

New Perspectives on the Ecology of Lake Mountain (ii): Significant Ecological Communities and Species

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Introduction

Significant ecological communities and species which have a restricted biogeographic range are in decline or are vulnerable to threats. Such sites of high conservation significance occur on the Lake Mountain plateau and include the communities and species highlighted below. The transitional communities and Leadbeater's Possum habitat in sub-alpine woodland were described in Part 1 (*The Victorian Naturalist* 1995, 112, 112-115).

Within the Echo Flat-Long Heath area, five plant taxa are recognised as having state or national significance and 33 have regional significance. Without exception, all 38 plant species are of regional or state significance because they are restricted to alpine or sub-alpine environments and are at their geographic limit within the region or the state. In particular, the Victorian endemic, Baw Baw Berry *Wittsteinia vacciniacea* is the only member in southeastern Australia of the Gondwanic family, Alseuosmiaceae and thus has special biogeographic and evolutionary significance (Table 1).

The most significant community at Lake Mountain is the wet sub-alpine heathland of the Echo Flat-Long Heath area (Fig. 1). It also supports the highest density of small mammals and all the amphibians in the area (Jelinek and Belcher, 1994) as well as a high diversity of aquatic macroinvertebrates (Doeg *et al.*, 1994).

Previous studies at Lake Mountain include an assessment of the dynamics of the wet heath at Echo Flat by Ashton and Hargreaves (1983). Reports of excursions to Lake Mountain by the Field Naturalists Club of Victoria over many years describe other aspects of the area's ecology and they also provide an important historical perspective. These include Morris (1929),

Willis (1948), Garnet (1948, 1949), Smith (1979) and Calder (1993).

This paper highlights significant ecological communities and species recorded during an assessment of environmental impacts of two proposed cross-country ski trails at Lake Mountain in December 1993 (CNR 1994). A special feature of the flora and fauna surveys was the inclusion of bryophytes, macrolichens, fish and aquatic macroinvertebrates in addition to observa-

Table 1. Significant Plant Taxa.

A. Taxa of State or National Significance
Baeckea, Mountain, <i>Baeckea utilis</i> var. <i>latifolia</i>
Baw Baw Berry, <i>Wittsteinia vacciniacea</i>
Daisy, Baw Baw, <i>Brachyscome obovata</i>
Lilac Berry, <i>Trochocarpa clarkei</i>
Tuft-rush, <i>Oreobolus oxycarpus</i> subsp. <i>oxycarpus</i>
B. Taxa of Regional Significance
Astelia, Silver <i>Astelia alpina</i> var. <i>novae-hollandiae</i>
Beard-heath, Mountain <i>Leucopogon hookeri</i>
Bitter-cress, Lilac <i>Cardamine lilacina</i>
Bossiaea, Leafy <i>Bossiaea foliosa</i>
Bottlebrush, Alpine <i>Callistemon pityoides</i>
Bristle-grass <i>Trisetum spicatum</i> subsp. <i>australiense</i>
Buttercup, Strawberry <i>Ranunculus collinus</i>
Buttercup, Subalpine <i>Ranunculus scapiger</i>
Club-rush, New Zealand <i>Isolepis aucklandica</i>
Cudweed <i>Euchiton fordianus</i>
Everlasting, Cascade <i>Ozothamnus secundiflorus</i>
Filmy Fern, Alpine <i>Hymenophyllum peltatum</i>
Fleabane, Violet <i>Erigeron pappocromus</i>
Grevillea, Royal <i>Grevillea victoriae</i>
Heath, Snow <i>Epacris petrophila</i>
Holy Grass, Sweet <i>Hierochloa redolens</i>
Hook-sedge, Weak <i>Ucinia flaccida</i>
Johnson-rush <i>Juncus alexandri</i> subsp. <i>alexandri</i>
Leek-orchid, White/Mauve <i>Prasophyllum candidum/suttonii</i>
Mint-bush, Alpine <i>Prostanthera cuneata</i>
Nertera, Matted <i>Nertera granadensis</i>
Orites, Alpine <i>Orites lancifolia</i>
Phebalium, Alpine <i>Phebalium phyllicifolium</i>
Plum Pine, Mountain <i>Podocarpus lawrencei</i>
Rusty-pods, Alpine <i>Hovea montana</i>
Sedge <i>Carex blakei</i>
Sky Lily <i>Herpolirion novae-zelandiae</i>
Speedwell, Snow <i>Derwentia nivea</i>
Tuft-rush, Fan <i>Oreobolus distichus</i>
Snow-grass, Horny <i>Poa fawcettiae</i>
Snow-grass, Soft <i>Poa hiemata</i>
Wallaby-grass, Alpine <i>Danthonia nudiflora</i>
Wattle, Alpine <i>Acacia alpina</i>

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Fig. 1. Wet sub-alpine heathland, Lake Mountain.

tions of terrestrial invertebrates.

The 47 bryophyte and 12 macrolichen species recorded by Cameron and Turner (1994) indicate the diversity of non-vascular flora at Lake Mountain (Table 2). Although none of the bryophytes recorded are known to be significant, the lichen *Cladonia staufferi* found in shrubby sub-alpine woodland is rare in sub-alpine habitats.

Doeg *et al* (1994) restricted their survey of fish and aquatic macroinvertebrates to sites on tributaries likely to be affected by the proposed new ski trails. They sampled fish by electrofishing and aquatic macroinvertebrates using the 'kick' sampling method once at each of four sites.

Significant Ecological Communities **Wet sub-alpine heathland**

Wet sub-alpine heathland of the Echo Flat-Long Heath area is the most significant community at Lake Mountain in terms of its biogeographic and conservation values. These heathlands also represent the most fragile ecosystem due to their restricted distribution, sensitivity to disturbance and specific hydrological requirements. Their current vulnerability is heightened by the recognition that they are

at present recovering from the impact of past cattle grazing activity, which ceased in 1964 (Ashton and Hargreaves 1983), fire disturbance, introduction of weeds, and the development of recreational facilities and their infrastructure.

The botanical significance of the wet heathlands of the study area can be demonstrated by an analysis of the most comprehensive listing of significant species for the region. Beauglehole (1983) lists 48 species which are recorded for the Lake Mountain Alpine Reserve and are considered on distributional criteria to have regional significance. Approximately 24 species (50%) can be considered to be exclusively or largely associated with wet sub-alpine heathland at Lake Mountain, demonstrating that the significance of this community for conservation of rare and threatened flora is disproportional to the very limited extent of the community within the landscape.

At Lake Mountain, wet sub-alpine heathland occupies the wettest sites, on peaty substrates, in broad, flat-bottomed depressions throughout the Echo Flat-Long Heath study area. The community occurs over an elevation range of 1350-1435 m asl and is

Table 2. Lake Mountain Bryophytes and Lichens.

Sub-Alpine Woodland (Grassy)	<i>Menegazzia</i> ? <i>platytrema</i>	<i>Balantiopsis diplophylla</i>
Bryophytes	<i>Parmelia</i> sp.	<i>Bryum</i> sp.
<i>Catagonium politum</i>	<i>Usnea molliuscula</i>	<i>Catagonium politum</i>
<i>Grimmia trichophylla</i>	<i>Usnea</i> sp.	<i>Chiloscyphus fissistipus</i>
<i>Hypnum cupressiforme</i>	Ecotonal Sub-Alpine Woodland with riparian elements	<i>Dicranoloma menziesii</i>
<i>Leptostomum inclinans</i>	Bryophytes	<i>Dicranoloma robustum</i>
<i>Leptotheca gaudichaudii</i>	<i>Achrophyllum dentatum</i>	<i>Grimmia trichophylla</i>
<i>Lophocolea bidentata</i>	<i>Acrobolbus concinnus</i>	<i>Hypnum cupressiforme</i>
<i>Lophocolea bispinosa</i>	<i>Balantiopsis diplophylla</i>	<i>Kurzia compacta</i>
<i>Lophocolea muricata</i>	<i>Balantiopsis tumida</i>	<i>Lepidozia laevifolia</i>
<i>Lophocolea semiteres</i>	<i>Brachythecium paradoxum</i>	<i>Leptostomum inclinans</i>
<i>Orthodontium lineare</i>	<i>Bryum billardieri</i>	<i>Leptotheca gaudichaudii</i>
<i>Racomitrium crispulum</i>	<i>Camptochaete arbuscula</i>	<i>Lophocolea biciliata</i>
<i>Rhynchostegium tenuifolium</i>	<i>Catagonium politum</i>	<i>Lophocolea bidentata</i>
<i>Sematophyllum amoenum</i>	<i>Dicranoloma menziesii</i>	<i>Lophocolea semiteres</i>
Lichens	<i>Dicranoloma robustum</i>	<i>Metzgeria decipiens</i>
<i>Cladonia</i> sp.	<i>Grimmia trichophylla</i>	<i>Orthodontium lineare</i>
<i>Hypogymnia enteromorphoides</i>	<i>Hypnodendron vitiense</i>	<i>Ptychomnium aciculare</i>
<i>Hypogymnia lugibris</i>	<i>Hypnum cupressiforme</i>	<i>Racomitrium crispulum</i>
<i>Parmelia</i> sp.	<i>Jungermannia orbiculata</i>	<i>Riccardia crassa</i>
Sub-Alpine Woodland (Shrubby)	<i>Lophocolea bidentata</i>	<i>Sematophyllum amoenum</i>
Bryophytes	<i>Lophocolea planiuscula</i>	<i>Thuidium</i> sp.
<i>Brachythecium paradoxum</i>	<i>Lophocolea semiteres</i>	<i>Wijkia extenuata</i>
<i>Dicranoloma billardieri</i>	<i>Plagiothecium denticulatum</i>	<i>Zoopsis leitgebiana</i>
<i>Dicranoloma dicarpum</i>	<i>Polytrichum commune</i>	Lichens
<i>Grimmia apocarpa</i>	<i>Racomitrium crispulum</i>	<i>Cladonia</i> sp.
<i>Hypnum cupressiforme</i>	<i>Rhizogonium mnoides</i>	<i>Usnea</i> sp.
<i>Lophocolea bidentata</i>	<i>Riccardia crassa</i>	Wet Sub-Alpine Heathland
<i>Lophocolea semiteres</i>	<i>Sematophyllum amoenum</i>	Bryophytes
<i>Pohlia nutans</i>	<i>Sphagnum cristatum</i>	<i>Balantiopsis diplophylla</i>
<i>Racomitrium crispulum</i>	<i>Tayloria octoblephorus</i>	<i>Breutelia pendula</i>
<i>Rhynchostegium tenuifolium</i>	<i>Thuidium sparsum</i>	<i>Catagonium politum</i>
<i>Sematophyllum amoenum</i>	<i>Wijkia extenuata</i>	<i>Grimmia trichophylla</i>
Lichens	Lichens	<i>Hypnum cupressiforme</i>
<i>Cladonia pyxidata</i>	<i>Cladonia scabriuscula</i>	<i>Lophocolea bidentata</i>
<i>Cladonia ramulosa</i>	Montane Riparian Thicket with Cool Temperate Rainforest elements	<i>Polytrichum commune</i>
<i>Cladonia scabriuscula</i>	Bryophytes	<i>Racomitrium crispulum</i>
<i>Cladonia staufferi</i> (rare)	<i>Achrophyllum dentatum</i>	<i>Rhynchostegium tenuifolium</i>
<i>Cladonia subradiata</i>		<i>Sphagnum cristatum</i>
<i>Hypogymnia enteromorphoides</i>		<i>Wijkia extenuata</i>

generally surrounded by extensive stands of sub-alpine woodland. In the Echo Flat area, wet heathland stands often merge with fringing stands of dry sub-alpine shrubland on the better-drained and more exposed sites. They may also merge with small fringing stands of montane riparian thicket on their more sheltered western margins.

Wet sub-alpine heathland is widely recognised as having a distinctive suite of rare and threatened plant species, many of which are restricted to this community. 11 of the 24 vascular species recorded within one quadrat along the Long Heath Trail are recognised by Beaglehole (1983) as regionally significant, of which the rarest

in the region are *Astelia alpina*, *Erigeron pappocromus*, *Nertera granadensis*, *Oreobolus distichus*, *Oreobolus oxycarpus* and *Podocarpus lawrencei*. Cryptogams, especially mosses, contribute significantly to both biomass and biodiversity, being represented in one quadrat by twelve species which account for one third of the recorded plant biodiversity. The most striking non-vascular species is the large cushion-forming moss *Breutelia pendula* which, like *Sphagnum cristatum*, forms extensive monospecific stands. These species perform a crucial role in the maintenance of water quality and stream flow and are dependent, in turn, on the hydrological stability of the surrounding head-

water catchments.

Wet sub-alpine heathlands support the greatest density of small mammals in the area (Table 3) (Jelinek and Belcher, 1994). Dusky Antechinus *Antechinus swainsonii*, was only recorded from wet sub-alpine heathland and its ecotones with montane riparian thicket and sub-alpine woodland. The Bush Rat *Rattus fuscipes* was abundant in all habitats, especially the wet sub-

alpine heathland and its ecotones (Fig. 2). The Broad-toothed Rat *Mastacomys fuscus* has previously been recorded in wet sub-alpine heathland in the Echo Flat area (Atlas of Victorian Wildlife 1994). It may be present in other wet sub-alpine heathlands, although in low numbers. During this study *M. fuscus* was not recorded in three wet sub-alpine heathlands in the Long Heath area despite intensive trapping

Table 3. Lake Mountain wet sub-alpine heathland fauna.
Key: # = Sub-alpine woodland includes dry rock sub-alpine shrubland and grassy sub-alpine shrubland; @ = Common and Waterhouse 1972; * = introduced species.

Mammals	Ecological Vegetation Type
Antechinus, Brown <i>Antechinus stuartii</i>	Dry rocky sub-alpine grassland fringe with dense shrubs and rock outcrops
Antechinus, Dusky <i>Antechinus swainsonii</i>	Wet sub-alpine heathland and its ecotones with montane riparian thicket and sub-alpine woodland
Bat, White-Striped Freetail <i>Tadarida australis</i>	Wet sub-alpine heathland sub-alpine woodland
*Deer, Sambar <i>Cervus unicolor</i>	Montane riparian thicket and sub-alpine woodland
*Dog/Dingo <i>Canis familiaris</i>	Wet sub-alpine heathland and sub-alpine woodland
*Fox <i>Vulpes vulpes</i>	Wet sub-alpine heathland and sub-alpine woodland
Possum, Leadbeaters <i>Gymnobelideus leadbeateri</i>	Sub-alpine woodland montane damp forest
Possum, Common Ringtail <i>Pseudocheirus peregrinus</i>	Sub-alpine woodland and montane damp forest
Rat, Bush <i>Rattus fuscipes</i>	Wet sub-alpine heathland and its ecotone with montane riparian thicket, sub-alpine woodland, dry rocky sub-alpine grassland fringe with dense shrubs and rock outcrops, grassy sub-alpine shrubland
Wombat, Common <i>Vombatus ursinus</i>	Wet sub-alpine heathland and sub-alpine woodland
Birds	
Cockatoo, Gang Gang <i>Callocephalon fimbriatum</i>	Sub-alpine woodland
Cuckoo, Fantailed <i>Cacomantis flabelliformis</i>	Sub-alpine woodland and montane riparian thicket
Currawong, Grey <i>Strepera versicolor</i>	Wet sub-alpine heathland and sub-alpine woodland
Currawong, Pied <i>Strepera graculina</i>	Sub-alpine woodland
Fantail, Grey <i>Rhipidura fuliginosa</i>	Sub-alpine woodland
Honeyeater, Crescent <i>Phylidonyris pyrrhoptera</i>	Sub-alpine woodland
Honeyeater, White-eared <i>Lichenostomus leucotis</i>	Wet sub-alpine heathland and sub-alpine woodland
Honeyeater, White-naped <i>Melithreptus lunatus</i>	Sub-alpine woodland
Kookaburra, Laughing <i>Dacelo novaeguineae</i>	Sub-alpine woodland
Lyrebird, Suberb <i>Menura novaehollandiae</i>	Sub-alpine woodland/montane riparian thicket ecotone
Nightjar, White-throated <i>Eurostopodus mystacalis</i>	Sub-alpine woodland
Owl, Boobook <i>Ninox novaeseelandiae</i>	Sub-alpine woodland
Pardalote, Striated <i>Pardalotus striatus</i>	Sub-alpine woodland
Pilotbird <i>Pycnoptilus floccosus</i>	Montane riparian thicket
Raven, Little <i>Corvus mellori</i>	Wet sub-alpine heathland and sub-alpine woodland
Robin, Flame <i>Petroica phoenicea</i>	Sub-alpine woodland
Robin, Eastern Yellow <i>Eopsaltria australis</i>	Sub-alpine woodland/montane riparian thicket ecotone
Rosella, Crimson <i>Platycercus elegans</i>	Sub-alpine woodland
Scrubwren, White-browed <i>Sericornis frontalis</i>	Wet sub-alpine heathland, montane riparian thicket and sub-alpine woodland
Silvereye <i>Zosterops lateralis</i>	Sub-alpine woodland
Shrike-thrush, Grey <i>Colluricincla harmonica</i>	Sub-alpine woodland
Swallow, Welcome <i>Hirundo neoxena</i>	Wet sub-alpine heathland and sub-alpine woodland
Thrush, Russet-tailed <i>Zoothera heinei</i>	Montane riparian thicket
Whipbird, Eastern <i>Psophodes olivaceus</i>	Montane riparian thicket
Whistler, Olive <i>Pachycephala olivacea</i>	Wet sub-alpine heathland montane riparian thickets
Whistler, Golden <i>Pachycephala pectoralis</i>	Sub-alpine woodland
Wattlebird, Red <i>Anthochaera carunculata</i>	Sub-alpine woodland
Reptiles and Amphibians	
Froglet, Common <i>Crinia signifera</i>	Wet sub-alpine heathland
Skink, Grass <i>Pseudemoia entrecasteauxii</i>	Sub-alpine woodland#
Skink, Southern Water <i>Eulamprus tympanum</i> CTF	Wet sub-alpine heathland and sub-alpine woodland#
Toadlet, Southern <i>Pseudophryne semimarmorata</i>	Wet sub-alpine heathland
Tree Frog, Alpine <i>Litoria verreauxii alpina</i>	Wet sub-alpine heathland

Table 3 cont.

Butterflies	Ecological Vegetation Type	Larval Food Plants@
Admiral, Australian <i>Vanessa itea</i> (Fabricius),1775	Wet Sub-alpine Heathland	Asteraceae
Brown, Common <i>Heteronympha merope merope</i> (Fabricius),1775	Wet Sub-alpine Heathland	Native grasses eg. <i>Poa</i> spp.
Painted Lady,Australian <i>Vanessa kershawi</i> (McCoy),1868	Wet Sub-alpine Heathland	Asteraceae
Swallowtail, Macleay's <i>Graphium macleayanum macleayanum</i> (Leach),1814	Wet Sub-alpine Heathland	<i>Tasmannia lanceolata</i> <i>Tasmannia xerophila</i> <i>Atherosperma moschatum</i>
White, Caper <i>Anaphaeis java teutonia</i> (Fabricius),1775	Wet Sub-alpine Heathland Sub-alpine Woodland	various species
White*, Cabbage <i>Pieris rapae rapae</i> (Linnaeus),1758	Wet Sub-alpine Heathland	mainly introduced species
Several unidentified species	All vegetation types	
Moth Species		
<i>Euphyia</i> sp.	Wet Sub-alpine Heathland	
Several other species of moths belonging to the Family Geometroidea	All vegetation types	

and searching for scats within suitable habitat (Table 4).

The Southern Water Skink *Eulamprus tympanum* (CTF), Alpine Tree Frog *Litoria verreauxii alpina*, Common Froglet *Crinia signifera* and Southern Toadlet *Pseudophryne semimarmorata* were recorded in wet sub-alpine heathland. Birds observed or heard included the Welcome Swallow *Hirundo neoxena*, Olive Whistler *Pachycephala olivacea*, White-browed Scrubwren *Sericornis frontalis*, White-eared Honeyeater *Lichenostomus leucotis*, Grey Currawong *Strepera versicolor* and Little Raven *Corvus mellori*.

Butterflies and moths (Table 3) observed in the wet sub-alpine heathland included Macleay's Swallowtail *Graphium macleayanum macleayanum* (Leach) (Fig. 3) and Australian Admiral *Vanessa itea* (Fabricius). Adult butterflies and moths were attracted to flowering plants, especially *Epacris paludosa*. Their larvae feed on a variety of plants in associated vegetation types, including the montane riparian thickets, cool temperate rainforest and sub-alpine woodland (Common and Waterhouse 1972).

Doeg *et al.* (1994) recorded 45 distinct macroinvertebrate taxa from small streams surrounded by wet sub-alpine heathland (Table 5). The substrate of these streams is characterised by boulders and cobbles with an average depth of about 10 cm and width

of about 0.5-1 m, and they are partly shaded by dense streamside shrubs. The endangered Barred Galaxias *Galaxia fuscus* is known to occur in the Upper Taggerty catchment although only trout were recorded at one of the sampling sites during this survey.

The most diverse Order of aquatic macroinvertebrates was the Diptera (two-winged flies) represented by 12 taxa from five families. Most of the taxa were from the family Chironomidae. The Plecoptera (stoneflies) were represented by ten taxa, including representatives from all known Australian families: Eustheniidae, Gripopterygidae, Notonemouridae and Austroperlidae. Trichoptera were represented by eight taxa spread through six families. The Coleoptera (beetles) were represented by seven distinct taxa, all from the family Elmidae. The Ephemeroptera (mayflies) were represented by two taxa. The non-insect fauna comprised six taxa, the most common being the Amphipoda. Other common taxa were immature Plecoptera and Oligochaeta.

Montane riparian thicket, and cool temperate rainforest

These two communities are represented by a structural and floristic continuum from mature cool temperate rainforest, through stands which are undergoing secondary succession at the ecological and altitudinal limit of the community, to mon-

Table 4. Predator scat analyses.
N.B. Scats were identified by smell and by diameter. A small proportion of scats may be misidentified.

Scats	Prey
6 x fox	Bush Rat
1 x fox	Brown Antechinus
5 x fox	Dusky Antechinus
1 x fox	Antechinus sp.
2 x fox	Ringtail Possum
1 x fox	Bird
2 x fox	Bush Rat, Dusky Antechinus
1 x fox	Ringtail Possum, Bush Rat, Beetle
1 x fox	Ringtail Possum, Dusky Antechinus
1 x fox	Wombat, Dusky Antechinus
1 x fox	Wombat, Bush Rat
1 x fox	Invertebrates-beetles, crustacea
1 x dog/dingo	Invertebrates-beetles,yabbies
1 x dog/dingo	Bush Rat, Ringtail, Antechinus sp.
1 x dog/dingo	Wombat, Ringtail, Bush Rat, Antechinus sp.
1 x dog/dingo	Dusky Antechinus



Fig. 2. Fauna survey site, wet sub-alpine heathland, Lake Mountain.



Fig. 3. Macleay's Swallowtail *Graphium macleayanum macleayanum* on *Epacris paludosa*, Lake Mountain.

Table 5. Aquatic Macroinvertebrates recorded by Doeg, T., Saddlier, S. and Reed, J. (1994).
N.B. 1. 'spp.' means individuals could not be or were not identified to lower taxonomic designations. 2. 'sp.1' and 'sp.2' refer to numbers in the voucher collection held in the Museum of Victoria.

A. INSECTA	<i>Cheumatopsyche</i> sp. 2
Ephemeroptera	Tasimiidae
Baetidae	<i>Tasiagma ciliata</i>
<i>Baetis</i> spp.	
Leptophlebiidae	Coleoptera
<i>Austrophlebioides</i> spp.	Elmidae
	<i>Austrolimnius</i> spp.
Plecoptera	<i>Austrolimnius metasternalis</i>
Austroperlidae	<i>Austrolimnius waterhousei</i>
<i>Austroheptura neboissi</i>	<i>Kingolus</i> spp.
Eustheniidae	<i>Notriolus victoriorum</i>
<i>Eusthenia venosa</i>	<i>Simsonia</i> spp.
Gripopterygidae	
<i>Dinotoperla brevipennis</i>	Diptera
<i>Dinotoperla hirsuta</i>	Chironomidae
<i>Eunotoperla ker shawi</i>	<i>Rheotanytarsus</i> spp.
<i>Leptoperla neboissi</i>	<i>Riethia</i> spp.
<i>Leptoperla</i> spp.	<i>Paratanytarsus</i> spp.
<i>Riekoperla rugosa</i> group	<i>Tanytarsus</i> spp.
Notonemouridae	<i>Thienemaniella</i> spp.
<i>Austrocercella tilliardi</i>	<i>Cricotopus</i> spp.
<i>Notonemoura lynchi</i>	<i>Procladius</i> spp.
	<i>Pentaneura</i> spp.
Trichoptera	Empididae
Calocidae	<i>Empididae</i> sp.2
<i>Calocidae</i> spp.	Psychodidae
Conoesucidae	<i>Psychodidae</i> spp.
<i>Conoesucidae</i> spp.	Simuliidae
Ecnomidae	<i>Austrosimulium cornutum</i>
<i>Ecnomus deani</i>	Tipulidae
Hydrobiosidae	<i>Tipulidae</i> sp.1
<i>Taschorema evansi</i>	
<i>Taschorema kimminsi</i>	B. NON-INSECTA
Hydropsychidae	<i>Oligochaeta</i> spp.
<i>Austropsyche victoriana</i>	<i>Hydracarina</i> spp.
	<i>Gastropoda</i> spp.
	<i>Psidium</i> spp.
	<i>Amphipoda</i> spp.
	<i>Ostracoda</i> spp.

tane riparian thicket. All stands along this continuum are significant because of their extreme fire-sensitivity, habitat-specificity, hydrological sensitivity, their linear configuration which renders them particularly susceptible to edge effects, their restricted occurrence within the landscape, and their concentration of rare and threatened, fire-sensitive and moisture-dependent plant species. Cool temperate rainforest and, to a lesser extent, montane riparian thickets, are considered to have special evolutionary

and biogeographic significance based on their relict and refugial status and also, their Gondwanic evolutionary origins.

Stands undergoing secondary succession have the potential to regenerate as mature cool temperate rainforest although the time required for full recovery may be considerable. The Interim Reference Areas Advisory Committee (1977) suggests that *Nothofagus-Leptospermum* cool temperate montane rainforest scrub may require two hundred years to recover to full floristic potential following a major crown fire. Despite their small size, such secondary stands have ecological significance in a local context as they potentially represent the highest occurrences of cool temperate rainforest in the Lake Mountain area at 1400 m asl.

Three high altitude occurrences of rainforest vegetation occur in the Echo Flat-Long Heath area. The largest occurs at an elevation of 1370-1395 m in a gully-head west of Royston Gap Road, 500 m south of Triangle Junction. It is a secondary stand, structurally transitional between montane riparian thicket and cool temperate rainforest. Another occurs at an elevation of 1410 m and is centred on a single mature *Nothofagus* individual associated with a minor drainage line entering Echo Flat downslope of the Muster Trail, 200 m southeast of Triangle Junction. Although a minor occurrence of cool temperate rainforest, this site is significant for the maturity of *Podocarpus lawrencei* associated with a mature *Nothofagus* individual, and the association of *Wittsteinia vacciniacea* and *Trochocarpa clarkei* in the ground layer.

An important gully-head occurrence of montane riparian thicket vegetation occurs in the Long Heath area. Whilst the stand currently has the structural and floristic characteristics of montane riparian thicket, there is evidence that it represented mature cool temperate rainforest prior to the destruction of its *Nothofagus cunninghamii* closed canopy in the 1939 wildfire, and that the regenerating stand is currently undergoing secondary succession. Evidence of secondary succession includes the following observations:

1. the stand is currently co-dominated by *Leptospermum grandifolium* (estimated cover 45%) and *Nothofagus cun-*

ninghamii (estimated cover 35%), most of which are multistemmed, having resprouted from the base of fire-killed parent crowns;

2. at least one fire-killed stag is emergent above the 2-4 m high closed-scrub in the boggy centre of the stand;

3. charcoal scars are evident on the butts of *Nothofagus* stumps, some of which were completely fire-killed, others are encircled by a ring of coppice stems now 5-8 m tall;

4. single-stemmed emergent pole-stage *Eucalyptus pauciflora* and *Pultenaea muelleri* and *Prostanthera cuneata* within the closed-canopy *Leptospermum-Nothofagus* stand suggest these scattered sclerophyll taxa invaded the former *Nothofagus* stand immediately following its incineration in 1939.

Cool temperate rainforest is the most fire-sensitive community in the region. Stands in the Echo Flat-Long Heath area support good populations of a number of species of state or regional significance including *Wittsteinia vacciniacea*, *Trochocarpa clarkei* and *Podocarpus lawrencei*. The cryptogamic flora is well represented with at least 25 species recorded within one quadrat, accounting for at least 40% of the plant biodiversity recorded within a 900 m² plot.

Such ecologically significant occurrences of cool temperate rainforest at their altitudinal limit need protection from disturbance which might increase the risk of recurrent wildfire, dessication, windthrow, sedimentation, deleterious alteration to the drainage characteristics of the site and invasion by exotic species such as Blackberry (**Rubus fruticosus* spp. agg.) which is recorded in the area.

Uncommon bird species or those associated with restricted habitats such as the Olive Whistler *Pachycephala olivacea*, and Pilotbird *Pycnoptilus floccosus*, were recorded only in montane riparian thickets and their ecotones. The Fantailed Cuckoo *Cacomantis flabelliformis*, Superb Lyrebird *Menura novaehollandiae*, Russet-tailed Thrush *Zoothera heinei*, Eastern Yellow Robin *Eopsaltria australis*, Eastern Whipbird *Psophodes olivaceus* and White-browed Scrubwren were also recorded.

Sub-alpine woodland

As a vegetation type, sub-alpine wood-

land is not considered to have specially high conservation significance. However, the community is represented by a number of distinct variants and forms which have diversified in response to variations in site exposure, depth of soil, soil moisture and fire history.

An ecologically significant stand of sub-alpine woodland occupying a gently south-east-trending basin is located south-east of the major rocky ridgeline due west of Long Heath. The stand is dominated by *Eucalyptus pauciflora* and is significant for the uniformly high (up to 50%) cover of *Wittsteinia vacciniacea* over an extensive area in the absence of woody species normally indicative of montane riparian thicket or cool temperate rainforest affinity. The only associated species indicating such riparian affinity are the fern *Blechnum pennamarina*, which is scattered in the stand, and the sedge *Carex appressa*, which is rare in the stand. This large and excellent stand of *Wittsteinia* is associated with a mixed shrub layer of *Tasmannia xerophila* (which is locally dominant), *Prostanthera cuneata* and *Pultenaea muelleri*. This significant stand of vegetation is dependent on the particular drainage characteristics of the site and is likely to be highly sensitive to any changes to site hydrology.

Another significant form of sub-alpine woodland is described in Part 1 under characteristics of Leadbeater's Possum habitat in subalpine woodland (*The Victorian Naturalist* 112, 1995, 112-15).

More typical shrubby understoreys are dominated by a suite of sclerophyllous shrubs of which the most prominent are *Acacia alpina*, *Oxylobium alpestre*, *Ozothamnus secundiflorus*, *Prostanthera cuneata*, *Pultenaea muelleri* and *Tasmannia xerophila*. In stands which are ecotonal with dry sub-alpine shrubland, *Olearia algida*, *Ozothamnus hookeri* and *Phebalium phyllifolium* are prominent.

Grassy and herbaceous understoreys in the sub-alpine woodland are best developed on sheltered western and northwest aspects. They are dominated by *Poa ensiformis*, sometimes almost to the exclusion of any other species, together with a suite of forbs and other graminoides of which the most prominent are *Asperula gunnii*, *Asperula pusilla*, *Caladenia lyalii*, *Carex*

breviculmis, *Hydrocotyle hirta*, *Leptostigma reptans*, *Lycopodium fastigiatum* and *Viola hederacea* subsp. *hederacea*.

A diversity of bryophytes and macrolichens occur throughout the sub-alpine woodland. The lichen *Cladonia staufferi* was recorded in two quadrats in shrubby sub-alpine woodland. This lichen is rare in sub-alpine habitats.

The White-striped Freetail Bat *Tadarida australis*, Common Ringtail Possum *Pseudocheirus peregrinus*, Brown Antechinus *Antechinus stuartii*, Bush Rat *Rattus fuscipes*, Grass Skink *Pseudemoia entrecasteauxii* and numerous bird species, including the Boobook Owl *Ninox novae-seelandiae* and White-eared Honeyeater *Lichenostomus leucotis* were common throughout the various forms of sub-alpine woodland. The White-throated Nightjar *Eurostopodus mystacalis*, a summer migrant to the area, was also recorded.

Significant Fauna

The discovery of Leadbeater's Possum, *Gymnobelideus leadbeateri* McCoy in sub-alpine woodland within the study area is significant and is reported in Part 1 (*The Victorian Naturalist* 112, 1995, 112-15).

Although not recorded during this survey, according to the Land Conservation Council (1991), the following significant species are likely to occur in the area. More extensive and intensive surveys are required to determine their occurrence and distribution in the Lake Mountain area.

- **The Broad-toothed Rat *Mastomys fuscus*** is rare in Victoria (CNR 1995) and although not recorded during this study, it has previously been recorded in the area (Atlas of Victorian Wildlife 1994). Analysis of predator scats collected from tracks in or near wet sub-alpine heathland reveals that wild dogs, dingoes and foxes prey on a variety of native fauna, including *Antechinus swainsonii* (Table 4). Green and Osborne (1981) highlight intensive and selective predation by foxes on *M. fuscus* in comparison with *R. fuscipes* which may be less palatable or more difficult to capture. This could account for *M. fuscus* not being recorded during this study. They also propose that each fox consumes 4-11 small mammals per

day, although the diet changes through the seasons, depending on the relative abundance of invertebrates and small mammals.

- **Smoky Mouse** *Pseudomys fumeus* is vulnerable in Victoria (CNR 1995) and occurs in sub-alpine woodland in surrounding areas (LCC 1991).

- **Pink Robin**, *Petroica rodinogaster*, is a significant species that lives and breeds in the upland cool temperate rainforests of the Central Highlands (LCC 1991).

The Alpine Tree Frog *Litoria verreauxii alpina* was recorded in wet sub-alpine heathland (Jelinek and Belcher 1994). This subspecies of *Litoria verreauxii* is restricted to sub-alpine communities (LCC 1991) and is currently classified as insufficiently known (suspected rare, vulnerable or endangered) (CNR 1995).

A diversity of aquatic macroinvertebrates from a range of invertebrate groups occurs in tributary streams of the Taggerty and Royston Rivers and Keppel Hut Creek (Doeg *et al.* 1994). Brown or Barred Galaxias *Galaxia fuscus* is listed as endangered on Schedule 1 of the Endangered Species Protection Act 1992 and as a threatened taxon on Schedule 2 of the Flora and Fauna Guarantee Act 1988. It is also classified as endangered by CNR (1995). *Galaxia fuscus* has been recorded in the Taggerty River, 1 km downstream of the study area (Doeg *et al.* 1994).

Significant Flora

A comprehensive census of the flora of the study area was compiled and compared with a statewide or regional overview of significant species. Gullan *et al.* (1990) provide the most consistent overview of rare or threatened plants of state or national significance. Beaughton (1983) provides the only statewide review of plant species of regional significance. Both listings need to be reviewed for consistency and updated in the light of taxonomic revision and current ecological and distributional information.

A comparison of a composite census with Gullan *et al.* (1990) and Beaughton (1983) indicates that the Department of Conservation and Natural Resources' Flora Information System (FIS) contains reliable quadrat or definable area records for the

study area of two species (*Brachyscome obovata* and *Wittsteinia vacciniacea*) considered rare in the state by Gullan *et al.* and a further 31 species considered regionally significant by Beaughton. Three additional taxa, *Baeckea utilis* var. *latifolia*, *Oreobolus oxycarpus* subsp. *oxycarpus* and *Trochocarpa clarkei*, are considered rare in Victoria and two additional species are considered regionally significant. One of these, *Cardamine lilacina*, is a poorly-known polymorphic taxon which is considered by some authorities to represent a number of distinct species. The second, *Trisetum spicatum* subsp. *australiense*, was not recorded by Beaughton or in previous FIS records within the Central Highlands region, and the Echo Flat record is therefore inferred to be of regional significance.

Although an additional species of state significance, *Coprosma moorei*, has not been confirmed by Flora Information System quadrat records for the study area, this rare sub-alpine species is reliably recorded for Lake Mountain by Beaughton (1983) and is likely to occur in the Echo Flat area.

Distributions of these plants indicate that each of the five species of state or national significance, as well as *Coprosma moorei*, and 29 of the 33 species of regional significance, occurs at, or near, the western limit of its geographic range within the study area. The only exceptions to this pattern are two grasses, *Hierochloa redolens* and *Poa fawcettiae*, which have disjunct occurrences in sub-alpine vegetation in the Grampians, and the Alpine Bog Sedge *Carex blakei*, which has a disjunct lowland record for Gellibrand Hill. This observation clearly serves to illustrate the outstanding biogeographic significance of the Lake Mountain plateau as the western limit of the Australian alps in south-eastern Australia. Without exception, all 38 species are of regional or state significance because they are restricted to alpine or sub-alpine environments which are rare and at their geographic limit within the region or the state.

Three taxa are of special biogeographic and conservation significance because they are endemic within the Central Highlands region as well as rare or restricted within Victoria. Two of these, *Baeckea utilis* var. *latifolia* and *Trochocarpa clarkei*, were not

considered rare in the state by Gullan *et al.* (1990) but are here considered worthy of such status. The third Victorian endemic, *Wittsteinia vacciniacea*, deserves particular consideration as its full biogeographic and evolutionary significance has not been fully appreciated.

In his synopsis of the family Alseuosmiaceae in New Zealand, New Caledonia, Australia and New Guinea, the Dutch systematist van Steenis (1984) established the true Gondwanic affinities of *Wittsteinia vacciniacea*, placing it alongside a small number of species which occur in New Caledonia and Papua New Guinea, within an expanded circumscription of the genus *Wittsteinia*. The Victorian endemic taxon thus becomes the only member, in south-eastern Australia, of the newly circumscribed Gondwanic family Alseuosmiaceae. The family is otherwise represented only by the genus *Crispiloba*, with a single species in rainforest on the Bellenden-Ker Range in north Queensland, and the genus *Alseuosmia*, which consists of a complex of taxa in New Zealand.

Most earlier writers had failed to appreciate the distinctly Gondwanic origins of *Wittsteinia* and other members of this small family. Prior to 1984, most Australian botanists had considered the affinities of the Victorian endemic to lie with the Laurasian family Ericaceae or its southern sibling family Epacridaceae. Most overseas systematists had relegated the members of the Alseuosmiaceae to affinity with a bewildering variety of predominantly Laurasian or pantropical families, including Caprifoliaceae, Escalloniaceae, Loganiaceae, Saxifragaceae, Rubiaceae, Pittosporaceae and Grossulariaceae.

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