heath being very slow post-fire.

Severe and extensive fires in alpine vegetation only occur after periods of severe drought. Such events have previously occurred only once or twice in a century.

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Appendix A

FIRE INFORMATION NOTE No.2

Part 3

Fire Research & Development

MONITORING THE ECOLOGICAL EFFECTS OF FIRE

- Vital Attributes –

The vital attributes of individual plant species are used to monitor vegetation composition, and to determine fire regimes which conserve all plant species. This method was developed by Noble and Slatyer to predict successional changes in plant communities subject to recurrent disturbances. Although succession is generally community-based, this method examines life history characteristics of individual species.

Succession is dependent on a number of factors. These include the species composition of a community immediately before the fire, the initial establishment in the absence of competition immediately after fire, later establishment of additional species in the presence of competition and the life span of all species.

There are three groups of vital attributes. The first group identifies the *method of persistence* during the fire. This is how a species persists or arrives into an area after a fire. There are two mechanisms available, either seed-based or vegetatively-based. However a combination of the two may be used by any one species. You will need to dig up some of the juvenile plants to determine the method of persistence for each species. **DO NOT** assume that because there is seed on the plant, that the method of persistence is by seed.

The second group of vital attributes identifies the *conditions required* by each species for establishment, and the ability to grow to maturity. When combined the first and second vital attributes give a 'species type'.

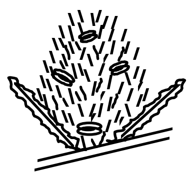
The third group identifies the *timing of the life stages* of each species. The length of time taken for each species to pass from one life stage to the next needs to be known.

The method works on identifying life history characteristics of all species in a specific community. It is these characteristics that are vital to the existence of individual species in vegetation replacement sequences. This method is based on classifying each species into a 'species type' (a combination of two vital attributes) and then examining the interaction between species to determine the succession replacement sequences. The breakdown of each vital attribute is given in Appendix 1.

The vital attributes model concentrates on the frequency of disturbance, however this method is flexible enough to apply to a variety of disturbance regimes. Community composition will also be affected by the intensity and the season of the disturbance.

There are a number of assumptions made when using this method. It is assumed that 100% of the area is burnt and all above ground shoots are killed. Generally the vital attributes of a species are consistent across a wide range of environments, but one should be alert to observe a different response in a different environment.

The advantages of using this method are that the results are qualitative and detailed. If no previous information exists, it may be time consuming to establish, however once established, this method is not difficult to maintain. You also need to be able to identify all species present in each community.



There are three major steps in determining fire regimes for a particular area. They are as follows:

1. A list of all plant species in each community needs to be constructed, and the vital attributes of each species must be identified.

2. The key species for each community need to be identified using the vital attributes. The key species are those that are most sensitive to frequent fire.

3. The frequency range between fires needs to be determined for species conservation.

Method:

1. Record location of site on map, including distance and compass bearing to a clearly identifiable and permanent point.
2. Maintain a field book, including the following details:
   - date and time;
   - location;
   - topography (aspect and slope).
3. Working through the site, assess and record the method of persistence, conditions for establishment and relative longevity for each species. You may need to dig up juvenile plants to determine the method of persistence. (Record in Figure 1.)
4. Determine the 'species type' for each species. (Example shown in Figure 2.)
5. Obtain an estimate of the longevity of each life stage by visiting a number of sites with a similar suite of species, but with a different post-fire age.
6. Identify the key species for each community. These species will be the most sensitive to frequent fires.
7. Line diagrams showing the replacement sequences for the community can then be constructed using the life stages of the key species.

NOTE : In determining the timing of the life stages, monitoring may be required over a number of years. Not all vital attributes of all species will be obtained with one or two measurements.

FURTHER READING:

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CONTACT:

For any queries or further details, please contact a Fire Research Scientist at Creswick Research Station on (053) 214-181 or (053) 214-162.

Figure 1. Record sheet for recording method of persistence, conditions for establishment and relative longevity for all species. (See Appendix 1 for definitions.)

Plant Community:			**Location :**		
Species	**Method of Persistence**	**Conditions for Establishment**	**Longevity (yrs)**		
			m	**l**	**e**

Figure 2. Table showing how to construct a 'species type'. (See Appendix 1 for definitions.)

Vital Attribute Group	**Biological Mechanism**	**Vital Attribute**	**Species Type**
Method of Persistence	long lived seed pool in the soil which is not exhausted after the first fire	S	SI
Conditions for Establishment	intolerant of competition from adults	I	

Appendix 1 to Fire Information Note No. 2

VITAL ATTRIBUTE GROUPS

1. Method of persistence:

Seed-based

D - seed dispersed long distances
S - seed stored, maintains viability for a long period, partial germination per disturbance
G - seed stored, maintains viability for a long period, single germination pulse
C - seed short-lived, exhausted after first disturbance

Vegetatively-based

V - sprouters : all ages survive, but all become juvenile
U - sprouters : mature remain mature and juveniles remain juvenile
W - sprouters : mature remain mature and juveniles die

Combination of seed and vegetative mechanisms

d - dispersed seed; mature remain mature and juveniles may or may not resprout
s - seed stored, with partial germination; mature remain mature and juvenile may or may not resprout
g - seed stored, with single germination pulse; mature remain mature and juveniles die

2. Conditions for establishment

T - tolerant; will establish in the presence of adult competition (multi-aged population)
I - intolerant; needs a disturbed site with competition removed (single-aged population)
R - requires some pre-condition to be met before establishment, delayed establishment

3. Relative longevity

m - the time taken for a species to reach reproductive maturity (sexual or vegetative)
l - the longevity of the species reproductive population within the community
e - the time taken to reach local extinction (no reproductive material remains)

Note that local extinction is dependent on the seed store as well as the death of mature individuals.

SENSITIVITY TO FIRE:

This will help in determining the key species of a community. The method of persistence needs to be considered first, especially when determining the lower end of the fire frequency range. Conditions for establishment are important when determining the upper end of the fire frequency range.

Method of persistence :

Most sensitive to fire:	G and C; because regeneration is by seed but all seed is used after a single fire.
Partially sensitive to fire:	W and g; because abundance levels will be reduced after a single fire.
Least sensitive to fire:	D, S, V, U, d and s; because these species should be able to re-establish after 2 or 3 fires in quick succession without loss of abundance.

Conditions for establishment :

Most sensitive to fire:	I and R; because only one age class is present so the species may die out without periodic disturbance.
Partially sensitive to fire:	T; because this is a multi-aged population able to establish over a long period of time.

Appendix 2 to Fire Information Note No. 2

WORKED EXAMPLE :

THIS IS AN EXAMPLE ONLY. The species used in this example can be found in the Grampians National Park, but are not necessarily from the one community.

1. Construct a species list and identify the vital attributes of each species.

Species	Method of Persistence	Conditions for Establishment	Longevity (yrs)		
			m	l	e
Arthropodium milleflorum	V	T	2	8	∞
Astroloma humifusum	V	I	2	25	25
Astroloma pinifolium	C	I	4	25	25
Baeckea ramosissima	V	I	2	20	20
Banksia marginata (shrub form)	Γ	I	5	35	36
Brunonia australis	U	T	2	15	15
Kennedia prostrata	S	I	3	25	50
Senecio hispidulus	W	I	2	10	10

2. Identify the key fire sensitive species.

In identifying the key species of a community, you must consider the effects of fire after 2 or 3 fires in quick succession. **The key species from this community are *Astroloma pinifolium*, *Banksia marginata* and *Senecio hispidulus*** because their method of persistence requires a period of time after one disturbance before they can withstand a second one. (Refer to Appendix 1 for details regarding the sensitivity classifications.) *Baeckea ramosissima* and *A.humifusum* also need to be considered because they only re-establish after a disturbance, but they are less sensitive than *A.pinifolium*, *Banksia marginata* and *S.hispidulus*.

3. Determine the frequency range between fires required for species conservation.

(i) First determine the lowest fire frequency by looking at the response and the longevity of the juvenile stage. Out of *A.pinifolium*, *B.marginata* and *S.hispidulus*, *B.marginata* takes the longest time to reach maturity, 5 years. Therefore you would not want a fire frequency of less than 5 years. If the fire frequency was at 4 years (i.e. suitable for *A.pinifolium* and *S.hispidulus*) *B.marginata* would not survive.

Please remember when determining the frequency range, that the first seed set will not necessarily be sufficient to maintain the abundance of a species. It may be up to double the age of the juvenile stage, before a species can reproduce enough material to maintain abundance of the species.

(ii) Next determine the longest inter-fire period before species start to die out. Look at the conditions required for establishment and time to local extinction. So looking at only those species with either an I or R classification, find the shortest time to local extinction. In this example, you would be looking at *A.humifusum*, *A.pinifolium*, *B.marginata*, *Baeckea ramosissima*, *Kennedia prostrata* and *S.hispidulus*. As *S.hispidulus* has the shortest period of time to local extinction, 10 years, you would want fire frequency to be more frequent than once every 10 years.

Therefore for this community, a fire is required once every 5 to 10 years. If any less frequent then *S.hispidulus* will die out, and if more frequent then *Banksia marginata* will not persist.

4. Continue to monitor the species in each community.

Monitoring of the key species in each community needs to continue after the vital attributes have been collected, so as to check that species are responding as predicted. Monitoring does not need to be carried out on a regular basis, but rather at times predicted by the vital attributes. For example, *B.marginata* should be monitored at approximately 5 years after fire to see if the species has reached maturity. Those species with unknown vital attributes also need to be monitored. If species are not responding as predicted then alterations need to be made to the vital attributes recorded and the fire regimes being used.

Appendix B

Alpine Fire Regimes Species Fire Response

Key to Appendix B

Scientific name

*	Introduced species are indicated by an asterisk before the scientific name.
**	Two asterisks after the scientific name indicates there is doubt about the method of persistence suggested by the classification.
***	Three asterisks after the scientific name indicates that the post-fire method of persistence is unknown.

Common name

N indicates no common name for the species

Life form

F = forb, M = monocot, S = shrub, T = tree, O = other

Plant community

This lists the range of alpine plant communities in which the species may be found, viz:
B = Sphagnum Bogland, G = Snow-grass Plains, H = Alpine Heathland,
W = Snow Gum Woodland

Locality

Indicates the area from which the data are derived, viz:

G = Gippsland High Plains, B = Bogong High Plains

Method of persistence

This lists the Vital Attribute data for each species according to the system employed by the respective researchers, whose initials appear as the sub-headings to the columns, viz:

HW = Henrik Wahren from Latrobe University who used the system for recording Vital Attribute data as set out in Fire Information Note No. 2 (Noble & Slatyer 1980; NRE 1996) (see Appendix A), as follows:

Seed-based mechanism	
D	- seed dispersed long distances
S	- seed stored, maintains viability for a long period, partial germination per disturbance
G	- seed stored, maintains viability for a long period, single germination pulse
C	- seed short-lived, exhausted after first disturbance
Vegetative mechanism	
V	- sprouters : all ages survive, but all become juvenile
U	- sprouters : mature remain mature and juveniles remain juvenile
W	- sprouters : mature remain mature and juveniles die
Combination of seed and vegetative mechanisms	
d	- dispersed seed; mature remain mature and juveniles may or may not resprout
s	- seed stored, with partial germination; mature remain mature and juvenile may or may not resprout
g	- seed stored, with single germination pulse; mature remain mature and juveniles die

Appendix B contined: Alpine Fire Regimes Species Fire Response Key to Appendix B

Method of persistence cont.

MG = (Malcolm Gill) – the following system for recording Vital Attribute data is set out in Gill (1995).

Category	Attribute
0	Unknown
Seed reproducers	
1	100% scorch kills, on plant seed storage
2	100% scorch kills, in soil seed storage
3	100% scorch kills, no storage in burnt area
8	category 1, 2, or 3, but which is unknown, and includes obligate seed regeneration
10	ferns
Resprouters	
4	survive 100% scorch, root suckers
5	survive 100% scorch, basal sprouts
6	survive 100% scorch, epicormics
7	survive 100% scorch, outgrowth of large apical bud
9	category 4, 5, 6 or 7, but which is unknown, and includes facultative resprouters
11	obligate resprouters

Note that some species display more than one method of persistence; any number above 11 in the 'Method of persistence' columns of the tables indicates a combination of the above categories.

KT/GM = Kevin Tolhurst/Greg McCarthy – recorded Vital Attribute data using a system which combined that set out in Fire Information Note No. 2 (described under HW above) and that set out by Gill (1995) and described under MG above.

Conditions for establishment (Tolerance)

T	tolerant; will establish in the presence of adult competition (multi aged population)
I	intolerant; needs a disturbed site with competition removed (single aged population)
R	requires some pre condition to be met before establishment, delayed establishment

Timing of life stages

(Sphagnum Bogland, Snow-grass Plains, Alpine Heathland, Snow Gum Woodland only)

Time to maturity: time (in years) taken for a species to reach reproductive maturity (sexual or vegetative)

Reproductive longevity: longevity (in years) of the species' reproductive population within the community

Total life span: time (in years) taken to reach local extinction (no reproductive material remains)

Note that 'Total life span' in these tables does not include an estimate of the time to loss of the seed store, which, together with the death of mature individuals, is the formal determinant of local extinction.

(Alpine Ash Forest only)

Juvenile: time (in years) to minimum reproductive maturity

Mature: age (in years) at which the species has full reproductive capability; that is, it can produce significant amounts of mature seed

Total life span: time (in years) taken to reach local extinction (no reproductive material remains)

Note that 'Total life span' in this table does not include an estimate of the time to loss of the seed store, which, together with the death of mature individuals, is the formal determinant of local extinction.

Appendix B contined: Alpine Fire Regimes Species Fire Response

Snow-grass Plains

Scientific name	Common name	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
					HW	MG	Tolerance	Time to maturity	Reproductive longevity	Total life span
Euphrasia collina ssp. *paludosa*	N	F	G	G	C	2	T	1	10	10
Agrostis parviflora	N	M	G	G	C	2	I	1	1	5
Agrostis venusta	N	M	G	G	C	2	I	1	1	5
**Aira praecox*	Early Hairgrass	M	GH	G	C	2	I	1	5	5
Craspedia coolaminica	Billy Button	F	G	G	d	25	T	1	10	10
Erigeron bellidioides	N	F	G	G	d	25	T	1	10	10
Euchiton fordianus	Cudweed	F	G	G	d	25	T	1	10	10
Euchiton gymnocephalus	Creeping Cudweed	F	GB	G	d	25	T	1	10	10
Bracteantha subundulata	N	F	GH	G	d	25	T	1	10	10
Craspedia aurantia	Billy Button	F	GH	G	d	25	T	1	10	10
Epilobium gunnianum	Gunn's Willowherb	F	GHBW	G	d	25	T	1	10	10
Craspedia jamesii	Billy Button	F	GHW	G	d	25	T	1	10	10
Caesia alpina	Alpine Grass-lily	M	G	G	g	25	T	1	5	5
**Aphanes arvensis*	Parsley Piert	F	G	G	S	2	T	1	10	10
Brachyscome decipiens	Field Daisy	F	G	G	S	2	I	1	10	10
Brachyscome rigidula	N	F	G	B	s	25	T	1	10	10
Brachyscome tenuiscapa	N	F	G	G	S	2	I	1	10	10
Cardamine lilacina	Bitter-cress	F	G	G	S	2	I	1	5	5
Limosella australis	Australian Mudwort	F	G	G	s	25	T	1	10	10
Oreomyrrhis argentea	Silver Carraway	F	G	G	S	2	T	1	10	10
Stellaria multiflora	Rayless Starwort	F	G	G	S	2	T	1	10	10
Wahlenbergia multicaulis	Tadgell's Bluebell	F	G	G	s	24	T	1	15	15
**Avena fatua*	Wild Oat	M	G	G	s	25	T	1	5	5
**Bromus hordeaceus*	Soft Brome	M	G	G	s	25	T	1	5	5
Australopyrum velutinum	Mountain Wheat-grass	M	G	G	s	25	T	1	1	5
Austrodanthonia pilosa	Velvet Wallaby-grass	M	G	G	s	25	T	1	5	5
Carex breviculmis	N	M	G	G	s	25	T	1	10	10
Deyeuxia crassiuscula	N	M	G	G	s	25	T	1	5	5
Deyeuxia monticoloa	N	M	G	B	s	25	T	1	5	5
Notodanthonia nudiflora	Alpine Wallaby-grass	M	G	G	s	25	T	1	5	5
Poa hiemata	Soft Snow-grass	M	G	B/G	s	25	I	1	10	10

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
Poa phillipsiana	Blue Snow-grass	M	G	B/G	s	25	T	1	10	10
Asterolasia trymaliodes	Alpine Starbush	S	G	G	S	2	I	5	45	50
Olearia algida	Alpine Daisy-bush	S	G	G	s	24	T	2	48	50
Poa costiniana	Bog Snow-grass	M	GB	B/G	s	25	I	1	10	10
Poa fawcettiae	Horny Snow-grass	M	GB	B/G	s	25	I	1	10	10
**Cerastium fontanum*	Common Mouse-ear Chickweed	F	GH	G	S	2	T	1	5	5
**Cerastium glomeratum*	Sticky Mouse-ear Chickweed	F	GH	G	S	2	T	1	5	5
**Taraxacum officinale*	Dandelion	F	GH	G	S	2	T	1	10	10
Acaena novae-zelandiae	Bidgee-widgee	F	GH	G	s	24	T	1	10	10
Acaena ovina	Sheep's Burr	F	GH	G	s	24	T	1	10	10
Aciphylla glacialis	Alpine Celery	F	GH	GB	s	25	T	1	15	15
Ajuga australis	Austral Bugle	F	GH	G	S	2	I	1	1	10
Brachyscome scapigera	N	F	GH	G	s	25	T	1	10	10
Geranium antrorsum	N	F	GH	G	S	2	T	1	10	10
Geranium potentilloides	N	F	GH	G	S	2	T	1	10	10
Gonocarpus micranthus	Creeping Raspwort	F	GH	G	S	2	T	1	10	10
Neopaxia australasica	White Purslane	F	GH	G	s	25	T	1	10	10
Scaevola hookeri	N	F	GH	G	S	2	T	1	10	10
Trachymene humilis	N	F	GH	G	S	2	T	1	15	15
Wahlenbergia ceracea	Waxy Bluebell	F	GH	G	s	24	T	1	15	15
**Poa pratensis*	Kentucky Blue-grass	M	GH	G	s	25	T	1	5	5
Trisetum spicatum	Bristle-grass	M	GH	G	s	25	T	1	10	10
Gonocarpus montanus	Mat Raspwort	F	GHB	G	S	2	T	1	10	10
**Acetosella vulgaris*	Sheep Sorrel	F	GHBW	G	s	24	T	1	5	5
**Hypochoeris radicata*	Catsear or Flatweed	F	GHBW	G	s	25	T	1	5	5
**Trifolium repens*	White Clover	F	GHBW	G	s	25	T	1	5	5
Asperula gunnii	Mountain Woodruff	F	GHBW	G	s	25	T	1	5	5
**Agrostis capillaris*	Brown-top Bent grass	M	GHBW	G	s	25	T	1	5	5
**Holcus lanatus*	Yorkshire Fog	M	GHBW	G	s	25	T	1	5	5
**Trifolium fragiferum*	Strawberry Clover	F	GHW	G	s	25	T	1	5	5
Asperula scoparia	Prickly Woodruff	F	GHW	G	s	25	T	1	5	5
Brachyscome spathulata	N	F	GHW	G	s	25	T	1	10	10
Oreomyrrhis eriopoda	Australian Carraway	F	GHW	G	S	2	T	1	10	10
Ranunculus graniticola	Granite Buttercup	F	GHW	G	s	25	T	1	15	15
Stellaria pungens	Prickly Starwort	F	GHW	G	S	2	T	1	10	10

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
Viola betonicifolia	Showy Violet	F	GHW	G	s	25	T	1	15	15
Viola hederacea	Ivy-leaved Violet	F	GHW	G	s	25	T	1	15	15
Austrostipa nivicola	Alpine Spear-grass	M	GHW	G	s	25	T	1	10	10
Carex hebes	N	M	GHW	G	s	25	T	1	10	10
Grevillea australis	Alpine Grevillea	S	GHW	G	S	2	I	10	40	50
*Hovea montana***	N	S	GHW	G	s	24	T	15	5	70
*Leucopogon montanus***	Snow Beard-heath	S	GHW	B	s	25	I	5	45	50
Microseris lanceolata	Yam daisy	F	GW	G	s	25	T	1	15	15
Senecio gunnii	N	F	GW	G	s	25	T	1	15	15
Senecio pinnatifolius var. *pleiocephalus*	Variable Groundsel	F	GW	G	s	25	T	1	15	15
**Anthoxanthum odoratum*	Sweet Vernal-grass	M	GW	G	s	25	T	1	5	5
Olearia erubescens	Silky Daisy-bush	S	GW	G	s	24	T	2	48	50
Herpolirion novae-zelandiae	Sky Lily	M	G	G	U	5	T	1	10	10
Leptorhynchos squamatus	Scaly Buttons	F	G	G	V	4	T	1	10	10
Dichelachne inaequiglumis	N	M	G	G	V	5	T	1	5	5
Baeckea ramosissima ssp. *ramosissima*	Rosy Baeckea	S	G	G	V	5	T	5	45	50
Leucopogon fraseri	Sharp Beard-heath	S	G	G	V	5	I	1	40	50
Trochocarpa clarkei	Lilac Berry	S	G	G	V	5	I	1	2	2
Epacris celata	N	S	GB	G	V	5	T	5	45	50
Pultenaea tenella	Delicate Bush-pea	F	GH	G	V	4	I	1	30	30
Lomandra longifolia	Spiny-headed Mat-rush	M	GH	G	V	4	T	1	15	15
Bossiaea foliosa	Leafy Bossiaea	S	GH	G	V	5	T	10	5	60
Cryptandra amara	N	S	GH	G	V	5	T	1	2	2
Epacris gunnii	Coral Heath	S	GHB	G	V	5	T	5	45	50
Hymenanthera dentata	Tree Violet	S	GHW	G	V	5	I	5	5	60
Kunzea muelleri	Yellow Kunzea	S	GW	G	V	5	I	5	45	50
Pimelea alpina	Alpine Rice-flower	S	GW	G	V	5	I	2	48	50
**Leucanthemum vulgare*	Oxeye Daisy	F	G	G	W	5	T	1	10	10
Alchemilla sp.	Lady's Mantle	F	G	G	W	5	T	1	10	10
Celmisia pugioniformis	Snow Daisy	F	G	G	W	5	T	1	15	15
Leptinella filicula	N	F	G	G	W	4	T	1	10	10
Pelargonium helmsii	N	F	G	G	W	5	T	1	10	10
Plantago alpestris	N	F	G	G	W	5	T	1	10	10
Podolepis robusta	N	F	G	G	W	5	T	1	15	15

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
Scleranthus singuliflorus	One-flowered Knawel	F	G	G	W	5	T	1	10	10
Solenogyne gunnii	N	F	G	G	W	5	T	1	15	15
Velleia montana	N	F	G	G	W	5	T	1	10	10
Veronica sp. aff. gracilis	N	F	G	G	W	4	T	1	10	10
Carex cephalotes	N	M	G	B	W	5	T	1	10	10
Eriochilus cucullatus	Parson's Bands	M	G	G	W	5	T	2	13	15
Festuca muelleri	Alpine Fescue	M	G	G	W	5	I	1	10	10
Stackhousia pulvinaris	Alpine Stackhousia	F	GB	G	W	5	T	1	10	10
Luzula modesta	N	M	GB	G	W	5	T	1	10	10
Prasophyllum sphacelatum	Alpine Leek-orchid	M	GB	G	W	5	T	2	13	15
Prasophyllum suttonii	Mauve Leek-orchid	M	GB	G	W	5	T	2	13	15
Stylidium graminifolium	Grass Trigger-plant	F	GBW	G	W	5	T	1	10	10
Rhodanthe anthemoides	Chamomile Sunray	F	GH	G	W	4	T	1	15	15
Scleranthus biflorus	Two-flowered Knawel	F	GH	G	W	5	T	1	10	10
Dichelachne crinita	Long-hair Plume-grass	M	GH	G	W	5	T	1	10	10
Derwentia derwentiana ssp. *derwentiana*	N	F	GW	G	W	4	T	1	10	10
Goodenia hederacea ssp. *alpestris*	N	F	GW	G	W	5	T	1	10	10
Helichrysum rutidolepis	Pale Everlasting	F	GW	G	W	4	T	1	10	10
Plantago euryphylla	N	F	GW	G	W	5	T	1	10	10

Appendix B contined: Alpine Fire Regimes Species Fire Response

Snow-gum Woodlands

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
					HW	MG	Tolerance	Time to maturity	Reproductive longevity	Total life span
Epilobium gunnianum	Gunn's Willowherb	F	GHBW	G	d	25	T	1	10	10
Craspedia jamesii	Billy Button	F	GHW	G	d	25	T	1	10	10
**Acetosella vulgaris*	Sheep Sorrel	F	GHBW	G	s	24	T	1	5	5
**Hypochoeris radicata*	Catsear or Flatweed	F	GHBW	G	s	25	T	1	5	5
**Trifolium repens*	White Clover	F	GHBW	G	s	25	T	1	5	5
Asperula gunnii	Mountain Woodruff	F	GHBW	G	s	25	T	1	5	5
**Agrostis capillaris*	Brown-top Bent grass	M	GHBW	G	s	25	T	1	5	5
**Holcus lanatus*	Yorkshire Fog	M	GHBW	G	s	25	T	1	5	5
**Trifolium fragiferum*	Strawberry Clover	F	GHW	G	s	25	T	1	5	5
Asperula scoparia	Prickly Woodruff	F	GHW	G	s	25	T	1	5	5
Brachyscome spathulata	N	F	GHW	G	s	25	T	1	10	10
Oreomyrrhis eriopoda	Australian Carraway	F	GHW	G	S	2	T	1	10	10
Ranunculus graniticola	Granite Buttercup	F	GHW	G	s	25	T	1	15	15
Stellaria pungens	Prickly Starwort	F	GHW	G	S	2	T	1	10	10
Viola betonicifolia	Showy Violet	F	GHW	G	s	25	T	1	15	15
Viola hederacea	Ivy-leaved Violet	F	GHW	G	s	25	T	1	15	15
Austrostipa nivicola	Alpine Spear-grass	M	GHW	G	s	25	T	1	10	10
Carex hebes	N	M	GHW	G	s	25	T	1	10	10
Grevillea australis	Alpine Grevillea	S	GHW	G	S	2	I	10	40	50
*Hovea montana***	N	S	GHW	G	s	24	T	15	5	70
*Leucopogon montanus***	Snow Beard-heath	S	GHW	B	s	25	I	5	45	50
Microseris lanceolata	Yam daisy	F	GW	G	s	25	T	1	15	15
Senecio gunnii	N	F	GW	G	s	25	T	1	15	15
Senecio pinnatifolius var. *pleiocephalus*	Variable Groundsel	F	GW	G	s	25	T	1	15	15
**Anthoxanthum odoratum*	Sweet Vernal-grass	M	GW	G	s	25	T	1	5	5
Olearia erubescens	Silky Daisy-bush	S	GW	G	s	24	T	2	48	50
Wahlenbergia gloriosa	Royal Bluebell	F	HW	G	s	24	T	1	15	15
Lycopodium fastigiatum	Mountain clubmoss	O	HW	G	s	10	T	1	5	5
Oxylobium ellipticum	Common Oxylobium	S	HW	G	s	25	T	5	45	50
Ozothamnus hookeri	Scaly Everlasting	S	HW	G	s	25	T	2	48	50
Podolobium alpestre	Alpine Oxylobium	S	HW	G	s	25	T	5	45	50

Scientific name	Common name	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
Arthropodium milleflorum	Pale Vanilla-lily	M	W	G	s	25	T	1	10	10
Dianella tasmanica	Tasman Flax-lily	M	W	G	s	25	I	1	10	10
Acacia alpina	Alpine Wattle	S	W	G	s	25	T	5	2	30
Olearia phloggopappa var. *flavescens*	Dusty Daisy-bush	S	W	G	s	24	T	2	48	50
Acacia dealbata	Silver Wattle	T	W	G	s	25	T	5	2	30
*Eucalyptus pauciflora***	Snow Gum	T	W	G	s	125	I	15	30	30
Polystichum proliferum	Mother Shield-fern	O	W	G	U	10	T	2	18	20
Hymenanthera dentata	Tree Violet	S	GHW	G	V	5	I	5	5	60
Kunzea muelleri	Yellow Kunzea	S	GW	G	V	5	I	5	45	50
Pimelea alpina	Alpine Rice-flower	S	GW	G	V	5	I	2	48	50
Coprosma hirtella	Rough Coprosma	S	W	G	V	5	T	5	2	30
Olearia megalophylla	Large-leaf Daisy-bush	S	W	G	V	5	T	2	48	50
Pimelea ligustrina ssp. *ciliata*	Tall Rice-flower	S	W	G	V	5	I	2	48	50
Polyscias sambucifolius	Elderberry Panax	S	W	G	V	4	T	5	45	50
Tasmannia xerophila	Alpine Pepper	S	W	G	V	5	I	5	45	50
Derwentia derwentiana ssp. *derwentiana*	N	F	GW	G	W	4	T	1	10	10
Goodenia hederacea ssp. *alpestris*	N	F	GW	G	W	5	T	1	10	10
Helichrysum rutidolepis	Pale Everlasting	F	GW	G	W	4	T	1	10	10
Plantago euryphylla	N	F	GW	G	W	5	T	1	10	10
Celmisia latifolia	Snow Daisy	F	W	G	W	5	T	1	15	15
Pterostylis decurva	Summer Greenhood	M	W	G	W	5	T	2	13	15
Uncinia compacta	N	M	W	G	W	4	T	1	10	10
Stylidium graminifolium	Grass Trigger-plant	F	GBW	G	W	5	T	1	10	10

Appendix B contined: Alpine Fire Regimes Species Fire Response

Sphagnum Bogland

Scientific name	Common name	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
					HW	MG	Tolerance	Time to maturity	Reproductive longevity	Total life span
*Richea continentis****	Candle Heath	S	B	G	?	89	?	?	?	50?
Isolepis aucklandica	N	M	B	G	C	2	T	1	5	5
Isolepis crassiuscula	Alpine Club-rush	M	B	G	C	2	T	1	5	5
Isolepis montivaga	N	M	B	G	C	2	T	1	5	5
Isolepis subtilissima	N	M	B	G	C	2	T	1	5	5
Euchiton gymnocephalus	Creeping Cudweed	F	GB	G	d	25	T	1	10	10
Epilobium gunnianum	Gunn's Willowherb	F	GHBW	G	d	25	T	1	10	10
Caltha introloba	Alpine Marsh-marigold	F	B	G	s	25	T	1	10	10
Chionogentias cunninghamii ssp. *cunninghamii*	Mountain Gentian	F	B	G	S	2	T	1	10	10
Cotula alpina	Alpine Cotula	F	B	G	s	25	T	1	10	10
Dichondra repens	Kidney Weed	F	B	G	S	2	T	1	5	5
Hydrocotyle sibthorpioides	N	F	B	G	s	24	T	1	10	10
Nertera granadensis	N	F	B	G	S	2	T	1	10	10
Oreomyrrhis ciliata	N	F	B	G	S	2	T	1	10	10
Pratia pedunculata	Matted Pratia	F	B	G	s	25	T	1	10	10
Pratia surrepens	Mud Pratia	F	B	G	s	25	T	1	10	10
Ranunculus millanii	Dwarf Buttercup	F	B	G	s	25	T	1	15	15
Ranunculus pimpinellifolius	Bog Buttercup	F	B	G	S	2	T	1	15	15
**Juncus effusus*	Soft Rush	M	B	G	s	25	T	1	20	20
Deyeuxia innominata	N	M	B	G	S	2	T	1	5	5
Juncus bufonius	Toad Rush	M	B	G	s	25	T	1	15	15
Juncus falcatus	Sickle-leaf Rush	M	B	G	s	25	T	1	15	15
Juncus homalocaulis	Wiry Rush	M	B	G	s	25	T	1	15	15
Schoenus calyptratus	Alpine Bog-rush	M	B	G	S	2	T	1	10	10
Poa costiniana	Bog Snow-grass	M	GB	B/G	s	25	I	1	10	10
Poa fawcettiae	Horny Snow-grass	M	GB	B/G	s	25	I	1	10	10
Gonocarpus montanus	Mat Raspwort	F	GHB	G	S	2	T	1	10	10
**Acetosella vulgaris*	Sheep Sorrel	F	GHBW	G	s	24	T	1	5	5
**Hypochoeris radicata*	Catsear or Flatweed	F	GHBW	G	s	25	T	1	5	5
**Trifolium repens*	White Clover	F	GHBW	G	s	25	T	1	5	5
Asperula gunnii	Mountain Woodruff	F	GHBW	G	s	25	T	1	5	5
**Agrostis capillaris*	Brown-top Bent grass	M	GHBW	G	s	25	T	1	5	5

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
**Holcus lanatus*	Yorkshire Fog	M	GHBW	G	s	25	T	1	5	5
Drosera peltata	Pale Sundew	F	B	G	V	5	T	1	5	5
Empodisma minus	Spreading Rope-rush	M	B	G	V	5	T	1	15	15
Sphagnum cristatum	N	O	B	G	V	11	T	1	70	70
Sphagnum subsecundum	N	O	B	G	V	11	T	1	70	70
Baeckea gunniana	Alpine Baeckea	S	B	G	V	5	T	5	45	50
Epacris breviflora	Drumstick Heath	S	B	G	V	5	T	5	45	50
Epacris glacialis	N	S	B	B	V	5	T	5	45	50
Epacris paludosa	Swamp Heath	S	B	G	V	5	T	5	45	50
Epacris celata	N	S	GB	G	V	5	T	5	45	50
Epacris gunnii	Coral Heath	S	GHB	G	V	5	T	5	45	50
Diplaspis hydrocotyle	Snow Pennywort	F	B	G	W	5	T	1	10	10
Hypericum japonicum	Matted St John's Wort	F	B	G	W	5	T	1	10	10
Myriophyllum pedunculatum	Mat Water-milfoil	F	B	G	W	4	T	1	10	10
Myriophyllum pedunculatum ssp. *longibracteolatum*	Mat Water-milfoil	F	B	G	W	4	T	1	10	10
Oschatzia cuneifolia	Wedge Oschatzia	F	B	G	W	4	T	1	10	10
Ranunculus gunnianum	Gunn's Alpine Buttercup	F	B	G	W	5	T	1	15	15
Utricularia dichotoma	Fairy Aprons	F	B	G	W	5	T	1	10	10
Carex appressa	Tall Sedge	M	B	G	W	5	T	1	10	10
Carex canescens	N	M	B	G	W	5	T	1	10	10
Carex cappilacea	N	M	B	G	W	5	T	1	10	10
Carex gaudichaudiana	N	M	B	G	W	5	T	1	10	10
Carex jackiana	N	M	B	G	W	5	T	1	10	10
Carpha nivicola	Broad-leaf Flower-rush	M	B	G	W	5	T	1	10	10
Luzula novae-cambriae	N	M	B	G	W	5	T	1	10	10
Oreobolus distichus	Fan Tuft-rush	M	B	G	W	5	T	1	10	10
Restio australis	Mountain Cord-rush	M	B	G	W	4	T	1	15	15
Thelymitra pulchella	Veined Sun-orchid	M	B	G	W	5	T	2	13	15
Stackhousia pulvinaris	Alpine Stackhousia	F	GB	G	W	5	T	1	10	10
Luzula modesta	N	M	GB	G	W	5	T	1	10	10
Prasophyllum sphacelatum	Alpine Leek-orchid	M	GB	G	W	5	T	2	13	15
Prasophyllum suttonii	Mauve Leek-orchid	M	GB	G	W	5	T	2	13	15
Stylidium graminifolium	Grass Trigger-plant	F	GBW	G	W	5	T	1	10	10

Appendix B contined: Alpine Fire Regimes Species Fire Response

Alpine Heathland

Scientific name	Common name	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
					HW	MG	Tolerance	Time to maturity	Reproductive longevity	Total life span
**Aira praecox*	Early Hairgrass	M	GH	G	C	2	I	1	5	5
Bracteantha subundulata	N	F	GH	G	d	25	T	1	10	10
Craspedia aurantia	Billy Button	F	GH	G	d	25	T	1	10	10
Epilobium gunnianum	Gunn's Willowherb	F	GHBW	G	d	25	T	1	10	10
Craspedia jamesii	Billy Button	F	GHW	G	d	25	T	1	10	10
**Cerastium fontanum*	Common Mouse-ear Chickweed	F	GH	G	S	2	T	1	5	5
**Cerastium glomeratum*	Sticky Mouse-ear Chickweed	F	GH	G	S	2	T	1	5	5
**Taraxacum officinale*	Dandelion	F	GH	G	S	2	T	1	10	10
Acaena novae-zelandiae	Bidgee-widgee	F	GH	G	s	24	T	1	10	10
Acaena ovina	Sheep's Burr	F	GH	G	s	24	T	1	10	10
Aciphylla glacialis	Alpine Celery	F	GH	GB	s	25	T	1	15	15
Ajuga australis	Austral Bugle	F	GH	G	S	2	I	1	1	10
Brachyscome scapigera	N	F	GH	G	s	25	T	1	10	10
Geranium antrorsum	N	F	GH	G	S	2	T	1	10	10
Geranium potentilloides	N	F	GH	G	S	2	T	1	10	10
Gonocarpus micranthus	Creeping Raspwort	F	GH	G	S	2	T	1	10	10
Neopaxia australasica	White Purslane	F	GH	G	s	25	T	1	10	10
Scaevola hookeri	N	F	GH	G	S	2	T	1	10	10
Trachymene humilis	N	F	GH	G	S	2	T	1	15	15
Wahlenbergia ceracea	Waxy Bluebell	F	GH	G	s	24	T	1	15	15
**Poa pratensis*	Kentucky Blue-grass	M	GH	G	s	25	T	1	5	5
Trisetum spicatum	Bristle-grass	M	GH	G	s	25	T	1	10	10
Gonocarpus montanus	Mat Raspwort	F	GHB	G	S	2	T	1	10	10
**Acetosella vulgaris*	Sheep Sorrel	F	GHBW	G	s	24	T	1	5	5
**Hypochoeris radicata*	Catsear or Flatweed	F	GHBW	G	s	25	T	1	5	5
**Trifolium repens*	White Clover	F	GHBW	G	s	25	T	1	5	5
Asperula gunnii	Mountain Woodruff	F	GHBW	G	s	25	T	1	5	5
**Agrostis capillaris*	Brown-top Bent grass	M	GHBW	G	s	25	T	1	5	5
**Holcus lanatus*	Yorkshire Fog	M	GHBW	G	s	25	T	1	5	5

Scientific name	**Common name**	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
**Trifolium fragiferum*	Strawberry Clover	F	GHW	G	s	25	T	1	5	5
Asperula scoparia	Prickly Woodruff	F	GHW	G	s	25	T	1	5	5
Brachyscome spathulata	N	F	GHW	G	s	25	T	1	10	10
Oreomyrrhis eriopoda	Australian Carraway	F	GHW	G	S	2	T	1	10	10
Ranunculus graniticola	Granite Buttercup	F	GHW	G	s	25	T	1	15	15
Stellaria pungens	Prickly Starwort	F	GHW	G	S	2	T	1	10	10
Viola betonicifolia	Showy Violet	F	GHW	G	s	25	T	1	15	15
Viola hederacea	Ivy-leaved Violet	F	GHW	G	s	25	T	1	15	15
Austrostipa nivicola	Alpine Spear-grass	M	GHW	G	s	25	T	1	10	10
Carex hebes	N	M	GHW	G	s	25	T	1	10	10
Grevillea australis	Alpine Grevillea	S	GHW	G	S	2	I	10	40	50
*Hovea montana***	N	S	GHW	G	s	24	T	15	5	70
*Leucopogon montanus***	Snow Beard-heath	S	GHW	B	s	25	I	5	45	50
Poa hothamensis	Ledge-grass	M	H	B/G	s	25	T	1	10	10
Olearia frostii	Bogong Daisy-bush	S	H	B	s	24	T	1	40	40
Olearia phloggopappa var. *subrepanda*	Dusty Daisy-bush	S	H	B	s	24	T	1	40	40
Ozothamnus alpinus	Alpine Everlasting	S	H	B	s	25	T	5	45	50
Ozothamnus secundiflorus	Cascade Everlasting	S	H	B	s	25	T	5	45	50
Phebalium phylicifolium	Alpine Phebalium	S	H	B	s	25	I	5	65	70
Phebalium squamulosum	Forest Phebalium	S	H	B	s	25	I	5	65	70
Wahlenbergia gloriosa	Royal Bluebell	F	HW	G	s	24	T	1	15	15
Lycopodium fastigiatum	Mountain clubmoss	O	HW	G	s	10	T	1	5	5
Oxylobium ellipticum	Common Oxylobium	S	HW	G	s	25	T	5	45	50
Ozothamnus hookeri	Scaly Everlasting	S	HW	G	s	25	T	2	48	50
Podolobium alpestre	Alpine Oxylobium	S	HW	G	s	25	T	5	45	50
Pultenaea tenella	Delicate Bush-pea	F	GH	G	V	4	I	1	30	30
Lomandra longifolia	Spiny-headed Mat-rush	M	GH	G	V	4	T	1	15	15
Bossiaea foliosa	Leafy Bossiaea	S	GH	G	V	5	T	10	5	60
Cryptandra amara	N	S	GH	G	V	5	T	1	2	2
Epacris gunnii	Coral Heath	S	GHB	G	V	5	T	5	45	50
Hymenanthera dentata	Tree Violet	S	GHW	G	V	5	I	5	5	60
Callistemon pityoides	Alpine Bottlebrush	S	H	G	V	5	T	5	45	50
Hakea microcarpa	Small-fruit Hakea	S	H	G	V	5	T	10	60	70

Scientific name	Common name	Life form	Plant community	Locality	Method of persistence		Conditions for establishment	Timing of life stages (years)		
Orites lancifolia	Alpine Orites	S	H	B	V	5	I	5	65	70
Prostanthera cuneata	Alpine Mint-bush	S	H	B	V	5	I	5	65	70
Rhodanthe anthemoides	Chamomile Sunray	F	GH	G	W	4	T	1	15	15
Scleranthus biflorus	Two-flowered Knawel	F	GH	G	W	5	T	1	10	10
Dichelachne crinita	Long-hair Plume-grass	M	GH	G	W	5	T	1	10	10

Appendix B contined: Alpine Fire Regimes Species Fire Response

Alpine Ash Forest

Scientific name	Common name	Method of persistence			Conditions for establishment	Timing of life stages (years)		
		KT/GM	HW	MG	Tolerance	Juvenile	Mature	Total life span
Acacia dealbata	Silver Wattle	S25	s	25	T			30
Acacia obliquinervia	Mountain Hickory Wattle	S2		0				
Acaena novae-zelandiae	Bidgee-widgee	S24	s	24	T	1	10	10
Agrostis sp. aff. hiemalis								
Ajuga australis	Austral Bugle		S		I	1	1	10
Arthropodium milleflorum s.l.								
Asperula conferta								
Asperula gunnii		S25	s	25	T	1	5	5
Asperula scoparia		S25	s	25	T	1	5	5
Asplenium flabellifolium	Necklace Fern			10				
Australina pusilla ssp. muelleri	Shade Nettle							
Baeckea gunniana		V5	V		T			5
Blechnum nudum	Fishbone Water-fern	D35		10				
Blechnum penna-marina								
Brachyscome aculeata	Branching Daisy							
Brachyscome spathulata ssp. spathulata	Spoon Daisy							
Carex appressa	Tall Sedge	W5	W	5	T	1		10
Carex breviculmis	Short-stem Sedge	S25	s	25	T	1		10
Cerastium glomeratum s.l.								
Coprosma hirtella	Rough Coprosma	V4	V	4	T			30
Daviesia latifolia	Hop Bitter-pea			5				
Derwentia derwentiana	Derwent Speedwell							
Deyeuxia quadriseta	Reed Bent-grass	V5		9				

Scientific name	**Common name**	Method of persistence			Conditions for establishment	Timing of life stages (years)		
		KT/GM	HW	MG	Tolerance	Juvenile	Mature	Total life span
Dianella tasmanica	Tasman Flax-lily	S25	s	25	I	1		10
Elymus scaber								
Epacris impressa	Common Heath	S25						
Epilobium billardierianum ssp. hydrophilum								
Eucalyptus dalrympleana ssp. dalrympleana								
Eucalyptus delegatensis ssp. delegatensis		C1			I	25	50	300
Eucalyptus pauciflora		S15						
Euchiton gymnocephalus s.s.	Creeping Cudweed	C2		8	T	4		
Euchiton involucratus s.s.								
Festuca muelleri		W5	W	5	I	1		10
Galium migrans	Bedstraw							
Gaultheria appressa								
Geranium potentilloides	Cinquefoil Cranesbill	S2	S	2	T	1		10
Glycine clandestina	Twining Glycine							
Gonocarpus montanus		S2	S	2	T	1		10
Gonocarpus tetragynus	Common Raspwort	V5		9				
Hakea lissosperma		C1				8	20	70
Helichrysum aff. Rutidolepis (Alps)								
Helichrysum rutidolepis s.l.								
Helichrysum scorpioides	Button Everlasting	V5		9				
Hydrocotyle algida								
Hydrocotyle hirta	Hairy Pennywort	C2		89				
Hypericum gramineum	Small St. John's Wort	C2		8		2		
Hypochoeris radicata								
Kunzea ericoides	Burgan	G1			I	5		5
Lagenifera stipitata	Common Lagenifera	V4		89				
Leptinella filicula		W4	W	4	T	1		10
Leptospermum grandifolium								
Leucopogon gelidus								
Leucopogon hookeri								
*Leucopogon montanus***	Snow Beard-heath	s25	s	25	I	5		45
Lomatia fraseri								
Luzula campestris spp. agg.	Field Woodrush							
Mentha laxiflora								
Olearia alpicola								
Olearia erubescens		s24	s	24	T			5
Olearia megalophylla		V5	V	5	T			5
Olearia myrsinoides	Silky Daisy-bush			0				

Scientific name	**Common name**	Method of persistence			Conditions for establishment	Timing of life stages (years)		
		KT/GM	HW	MG	Tolerance	Juvenile	Mature	Total life span
Olearia phlogopappa	Dusty Daisy-bush			8				
Oreomyrrhis ciliata		S2	S	2	T	1		10
Oreomyrrhis eriopoda			S		T	1		10
Oxylobium ellipticum		s25	s	25	T			5
Picris angustifolia ssp. merxmuelleri								
Pimelea axiflora ssp. axiflora								
Platylobium formosum	Handsome Flat-pea	s24		29				
Poa australis spp. agg.	Tussock Grass	V5						
Poa labillardierei var. labillardierei		V5						
Polyscias sambucifolia	Elderberry Panax	d34						
Polystichum proliferum	Mother Shield-fern	U	U	10	T			20
Pteridium esculentum	Austral Bracken	V4		4				
Ranunculus lappaceus	Australian Buttercup	C2						
Ranunculus plebeius s.l.								
Rubus parvifolius	Small-leaf Bramble			0				
Senecio gunnii		s25	s	25	T	1		15
Senecio linearifolius	Fireweed Groundsel			8				
Senecio minimus	Shrubby Fireweed	D3						
Senecio pinnatifolius								
Senecio quadridentatus								
Stackhousia monogyna	Creamy Candles	C2		9				
Stellaria pungens	Prickly Starwort	V4	S	2	T	1		10
Stylidium graminifolium	Grass Trigger-plant	U5	W		T	1		10
Tasmannia lanceolata								
Tasmannia xerophila	Alpine Pepper	V5	V	5	I	5		45
Veronica serpyllifolia								
Viola hederacea s.l.		C2			T	2		
Wahlenbergia gloriosa			s		T	1		15
Wahlenbergia stricta								