



CHAPTER 17

# The Australian Alps Bioregion

## 1. Location

Alpine habitats have a very limited extent in Australia, with a total coverage of 793,818 ha, 54.02% of which is in NSW. This bioregion is the smallest in NSW, occupying 0.54% of the state, and is one of the smallest bioregions in Australia. The bioregion spans 428,832 ha of NSW, with most of the remainder in Victoria (323,549 ha) and a small proportion (40,710 ha) in the southwest of the ACT. In NSW, the bioregion is entirely surrounded by the South Eastern Highlands Bioregion. In Victoria, it becomes discontinuous towards Mt Buffalo, with outlying patches.

Part of the Australian Alps Bioregion lies in the Murray-Darling Basin, encompassing the headwaters of the Murray, Murrumbidgee and Snowy rivers and traversed by the Tumut and Yarrangobilly rivers.

NSW towns in the bioregion include Cabramurra, the highest town in Australia, and the ski resort towns of Guthega, Perisher Valley, Smiggins Holes and Thredbo Village. Other notable areas include Yarrangobilly Caves, and Mts Kosciuszko, Jagungal and Tom Groggin.

## 2. Climate

Although dominated by a montane climate, with no dry season and a mild summer (Stern *et al.* 2000), the Australian Alps Bioregion contains a patch of true alpine climate. This area, in the southwest of the bioregion presents the only example of alpine and sub-alpine climate in NSW, characterised by no dry season and a cool summer.

The extreme climatic gradient across the alpine ranges is reflected in the soil and vegetation that pass from lowland eucalypt forest on texture contrast soils to alpine herbfield on organic uniform soils at the highest elevations. Above 1,400 m, snow may persist for 4 to 6 months and frost can occur throughout the year. The northeastern tip of the bioregion is representative of the temperate zone, which prevails in the New England Tableland, South Eastern Highlands and Sydney Basin bioregions where there is a warm summer and no dry season (Stern *et al.* 2000).

Mean Annual Temperature	Minimum Average Monthly Temperature	Maximum Average Monthly Temperature	Mean Annual Rainfall	Minimum Average Monthly Rainfall	Maximum Average Monthly Rainfall
3 – 12°C	-7 – 0.4°C	15.9 – 29.5°C	606 – 2,344mm	44 – 126mm	63 – 295mm

### 3. Topography

The Australian Alps Bioregion constitutes the highest section of the Great Dividing Range, and contains Australia's highest mountain, Mt Kosciuszko (2,228 m). The landscape is characterised by peaked ranges, and broad, forested valleys, and is the only true alpine environment in NSW.

### 4. Geology and geomorphology

The alpine area comprises granites that have formed faulted, stepped ranges at the point where the South Eastern Highlands in NSW turn west into Victoria. More recent volcanic activity produced basalts and, in the Pleistocene, the cold climate superimposed glacial features on the landscape.

The bioregion was the only part of the mainland to have been affected by Pleistocene glaciation and contains a variety of unique glacial and periglacial landforms above 1,100m altitude. Evidence of glaciation has been obtained from pollen preserved in alpine and subalpine lakes and bogs.

The original uplift of the steep seaward scarp of the Great Divide is attributed to the intersection of two coastal uplift zones created by the opening of the Tasman Sea and Southern Ocean during the break up of Gondwana. Elsewhere, more recent volcanic activity in the Tertiary produced the basalts found in the Cabramurra-Kiandra area.

The upper surfaces of the granite blocks have a low relief and form an environment of high plains where cold air drainage has a major impact on vegetation patterns. Stream patterns have also been affected by the geology.

Meandering systems on the high plains become deeply incised gorges with waterfalls and cascades as the streams cross the fault block margins. Larger streams follow major fault lines such as the Thredbo-Crackenback valley.

### 5. Geodiversity

Important features include the following:

- the bioregion contains Australia's highest mountain (Mt Kosciuszko 2,228m) and is the only part of the mainland to boast a suite of Pleistocene glacial and periglacial landscape features;
- there are well-documented karst landforms at Yarrangobilly and Cooleman;
- there are pseudokarst landforms in alpine block streams and boulder piles;
- the sub-basalt sediments at Kiandra are exposed by mining and contain important leaf fossils preserved in lignite;
- mining heritage items relating to sluicing and dredging operations are present; and
- construction works of the Snowy Mountains Hydro-Electric Authority, which began in 1949, are also heritage items in the context of engineering geology.

### 6. Soils

The soils of this bioregion reflect the extreme climatic gradient across the ranges. The lowlands consist mainly of texture contrast soils, grading to uniform, organic soils and peats at the highest elevations.



Photo: D. Perryman

7. Biodiversity

7.1 Plant communities

Both altitude and rainfall influence the vegetation communities of the Australian Alps Bioregion. There are four main physiographic elements to the bioregion, these being alpine, sub-alpine, montane and tableland areas (NSW NPWS 1988).

7.1.1 Alpine (areas above 1,850 m)

Tall alpine herbfield and heathland communities dominate the high alpine areas of the bioregion (Costin *et al.* 1979). Other communities such as sod tussock grassland, short alpine herbfield, feldmark (unique species or communities of prostrate plants that occur in remote alpine regions), bog and fen can occur where the effects of temperature, aspect, drainage and exposure impede the growth of tall herbfields (NSW NPWS 1988).

The highly organic soils of the alpine areas support about 200 plant species (Mitchell 2002). *Brachycombe nivalis*–*Danthonia alpicola* and *Poa* sp.–*Celmisia* sp. associations dominate the tall alpine herbfield communities (NSW NPWS 1988). Species such as the silver snow daisy (*Celmisia* sp.), ribbony grass (*Chionochloa frigida*), mountain celery (*Aciphylla glacialis*) and white purslane (*Neopaxia australasica*) also occur here (Mitchell 2002).

Tall herbfields on the flat or gentle sloping valley floors support sod tussock grasslands and several other inter-tussock herbs, especially Asteraceae species, including some that are rare and endemic (NSW NPWS 1988). Prickly snow grass (*Poa costiniana*) and alpine wallaby grass (*Danthonia nudiflora*) occur in tussock grasslands (Mitchell 2002).

*Plantago* sp. (*Neopaxia australasica*) associations dominate the short alpine herbfield communities that grow in areas below snowdrifts where cold snow water hampers the growth of the taller herbfield species (NSW NPWS 1988). Several other significant species comprise the community, including *Caltha introloba*, which has the unique characteristic of commencing flowering beneath the snow, and other low-growing species such as *Dichosciadium ranunculaceum*, *Brachycome stolonifera*, *Diplaspis hydrocotyle* and *Parantennaria uniceps* (NSW NPWS 1988).

Valleys and raised bogs support sphagnum, sedge (*Carex gaudichaudiana*) and heath (*Epacris glacialis*). The unique feldmark communities of the alpine region support ground-hugging alpine species such as coral heath (*Epacris microphylla*), eye-bright (*Euphrasia collina*), silver ewartia (*Ewartia nubigena*) and felted buttercup (*Ranunculus muelleri*), which are found on extremely stony and exposed snow patch sites (Mitchell 2002).

A high proportion of alpine species are endemic and all have restricted ranges (Mitchell 2002).

7.1.2 Subalpine (areas between 1,400 and 1,850 m)

*Eucalyptus pauciflora*–*E. pauciflora* ssp. *niphophila* (snow gum) woodland dominates the sub-alpine areas of the bioregion, interspersed with extensive open grasslands and heath (Mitchell 2002). About 80% of these woodlands have regenerated following severe bushfires over the last 50 years. A dense understorey of shrubs lies beneath the tree canopy, including *Oxylobium ellipticum*–*Podocarpus lawrencii* associations, with *Bossiaea foliosa* species (NSW NPWS 1988). These species form both the tall, shrubby understorey and, on exposed sites, dense heaths. A short heath of *Kunzea muelleri*–*Epacris* spp. grows in place of the tall heath on sites with poor drainage (NSW NPWS 1988).

Cold air drainage into the valleys, known as frost hollows, prevents trees growing in the sod tussock grasslands on the valley floors where *Poa* sp.–*Danthonia nudiflora* associations dominate (NSW NPWS 1988). Bogs and fens develop here in the valleys where the water tables rise up to or above the ground. Fen communities are dominated by *Carex* species and are limited by permanent watercourses or are part of bog communities, which are usually defined by *Sphagnum* species.

7.1.3 Montane (areas between 1,100 and 1,400 m)

The montane areas of the bioregion are dominated by forests and woodlands of stringybarks and gums which grow in sequence from swamp gums (*Eucalyptus ovata*), peppermint forests (narrow-leaved peppermint *E. radiata*) and blue gums (*E. globulus* ssp. *bicostata*) on the lower slopes, to mountain gum (*E. dalrympleana*), candlebark (*E. rubida*), ribbon gum (*E. viminalis*) and alpine ash (*E. delegatensis*) which eventually give way with altitude to pure stands of snow gum which grow directly below the treeline (Costin *et al.* 1979).

These montane forests and woodlands are mainly associated with snow gums, including *E. pauciflora*, *E. dalrympleana*, *E. rubida*, *E. viminalis*, and *E. stellulata*. *E. delegatensis* dominates the wetter areas with southerly and southeasterly aspects (NSW NPWS 1988). This wet sclerophyll forest has an understorey of species, including *Bossiaea foliosa*, that are similar to those in sub-alpine areas. *E. globulus* ssp. *bicostata*, *E. glaucescens* and *E. fastigata* occur in more sheltered areas as dominant trees or are co-dominant with other species or associations. Isolated occurrences have been recorded for *E. kybeanensis*, *E. chapmaniana*, *Acacia dallachiana* and *Atherosperma moschatum* (NSW NPWS 1988). The more westerly aspects comprise narrow-leaved peppermint (*E. radiata*)–ribbon gum (*E. viminalis*)–candlebark (*E. rubida*) associations as dominants. Sheltered areas with easterly aspects are dominated by brown barrel (*E. fastigata*)–alpine ash (*E. delegatensis*) associations (NSW NPWS 1988) and black sallee (*E. stellulata*) lines the streams on the high plains (Mitchell 2002).

High plains grasslands are dominated by snow grass (*Poa* sp.) with patches of heath that include leafy bossiaea (*Bossiaea foliosa*), yellow kunzea (*Kunzea muelleri*), royal grevillea (*Grevillea victoriae*), alpine pepper (*Tasmannia xerophila*), small-fruit hakea (*Hakea microcarpa*) and mountain shaggy pea (*Oxylobium alpestre*). Sphagnum bogs (*Sphagnum cristatum*) with candle heath (*Richea continentis*) and swamp heath (*Epacris paludosa*) occur at the head of most creeks (Mitchell 2002).

7.1.4 Tableland (areas below 1,100 m)

Savannah woodlands are common in the tableland areas of the Australian Alps Bioregion and are dominated by *E. melliodora*–*E. blakelyi* and *E. viminalis*–*E. rubida* associations (NSW NPWS 1988). Mixed eucalypt forest is found at the lowest elevations (Mitchell 2002). On dry aspects or well-drained granites, the forests are typified by red stringybark (*E. macrorhyncha*), white gum (*E. rossii*), broad-leaved peppermint (*E. dives*), candlebark (*E. rubida*), and brittle gum (*E. mannifera*) with a diverse understorey of shrubs and grasses (Mitchell 2002). On sedimentary rocks or in moist aspects and higher rainfall areas, more common tree species include alpine ash (*E. delegatensis*), mountain gum (*E. dalrympleana*), narrow-leaved peppermint (*E. radiata*), manna gum (*E. viminalis*) and brown barrel (*E. fastigata*) (Mitchell 2002). The peppermints (broad-leaved *E. dives* and narrow-leaved *E. radiata*) are dominant on exposed sites, while *E. dalrympleana*, *E. pauciflora* and *E. viminalis* occur at higher altitudes in moister areas (NSW NPWS 1988). Moist gullies support soft tree ferns (*Dicksonia antarctica*), blackwood (*Acacia melanoxylon*), southern sassafras (*Atherosperma moschatum*) and hazel pomaderris (*Pomaderris aspera*).

7.2 Significant flora

Within the alpine areas of the bioregion there are about 30 exclusively alpine species and 21 locally endemic species (NSW NPWS 1988). Furthermore, 61 species are singularly representative of their genus and 20 are singular representatives of their family that grows above the treeline.

Feldmarks cover less than one per cent of alpine areas (NSW NPWS 1988). Cold feldmarks are found in sheltered areas of high mountain saddles, while wind-swept feldmarks occur in more exposed locations at higher altitudes on the windward side of saddles. Feldmark communities support *Coprosma pumila*–*Colobanthus* sp. and *Epacris microphylla*–*Chionohebe densifolia* associations.

7.3 Significant fauna

The record of species such as the tiger quoll (*Dasyurus maculatus*) and koala (*Phascolarctos cinereus*) in Kosciuszko National Park is significant, because these species are not recorded frequently in NSW and their ranges in the park appear to be diminishing (NSW NPWS 1988). The broad-toothed rat (*Mastacomys fuscus*) was once widespread throughout southeastern Australia and is now restricted to certain areas of the Australian Alps Bioregion within Kosciuszko National Park (NSW NPWS 1988).

The eastern or Tasmanian bettong (*Bettongia gaimardi*) has been recorded in the Australian Alps Bioregion since European settlement although it has not been seen for many years and is now considered to be extinct on the Australian mainland. Like the bettong, the eastern quoll (*Dasyurus viverrinus*) has been recorded in the bioregion and unconfirmed reports were received occasionally until 1970, the date of the last report (NSW NPWS 1988).

Of the 202 bird species recorded in Kosciuszko National Park, two are locally extinct. The orange-bellied parrot (*Neophema chrysogaster*), which is now extinct in the bioregion, was known from a single specimen collected in Thredbo in 1917. The Australian bustard (*Ardeotis australis*) is also locally extinct, having been recorded in the park in 1896, and it is now known only from the far northwest of NSW (NSW NPWS 1988)

Other species have not been recorded in Kosciuszko National Park for many years. These include the masked owl (*Tyto novaehollandiae*, last recorded in 1896), the banded plover (*Vanellus tricolour*, in 1946) and the southern whiteface (*Aphelocephala leucopsis*, also in 1946) although they may still be present in small numbers (NSW NPWS 1988). Some species regarded as uncommon or scarce in NSW have been seen in the Park. These include the pink robin (*Petroica rodinogaster*), the black-eared cuckoo (*Chrysocossyx osculans*) and the blue-winged parrot (*Neophema chrysostoma*).

The variety of altitudes in the bioregion gives rise to altitudinal migration throughout the year. Birds such as the pipit (*Anthus novaeseelandiae*), nankeen kestrel (*Falco cenchroides*) and the Australian magpie (*Gymnorhina tibicen*) occupy the treeless alpine areas during summer, retreating to lower elevations in autumn. Some species, however, are not discouraged by the harsh winter climate of the higher altitudes; the gang-gang cockatoo (*Callocephalon fimbriatum*) inhabits the sub-alpine snow gums even in winter (NSW NPWS 1988).

As no Australian bird species are truly alpine, and none is endemic to the bioregion, the Australian Alps Bioregion has a low bird species diversity, the frequently sighted species generally living in the woodlands adjacent to the alpine grass and herbfields. Declines in species such as the gang-gang cockatoo and the flame robin, which occupy higher altitudes, may reflect the warmer weather of the last few decades although this cannot be confirmed without further studies. However this loss of upland species and a

contraction of grassland is a likely future scenario if the trend towards higher temperatures continues.

Reptiles and frogs in the Australian Alps Bioregion display a surprising degree of diversity considering its harsh climate. There are reported to be 31 species of reptiles in Kosciuszko National Park. One of these, the alpine water skink (*Sphenomorphus koscuiskoi*), is restricted to habitats higher than 1,000 m in the southern tablelands and so its range is almost entirely restricted to the Park. There are 7 snakes known to occur in the Park although some species are rarely seen. Of the lizards known to occur in the Park, some have not been recorded for many years (NSW NPWS 1988). There are reported to be 11 species of frogs in the Park, including the unusual corroboree frog (*Pseudophryne corroboree*), which can be identified by its distinctive black and yellow markings and is found in the sphagnum bogs of the alpine areas. The species is known to have 2 forms, a northern form, which occurs mainly in the ACT, and a southern form, which may be endemic to Kosciuszko National Park.

The rivers in the east of Kosciuszko National Park support species of migratory eels and two freshwater fish species from the galaxiid family, while species of perch, gudgeon, Murray cod and possibly galaxiids occur in the western rivers. Brown, rainbow and brook trout, as well as Atlantic salmon and redfin, have been introduced to the rivers in the bioregion (NSW NPWS 1988).

7.4 Significant wetlands

All of the wetlands of the bioregion are considered to be in near pristine condition despite problems with feral animals and impacts from tourism activities. No decline in status is evident, largely because they have been protected within Kosciuszko National Park.

Blue Lake is the only dimictic lake in mainland Australia, meaning its thermal layers are mixed completely twice each year. Such glacial lakes are significant because they are low in nutrients and are completely iced over for half the year, providing key habitat for species of invertebrate fauna not found elsewhere (ANCA 1996).

Kosciuszko alpine fens, bogs and lakes are the only alpine wetlands in NSW. Alpine plant succession in the area has been studied since the exclusion of cattle grazing in 1958 (ANCA 1996). The sphagnum bogs of these wetlands are probably suitable breeding habitat for the southern corroboree frog.

Rennex Gap lies at the inside edge of the sub-alpine snow gum woodland of Mt Kosciuszko and is considered to be a good example of upland peatland. The area provides fire and vegetation histories close to the Pleistocene ice cap (ANCA 1996). Snowgum Flat, like Rennex Gap, is also a good example of upland peatland and is representative of low altitude sub-alpine bogs characteristic of the southern end of Kosciuszko National Park (ANCA 1996).

8. Regional history

8.1 Aboriginal occupation

The Australian Alps Bioregion was the traditional home of two Aboriginal groups. The Walgal people occupied the northern part of the bioregion near Kiandra in what is now Kosciuszko National Park, while the Ngarigo people lived in the region around the highlands (HO and DUAP 1996).

Many of the Aboriginal groups in the southern part of NSW gathered in the Australian Alps Bioregion in the summer months on an annual pilgrimage to the Bogong and Snowy Mountains. Here, the men participated in a feast of bogong moths (*Agrotis infusa*) that were to be found in abundance on the rocky outcrops of the mountains (HO and DUAP 1996).



The traditional lifestyles of the local Aborigines, including the annual Bogong moth feast, were disrupted from the late 1820s when graziers brought stock into the area and are considered to have ceased by 1850 in this and nearby bioregions (HO and DUAP 1996). Diseases brought in by the new settlers infected Aboriginal communities, diminishing their population in this bioregion and across NSW (HO and DUAP 1996).

8.2 European occupation

Due to the pressure for grazing land, squatters with cattle occupied the Australian Alps Bioregion and surrounds by the 1820s, moving outside the “limits of location” set for the colony at the time (NSW NPWS 1991). Almost all areas, from the base of the Alps to the coast, were already occupied by squatters on land suitable for grazing both sheep and cattle (HO and DUAP 1996). It was not until the 1860s that the settlers realised the potential of alpine grazing and stock were moved up into the alpine areas during summer and returned to the valleys in autumn. Sometimes this practice ended in disaster when winter set in early (HO and DUAP 1996), resulting in loss of both stock and men (NSW NPWS 1991). This practice led to the introduction of snow leases, which ran from 1889 until 1957 when their impact on the vulnerable alpine environment was recognised and the leases were abolished.

By then, the stock routes for cattle and sheep were well-trodden and the stockmen’s huts which can be found along the route are now important heritage items in the area (HO and DUAP 1996). In 1859, the discovery of gold at Kiandra, northeast of Cabramurra, rapidly stimulated a gold rush. Many miners arrived in Kiandra in the winter of 1860 in readiness to start mining in the spring. It was at about this time that skiing was introduced at Kiandra by gold miners from northern Europe (NSW NPWS 1991). Of course, skiing has remained an important part of the social history of the bioregion and a popular tourist drawcard to the present day. During its peak, the Kiandra goldfield supported 10,000 people, including several hundred Chinese miners. The Kiandra goldrush lasted until early 1861 at which time miners moved on to the next prospering fields (NSW NPWS 1991). The Chinese miners brought with them their traditional ways, using yokes to carry equipment through the harsh alpine country. Several remained in the bioregion, some establishing stores which lasted until the 1900s.

While gold rushes moved around the countryside with each new discovery, small-scale mining continued in the Australian Alps Bioregion from 1905-1930, becoming more profitable with the introduction of hydraulic sluicing and dredging (NSW NPWS 1991). Remnants of gold, silver and tin mining occur in what is now the southern end of Kosciuszko National Park.

The Snowy Mountains Hydro-Electric Scheme altered the bioregion considerably from 1949, both physically and demographically. Construction of the scheme began at Adaminaby in the South Eastern Highlands Bioregion (Department of Immigration website – <http://www.immi.gov.au/> ). Several towns in the Australian Alps Bioregion, for example Khancoban and Cabramurra, owe their existence to the scheme, which brought around 100,000 people to the area over a 25-year period (Snowy Mountains Hydro-Electric Scheme website – <http://www.snowyhydro.com.au/>).

Kosciuszko National Park, which occupies most of the bioregion, was gazetted in 1967 but had been recognised under the Kosciuszko State Park Act since 1944. In 1977 the United Nations Educational, Scientific and Cultural Organisation (UNESCO) recognised Kosciuszko National Park under its *Man and the Biosphere* program as an “International Biosphere Reserve”, one of only 2 in NSW (UNESCO website – [www2.unesco.org/mab/br/brdir/directory/biores.asp](http://www2.unesco.org/mab/br/brdir/directory/biores.asp)).

Land use is restricted to sheep and cattle in the rugged areas (HO and DUAP 1996) and has resulted in an important wool, mutton and beef industry in the bioregion and surrounds. Dairying was important for a time in the 1890s but this lasted only until the 1920s. Although the region was subject to some drought and low wool prices in the 1840s and again in the 1880s, the great drought of the late 1890s did not affect the bioregion. Rabbits were not such a problem here as in the west.

9. Bioregional-scale conservation

In NSW, the Australian Alps Bioregion receives the highest proportion of conservation-oriented management of any of the NSW bioregions, constituting about 90.34% of the bioregion, or 386,744.96 ha. While the area under some form of conservation-oriented management is large, the range of mechanisms used is relatively small.

Most conservation occurs in national parks and nature reserves. Kosciuszko National Park occupies a large proportion (87.18%) of the bioregion, while the remaining reserved areas within the bioregion consist of Bimberi, Scabby Range and Yaouk Nature Reserves. Almost one-third of the area of national parks and nature reserves are also managed under the Wilderness Act 1987, comprising the Bimberi, Bogong Peaks, Goobarragandra, Jagungal and Pilot wilderness areas which occupy approximately 32.80% of the bioregion.

Of the other conservation mechanisms listed in the NPW Act 1974, only the voluntary conservation agreement and wildlife refuge provisions are utilised. There are no historic sites, no Aboriginal areas, no state recreation areas and no regional parks in the bioregion.

One voluntary conservation agreement has been entered into by a landholder within the bioregion. This agreement occupies 90.95 ha or 0.02% of the bioregion. One wildlife refuge occupying 217.35 ha or 0.05% of the bioregion is held by another landholder in the bioregion. Two more wildlife refuges are likely to be added in the near future. There is also one property agreement (NVC Act 1997). The conservation zone of this property agreement occupies an area of 120.23 ha or 0.03% of the bioregion. Thus the total area of land managed in the Australian Alps under private land conservation legislation constitutes 0.10% of the bioregion, or 428.53 ha.

Some land is managed under the Forestry Act 1916. While there are no formal or informal reserves (Forest Management Zones 1, 2 and 3a) in the bioregion there are 2 state forests, Maragle and Ingebirah, which are managed for a range of forestry activities including timber production and forest management. Together these occupy about 2,486 ha or 0.58% of the bioregion.

10. The sub-region of the Australian Alps Bioregion

The entire NSW portion of the Australian Alps Bioregion has been delineated as a sub-region.  
(Morgan 2001)

Geology	Characteristic landforms	Typical soils	Vegetation
Block-faulted granites and Palaeozoic metamorphic rocks. Small areas of Tertiary basalt with buried river gravels and lake sediments. Quaternary glacial landforms and sediments above 1,800 m, more extensive periglacial features above 1,200 m.	Low-relief high plains with steep margins and slopes and fault aligned river valleys with deep gorges and waterfalls. Relic cirque glaciers, blockstreams and periglacial solifluction lobes in highest regions.	Soils change with altitude. At lower levels in forests texture contrast soils are the norm. In the sub-alpine snow gum areas deep gradational soils with moderate amounts of organic matter are common. Above the tree line, wet, alpine humus soils with abundant organic matter are widespread. Steep slopes have stonier, shallow profiles.	Vegetation changes with altitude, aspect, cold air drainage and soil saturation. Low elevations with dry aspects carry red stringybark, white gum, broad-leaved peppermint, candlebark and brittle gum. Moist sites have alpine ash, mountain gum, narrow-leaved peppermint, manna gum and brown barrel, with tree ferns, blackwood and sassafras in gullies. Between 1,000 and 1,500 m alpine ash and mountain gum dominate and abruptly change to sub-alpine snow gum woodlands, heath, grasslands and bogs between 1,500 and 1,800 m. Common species include snow grasses, leafy bossiaea, yellow kunzea, alpine pepper and sphagnum bogs, with candle heath and swamp heath. Alpine herbfield and rare feldmark communities are found above the tree line at 1,800 m. Common species include prickly snow grass, alpine wallaby grass, silver snow daisy, ribbony grass, white purslane, eye-brights, gentians and buttercups. Most alpine species have a limited range.

11. References

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