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TASMANIAN HIGH MOUNTAIN VEGETATION II - ROCKY HILL AND PYRAMID MOUNTAIN

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(with two tables, three text-figures and four plates)

ABSTRACT

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Rocky Hill and Pyramid Mountain are composed of horizontally bedded Permian to Upper Carboniferous sedimentary rocks, the nature of which has encouraged the development of fjaeldmark and nonsorted stone steps and stripes. Buried *Athrotaxis* logs in the present alpine zone, the patterns of distribution of fire-susceptible species and other evidence suggest that the area has been subject to at least two severe and extensive fires, which have resulted in landscape instability. Nevertheless, the present vegetation of the area is varied, lacking only deciduous heath and tussock grassland of the alpine subformations and having a full range from sedgeland to closed-forest in the subalpine vegetation. The species composition of the vegetation of the two mountains is most similar to that of Cradle Mountain.

INTRODUCTION

The Tasmanian high mountains possess varied floras and vegetation complexes, these variations most strongly relating to precipitation and soil characteristics (Kirkpatrick 1980, 1982, 1983). Most of the mountains with alpine vegetation (*sensu* Kirkpatrick 1982) consist of dolerite or highly siliceous quartzites and quartzitic conglomerates. However, there is a small number of mountains formed of horizontally bedded Permian to Upper Carboniferous sediments, on which there are concentrated the Tasmanian fjaeldmarks (Kirkpatrick & Harwood 1980, Kirkpatrick 1983). This paper provides a description of the fjaeldmarks and other vegetation of two of these sedimentary mountains, Rocky Hill (1160 m) and Pyramid Mountain (1250 m), both located in the wilderness between Lake St Clair and Queenstown (fig. 1). No nearby climatic data are available but mean annual precipitation certainly exceeds 2000 mm.

METHODS

All higher plant species observed were noted and/or collected during a field trip in February 1983. Nomenclature follows Curtis (1963, 1967, 1979), Curtis & Morris (1975), Curtis & Stones (1978) and Willis (1970) with the latest publication having precedence. Authors are given in table 1 (tables after references) wherever nomenclature cannot follow these authorities. Specimens are held in the Herbarium of the Tasmanian Museum and Art Gallery.

Notes were made of the occurrence and environmental relationships of species, vegetation structure and periglacial landforms. Twenty-nine 10 × 10 m quadrats were located in order to encompass the major part of the variation in alpine vegetation. All higher plant species, the dominant species, the vegetation structure and details of the environment of each quadrat were recorded.

The vegetation was mapped from field observation and interpretation of 1979 panchromatic vertical aerial photographs. Fire boundaries were obtained from earlier photographs and field evidence.

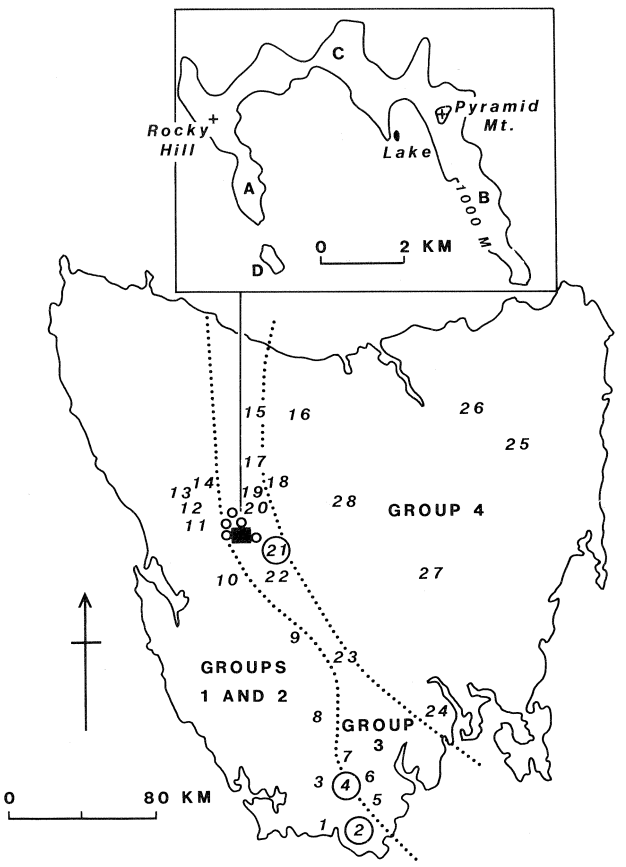

FIG. 1 - Locations of study area, the mountain flora classification of Kirkpatrick (1982), and known locations of nonsorted stone stripes and steps (large and small circles). Mountain codes:

1 Ironbound Range
2 Southern Range (including Mt La Perouse)
3 Eastern Arthur Range
4 Mt Bobs/Boomerang
5 Adamsons Peak
6 Hartz Mountains
7 Mt Picton
8 Mt Anne
9 Denison Range
10 Frenchmans Cap
11 Mt Sedgwick
12 Tyndall Range
13 Mt Read
14 Mt Murchison
15 Black Bluff
16 Mt Roland
17 Cradle Mt-Barn Bluff
18 Mt Oakleigh
19 Mt Ossa/Pelion East
20 Walled Mountain
21 Mt Rufus
22 Mt King William
23 Mt Field
24 Mt Wellington
25 Ben Lomond
26 Mt Barrow
27 Table Mountain
28 Central Plateau.

Species associations in the alpine vegetation were discriminated using the matrix-resorting methods described and justified in Kirkpatrick (1980). Structural terminology follows Kirkpatrick (1983) for alpine vegetation and Specht (1974) for other vegetation.

RESULTS

Floristic Relationships

Rocky Hill and Pyramid Mountain have highly similar alpine floras (fig. 2, table 1), that of Pyramid Mountain largely being a subset of the richer Rocky Hill flora. Pyramid Mountain lacks site conditions suitable for many of the species found in bolster heath and short alpine herbfield. It also lacks the areas of quartzite found at the lowest alpine elevations on Rocky Hill, within which were confined characteristically western species such as *Isophysis tasmanica*, *Eucalyptus vernicosa* and *Monotoca submutica*.

Both mountains belong in group 3 of Kirkpatrick (1982), the central group of floras which extends from Black Bluff in the north to Adamsons Peak in the south (fig. 1), their closest affinities being with Cradle Mountain (fig. 2). The mountains with alpine floras

least similar to those of Pyramid Mountain and Rocky Hill are those in the West Coast Range and the far east of the State, the floristic extremes within Tasmania.

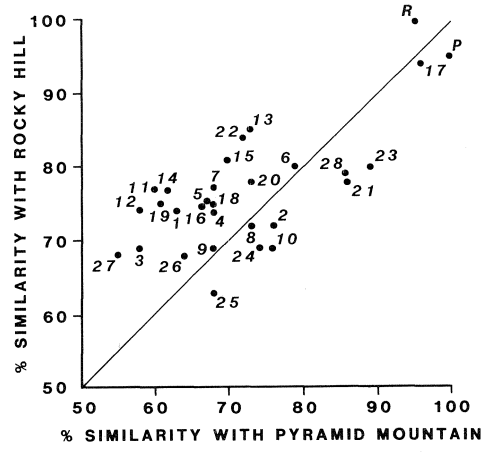

FIG. 2 - Floristic similarities between Pyramid Mountain, Rocky Hill and other Tasmanian mountains, shown in figure 1.

Species Associations

Several strong groups of species with similar distributions in the alpine vegetation of the study area are evident in table 2. The most widespread of these associations was that between *Orites revoluta, Olearia ledifolia, Epacris serpyllifolia, Poa gunnii, Euphrasia striata, Pentachondra pumila* and *Helichrysum milliganii*. The association *Richea sprengelioides-Senecio pectinatus-Exocarpos humifusus-Helichrysum backhousii-Bellendena montana* was found throughout the fjaeldmark vegetation, while the associations *Senecio leptocarpus-Agrostis venusta-Drapetes tasmanica-Plantago tasmanica* and *Coprosma nitida-Deyeuxia monticola-Dichosciadeum ranunculaceum* were confined to the fjaeldmark on the steepest slopes of Pyramid Mountain. The strong association *Microcachrys tetragona-Cyathodes dealbata-Erigeron stellatus-Carpha alpina* occurs in the gentler-sloping fjaeldmark and the vegetation with complete cover on other sampled alpine sites. The more poorly drained sites on both mountains were characterized by the association *Ewartia meredithae-Sprengelia incarnata-Baeckea gunniana-Oreobolus pumilio-Danthonia pauciflora*. The weak association *Drosera arcturi-Gleichenia alpina-Microlaena tasmanica-Actinotus suffocata-Donatia novae-zelandiae-Anemone crassifolia* was confined to some of the poorly-drained sites outside Pyramid Mountain.

Few of the above associations are similar to those revealed for Mt Picton, the Eastern Arthur Range, Mt Bobs and the Boomerang by similar analyses in Kirkpatrick (1980) and Kirkpatrick & Harwood (1980) despite these mountains having a high proportion of their alpine species in common with Rocky Hill and Pyramid Mountain (fig. 2). The degree of mountain specificity in Tasmanian alpine plant associations can only ultimately be tested by a statewide analysis of quadrat/releve data.

Fjaeldmark

Fjaeldmark is found in the study area of slopes varying from 1:1 to 1:3. The vegetation type is confined to the western slopes and the tops of hills and peaks, the slopes sheltered from the prevailing winds invariably possessing complete plant cover (fig. 3).

The flat-topped hills A and B (fig. 1) support a fjaeldmark in which there is clear evidence of the migration of individual shrubs in the same manner as has been recorded for the metasediment ridges at Kosciusko (Barrow *et al.* 1968) and the Boomerang (Kirkpatrick & Harwood 1980). All shrub species occurring within this fjaeldmark (*Epacris serpyllifolia, Richea sprengelioides, Microcachrys tetragona, Orites revoluta, Leptospermum rupestre, Cyathodes petiolaris, Cyathodes dealbata, Pentachondra pumila*) were examined and proved to layer and to have dead stems on their windward side. The rhizomatous herbs *Erigeron stellatus, Helichrysum milliganii, Senecio pectinatus, Poa gunnii* and *Oreobolus oligocephalus* also occurred in this fjaeldmark. The shrubs do not have the even distribution that occurs at Kosciusko as the uniformity of the substrate is broken by occasional bedrock outcrops, creating a tendency towards lineation. However, individual shrubs are well separated within these weak lines, their past movements being marked by strings of dead stems which are abraded flat to windward.

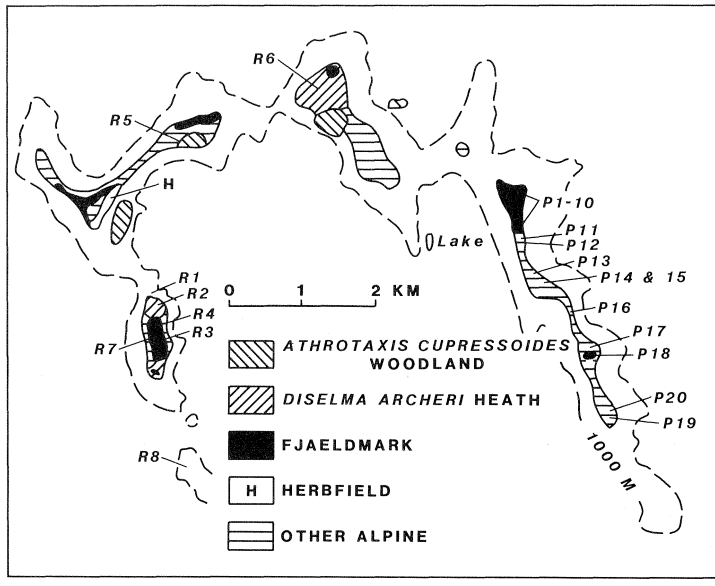

FIG.3 - The distributions of alpine plant communities and *Athrotaxis cupressoides* woodland.

Nonsorted stone steps (Washburn 1979) occur on the slightly steeper slopes surrounding the stone pavements occupied by migrating shrubs (plate 1). They are also found on Rocky Hill and on the southern aspect of the aptly named Pyramid Mountain. At Pyramid Mountain the nonsorted stone steps imperceptibly change to nonsorted stone stripes, the transition occurring at a general slope angle of approximately 8°. The steps and stripes have an alignment independent of the underlying rock stratigraphy. The treads of both steps and stripes support only an extremely sparse cover of *Drapetes tasmanica*, *Senecio pectinatus* and, occasionally, *Dichosciadeum ranunculaceum*. The risers are fully vegetated with herbs such as *Senecio leptocarpus* and *Milliganía densiflora* sheltering under 0.2-0.5 m tall tangled shrubs (plate 2). On the Pyramid Mountain steps and stripes, the risers vary in height from 1.00 to 1.75 m and in width from 1.50 to 3.0 m, while the treads vary in width from 4 to 9 m. On the stone stripes the treads have their maximum steepness parallel to the risers, this slope being typically in the range 15-25°. The material in the treads consists of small shattered rock particles over a mixture of rock particles and fines. Vegetation traps rock and soil particles, creating the steep (25-40°) risers. Particles are moved downhill by water and by gravitational movement after needle ice disruption. Finer particles are transported uphill by the strong prevailing westerly winds until trapped in the riser vegetation.

On hills A and C (fig. 1) flat, bare areas have developed amongst *Diselma archeri* coniferous heath. These areas are occupied by pools of water after heavy or prolonged rain, the alternation between inundation and exposure excluding higher plant growth. Small lunette dunes form to the leeward of these features (plate 3) which show evidence of erosion rather than deposition on their other margins.

Snow Patch Vegetation

A distinct vegetation is found in those situations below the leeward edges of plateaus and peaks where snow tends to accumulate and be protected from wind ablation. Steep, slightly stepped east-facing slopes develop a characteristic vegetation sequence (table 2,

R4 and P20), probably related to snow patch duration, movement and melting patterns. At the break of slope between the plateau and the snow patch there is a dense growth of metre tall shrubs with their foliage extended away from the prevailing winds and pruned to the general height of the nearby plateau. *Leptospermum rupestre* is the dominant species in this zone. On the steep slopes immediately below the *L. rupestre* heath there is a mat heath dominated by *Cyathodes dealbata* and *Pentachondra pumila*. *Microcachrys tetragona* forms a prostrate coniferous heath immediately below the mat heath and in turn gives way to a heath in which *Richea sprengelioides* and *Helichrysum backhousii* are the most prominent species as the slope gets successively gentler and the snow lie more prolonged. *Richea sprengelioides*, *H. backhousii* and *M. tetragona* have a characteristic growth habit in these snow patch situations, their stems extending down hill, and being upright only at their extremes, thus incurring minimum damage with snow movement. *Nothofagus cunninghamii* scrub is found below the snow patch vegetation.

The largest snow patch in the study area occurs along the base of the uppermost cliffs on Rocky Hill. The southernmost part of this patch is a *Milligania densiflora* tall alpine herbfield. The northern part of the patch supports a short alpine herbfield dominated in wet areas by *Ranunculus nanus* and *Juncus antarcticus*. Short alpine herbfield also occurs in patches along stream lines in the *Nothofagus cunninghamii* scrub below the herbfield.

Short Alpine Herbfield

Short alpine herbfield is most extensive on Rocky Hill, but even there occupies less than one hectare. It is found mostly on convex deposits on fines below cliffs and along stream lines. The convexity of these deposits is due to the effective trapping of silt and clay particles by the uppermost vegetation where water moves in a sheet flow. The alpine herbfields are intensively grazed by marsupials which may be responsible for maintaining them as short swards. There is considerable floristic variation related to drainage status, with *Ranunculus* spp. being most common along the most persistent drainage lines and *Acaena montana*, *Rubus gunnianus* and *Pernettya tasmanica* characterizing some of the less constantly soaked situations. Small grasses such as *Agrostis parviflora*, *Erythranthera*

PLATE 1 - Nonsorted stone steps.

PLATE 2 - Stone stripe riser and tread.

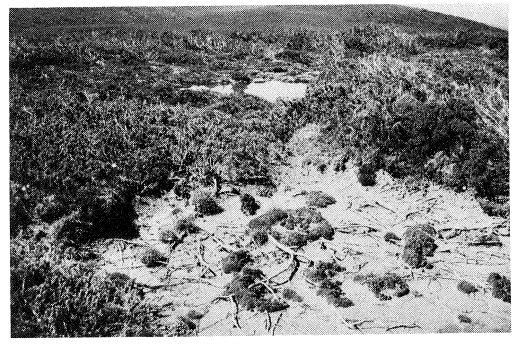

PLATE 3 - Lunette dune to east of an intermittent pool.

australis and *Danthonia pulvinorum* are intimately mixed with herbs such as *Microseris scapigera*, *Plantago paradoxa*, *Epilobium gunnianum*, *Hypericum japonicum* and *Colobanthus apetalus*. Many of the species recorded for the short alpine herbfields were confined to this vegetation type in the study area (table 1).

A small area of short alpine herbfield was located on the peak of Pyramid Mountain. This contained two species, *Helichrysum acuminatum* and *Drapetes tasmanica* that were absent from the Rocky Hill herbfield, and lacked many of the species found at Rocky Hill, but resembled this latter herbfield in its structure and local species richness. Small areas of the less species-rich *Gunnera cordifolia* short alpine herbfield were found between *Astelia alpina* tall alpine herbfield and *Athrotaxis cupressoides* woodland at Rocky Hill.

Other Alpine Vegetation Types

Of the alpine vegetation types recognized by Kirkpatrick (1983) only tussock grassland and deciduous heath are absent from the study area, and, excluding the communities described above, bolster heath, coniferous heath, heath, tall alpine herbfield and bog communities can all be found.

Bolster heath dominated by *Donatia novae-zelandiae* is absent from the Pyramid Mountain alpine area but is found on all others within the study area. The bolster plants *Abrotanella forsteroides*, *Dracophyllum minimum*, *Phyllachne colensoi*, *Pterygopappus lawrencii* and *Mitrasacme archeri* were not observed within the study area, although *Carpha rodwayi*, *Oreobolus pumilio*, *O. oligocephalus* and *Ewartia meredithae* were present. On the relatively low altitude quartzite, hill D, *Donatia novae-zelandiae* shares dominance with *Gymnoschoenus sphaerocephalus*. Elsewhere the most abundant associates include *Microcachrys tetragona*, *Empodisma minus* and *Oreobolus oligocephalus*.

On hills A and C *Donatia* bolster heath is replaced on slightly better drained ground by *Diselma archeri* coniferous heath. The *D. archeri* bushes are up to 1.8 m tall and vary from sparse to dense cover. *Microcachrys tetragona* coniferous heath occurs on all hills and mountains within the study area, being mostly located on shallow soils with gentle slopes. Other alpine heath dominants recorded for the study area are *Epacris serpyllifolia*, *Baeckea gunniana*, *Cyathodes dealbata*, *Pentachondra pumila*, *Leptospermum rupestre*, *Richea scoparia* and *Nothofagus cunninghamii*. The latter species forms a metre high heath, with approximately 50% cover in the dominant stratum, in a belt between *N. cunninghamii* scrub and the higher altitude heath communities.

On the shelves below the upper treeline some poorly drained areas are occupied by bog in which *Sphagnum cristatum* is ubiquitous and *Richea gunnii*, *Astelia alpina* and *Carex gaudichaudiana* are prominent, or by *Astelia alpina* tall alpine herbfield.

Other Vegetation

The numerous cliffs found in the study area support a sparse vegetation characterized by faithful species such as *Gnaphalium umbricola* and *Aristotelia peduncularis*. The cliffs are rich in ferns, grasses and soft herbs such as *Veronica calycina* and *Geranium sessiliflorum* (table 1).

The subalpine heaths are dominated by *Melaleuca squamea*, which is typically more than 1 m tall. On the most poorly-drained sites these heaths grade into *Gymnoschoenus sphaerocephalus* tussock sedgeland. With slightly improved drainage they grade into *Leptospermum nitidum* scrub and forest which, with improved drainage, in turn gives way to *Eucalyptus simmondsii* open-forest or *Eucalyptus subcrenulata* woodland over *Nothofagus cunninghamii* closed-forest.

Eucalyptus coccifera open-scrub, open-forest and woodland forms a narrow altitudinal belt terminating at the upper slope treeline on the western and northern aspects of both mountains where slopes are steep. On the other aspects *Nothofagus cunninghamii* scrub predominates below the treeline. *Athrotaxis cupressoides* woodland is confined to two shelves and two, high altitude, south-facing half-basins (plate 4). A few individuals of

A. selaginoides were found in the central *A. cupressoides* woodland (fig. 3), and only one individual was found in the Pyramid Mountain alpine area.

The one lake in the study area (fig. 3) contained a small area of reed swamp dominated by an unidentified sedge or rush, and in various parts its aquatic vegetation was dominated by *Potamogeton australiensis*, *Isoetes gunnii* and *Myriophyllum pedunculatum*. A low closed-herbland dominated by *Scirpus subtilissimus* and *Myriophyllum pedunculatum* is found at the northern end of the lake where also is found a *Richea gunnii-Sphagnum cristatum* bog. A *Leptospermum lanigerum* closed-forest occurs on slightly better-drained ground than the bog. A soft organic deposit more than 2 m deep underlies the bog and the aquatic vegetation near the north and west shores of the lake.

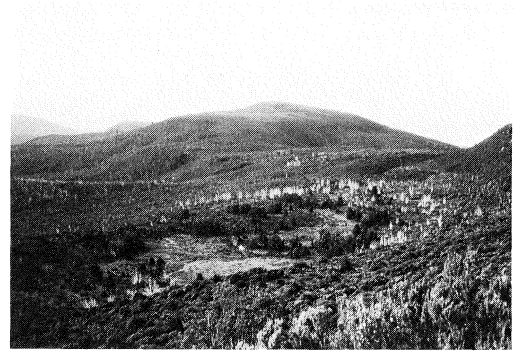

PLATE 4 - *Athrotaxis cupressoides* woodland mixed with bog on a shelf below Rocky Hill. The boundary of the last fire is marked by tree skeletons. *Nothofagus cunninghamii* scrub occupies the foreground.

DISCUSSION

The study area contains evidence for at least two major fires, and for a recent period of severe landscape instability. Very little vegetation could have escaped a fire which eliminated *Athrotaxis* spp. and *Diselma archeri* from most of the sites suitable for their occurrence. On the southern flanks of the fjaeldmark of hill A a metre-deep gully has been cut through a nonsorted stone step revealing a large *Athrotaxis* log at an altitude presently bereft of tree growth. Many such buried logs were also revealed by erosion, or found partly protruding from the soil, on the upper terraces of Rocky Hill. The event that killed these trees must have affected almost all of Pyramid Mountain where only one individual of *Athrotaxis* and no *Diselma* were found.

A second fire burned most of Rocky Hill, probably in 1934. This fire further reduced the area occupied by *Athrotaxis cupressoides* but missed the small remaining areas of *Diselma archeri* heath, and could not burn the fjaeldmark. An earlier fire almost certainly occurred within the last one or two centuries as many individuals of *Nothofagus cunninghamii* and *Eucalyptus subcrenulata*, while large enough to be one or two centuries old, show evidence of being derived from resprouts from the base of older stems. The buried *Athrotaxis* logs were probably killed by fire as they occur on gentle enough slopes to exclude landslip or avalanche and windthrow does not seem to be common with these species. The *Athrotaxis* skeletons remain standing for several decades following fire kill, so their burial must be related to a later event. The presence of *Athrotaxis* logs beneath fjaeldmark cannot be taken as evidence of a warmer climate in the recent past as *Athrotaxis* survives as a tree at higher altitude on the nearby northeastern spur of Rocky Hill. However, this situation does suggest that an extremely long period without fire preceded the event that killed the now-buried *Athrotaxis*, as trees as large as that found buried have been shown to be 300 years old in a less exposed environment (Kirkpatrick & Harwood 1980), and as the occupation of a potential fjaeldmark site by forest would require a long term building up of vegetation shelter to windward.

Nonsorted stone steps and nonsorted stone stripes are associated with the sandstones and mudstones of the Tasmanian high mountains. Outside the study area either or both of these features also occur on Dome Hill, Castle Mountain, High Dome, Last Hill, Camp Hill, Little Sugarloaf, Goulds Sugarloaf, Mt Rufus, the Boomerang and the Southern Range (fig. 1). The migrating fjaeldmark type is also known from the Boomerang and Mt La Perouse in the Southern Ranges. The proportion of Tasmanian fjaeldmark that could be occupied by other vegetation types in the extremely long term absence of fire is uncertain. In the cases of extremely steep-sided and unstable ridges and poorly drained horizontal pavements even minor disturbance might be sufficient to lead to an accelerating break in plant cover.

Where shrubs and trees could establish complete cover on steep screes they would tend to accumulate sediment from above, and thus become prone to landslip, a common feature of steep subalpine slopes in Tasmania even where fire has been long absent.

One notable feature of the alpine vegetation of the area burned in the earlier fire is the ubiquity of *Microcachrys tetragona*, a species among those most susceptible to fire. This ubiquity suggests a means of medium distance dispersal, a means provided by the mountain jay (*Strepera fuliginosa*) whose cigar-shaped regurgitate contained virtually unmodified sections of the *Microcachrys* cones in a matrix of *Pentachondra pumila* fruits in January 1983 throughout the study area.

The partly random nature of survival after fire, and dispersal from surviving individuals, may account for much of the variation observed within and between the vegetation of Tasmanian high mountains, as must the patterning of the dispersal paths available during the Last Glacial. However, despite some noticeable idiosyncracies, the vegetation and flora of Rocky Hill and Pyramid Mountain fit well within the available statewide models, which are based on present environmental conditions.

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TABLE 1

TAXA OBSERVED ON ROCKY HILL AND PYRAMID MOUNTAIN

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/scrub	Aquatic
PTERIDOPHYTA							
ASPIDIACEAE							
Polystichum proliferum	x	x	x	x			
ASPLENIACEAE							
Asplenium trichomanes				x			
ATHYRIACEAE							
Cystopteris fragilis (L.) Bernb.				x			
BLECHNACEAE							
Blechnum fluviatile				x			
B. penna-marina	x	x		x	x		
B. vulcanicum (Bl.) Kuhn				x			
B. wattsii Tindale			x				
GLEICHENIACEAE							
Gleichenia alpina	x	x					
GRAMMITIDACEAE							
Grammitis billardieri			x				
HYMENOPHYLLACEAE							
Hymenophyllum peltatum			x				
ISOETACEAE							
Isoetes gunnii							x
LYCOPODIACEAE							
Huperzia selago		x					
Lycopodium fastigiatum	x	x		x	x		
L. scariosum	x	x					
GYMNOSPERMAE							
CUPRESSACEAE							
Diselma archeri		x	x				
PODOCARPACEAE							
Microcachrys tetragona	x	x					
Phyllocladus asplenii folius	x	x	x				
Podocarpus lawrencii	x	x					
TAXODIACEAE							
Athrotaxis cupressoides		x	x				
A. selaginoides	x	x					
ANGIOSPERMAE							
MONOCOTYLEDONEAE							
CENTROLEPIDACEAE							
Centrolepis monogyna	x	x					
C. muscoides	x	x					

Rocky Hill and Pyramid Mountain Vegetation

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/ scrub	Aquatic
CYPERACEAE							
Carex appressa			x	-	-	x	-
C. gaudichaudiana		x					
Carpha alpina	x	x	x			x	
C. curvata W.M. Curtis ined.		x					
C. rodwayi W.M. Curtis ined.	x	x					
Gahnia grandis							
Gymnoschoenus sphaerocephalus			x			x	
Lepidosperma filiforme		x				x	
L. lineare var. *inops*	x	x					
Oreobolus acutifolius	x	x					
O. oligocephalus W.M. Curtis ined.	x	x					
O. pumilo	x	x					
Schoenus calyptratus	x	x					
Scirpus aucklandicus		x	x	-	x	x	
S. fluitans							x
S. subtilissimus						x	
S. sp.							x
Uncinia compacta R.Br.	x	x					
U. flaccida	x			x			
U. tenella			x				
HYPOXIDACEAE							
Campynema lineare	x	x					
IRIDACEAE							
Diplarrhena latifolia	x	x	x	-	-	x	-
Isophysis tasmanica		x					
JUNCACEAE							
Juncus antarcticus	x	x	-	-	x	-	-
J. sp. 1			x				
J. sp. 2				x			
Luzula spp.	x	x	-	x	x	-	-
LILIACEAE							
Astelia alpina	x	x	x			x	
Blandfordia punicea	x	x	x			x	
Libertia pulchella				x			
Milligania densiflora	x	x		x			
ORCHIDACEAE							
Prasophyllum alpinum	x	x					
Pterostylis dubia	x	x		x			
Thelymitra sp.		x					
POACEAE							
Agrostis aemula				x			
A. parviflora					x		
A. venusta	x	x		x	x		
Danthonia fortunae-hibernae			x	x		x	
D. nivicola	x	x					
D. pauciflora	x	x			x		
D. pulvinorum D.I. Morris					x		
Deyeuxia carinata	x	x		x			
D. monticola	x	x		x		x	
D. sp.	x	x		x			

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/ scrub	Aquatic
Erythranthera australia (Petrie) Zotov					x		
Hierochloe fraseri	x	x					
H. redolens						x	
Microlaena tasmanica	x	x	x	x		x	
Poa gunnii	x	x			x	x	
P. labillardieri Steud.	x						
P. saxicola	x						
POTAMOGETONACEAE							
Potamogeton australiensis							x
RESTIONACEAE							
Calorophus elongatus						x	
Empodisma minus (Hook. F.) Johnson & Cutler	x	x	x			x	
Restio complanatus		x				x	
XYRIDACEAE							
Xyris marginata		x				x	
DICOTYLEDONAE							
APIACEAE							
Actinotus bellidioides						x	
A. moorei		x					
A. suffocata	x	x					
Dichosciaduem ranunculaceum	x						
Diplaspis hydrocotyle					x		
Hydrocotyle sibthorpioides	x	x			x		
Oreomyrrhis ciliata	x	x			x		
ASTERACEAE							
Abrotanella scapigera		x	-	x	-	-	-
Brachycome tenuiscapa		x			x		
Celmisia longifolia	x	x					
Cotula alpina		x			x		
Erigeron pappachroma	x	x	x				
E. stellatus	x	x					
Ewartia meredithae	x	x					
E. planchonii	x	x		x	x		
Gnaphalium traversii	x	x			x		
C. umbricola				x			
Helichrysum acuminatum	x						
H. backhousii	x	x					
H. ledifolium		x					
H. milliganii	x	x					
H. pumilum		x					
H. scorpioides			-	x	-	-	-
Lagenifera stipitata		x	x		x		
Microseris scapigera					x		
Olearia ledifolia	x	x			x		
O. persoonioides			x				
O. phlogopappa				x			
O. pinifolia	x	x	x				
Senecio gunnii				x			
S. leptocarpus	x	x					
S. pectinatus	x	x					

Rocky Hill and Pyramid Mountain Vegetation

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/scrub	Aquatic
BORAGINACEAE							
Mysotis australis			x	x			
BRASSICACEAE							
Cardamine sp.					x		
CAMPANULACEAE							
Wahlenbergia saxicola	x	x		x	x		
CARYOPHYLLACEAE							
Colobanthus apetalus					x		
CUNONIACEAE							
Anodopetalum biglandulosum			x				
Bauera rubioides	x	x	x	-	-	x	
DILLENIACEAE							
Hibbertia procumbens						x	
DONATIACEAE							
Donatia novae-zelandiae		x					
DROSERACEAE							
Drosera arcturi	x	x	-	-	x	-	-
D. pygmaea					x		
ELAEOCARPACEAE							
Aristotelia peduncularis			-	x	-	-	-
EPACRIDACEAE							
Archeria eriocarpa			x				
A. hirtella			x				
A. serpyllifolia	-	x					
Cyathodes dealbata	x	x					
C. parvifolia	x	x	x				
C. petiolaris	x	x					
C. straminea	x	x	x				
Epacris serpyllifolia	x	x				x	
Lissanthe montana	x	x	x	x			
Monotoca sp. aff. *linifolia*	x	x					
M. submutica			-	-	-	x	-
Pentachondra pumila	x	x	-	-	-	x	-
Prionotes cerinthoides		x	x	x			
Richea gunnii	x	x					
R. pandanifolia	x	x	x				
R. scoparia	x	x	x			x	
R. sprengelioides	x	x	x				
Sprengelia incarnata	x	x	x			x	
Trochocarpa cunninghamii	x	x	x				
T. gunnii			x				
ERICACEAE							
Galtheria hispida	x	x	x	x	-	-	-
Pernettya tasmanica	x	x					

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/ scrub	Aquatic
ESCALLONIACEAE							
Anopterus glandulosus			x				
Tetracarpaea tasmanica	x	x	x				
EUCRYPHIACEAE							
Eucryphia lucida			x				
E. milliganii			x	-	-	x	-
FABACEAE							
Oxylobium ellipticum		x	x			x	
FAGACEAE							
Nothofagus cunninghamii	x	x	x			x	
GENTIANACEAE							
Gentianella diemensis	x	x					
GERANIACEAE							
Geranium potentilloides			x	x	-	-	-
G. sessiliflorum				x	x		
HALORAGACEAE							
Gonocarpus micranthus Thunb.		x			x		
G. montanus (Hook. f.) Orchard	x	x	x				
Gunnera cordifolia		x					
Myriophyllum pedunculatum							x
HYPERICACEAE							
Hypericum japonicum	x	x	-	-	x		
LOGANIACEAE							
Mitrasacme montana	x	x				x	
MYRTACEAE							
Baeckea gunniana	x	x				x	
Eucalyptus coccifera			x			x	
E. simmondsii Maiden			x			x	
E. subcrenulata			x			x	
E. vernicosa		x					
Leptospermum lanigerum			x			x	
L. nitidum			x			x	
L. rupestre	x	x					
Melaleuca squamea						x	
ONAGRACEAE							
Epilobium gunnianum			-	-	x		
E. tasmanicum			x	x	-		
OXALIDACEAE							
Oxalis lactea	x	x	x	x	x	-	-
PLANTAGINACEAE							
Plantago daltonii			x		x		
P. paradoxa					x		
P. tasmanica	x	x					

Rocky Hill and Pyramid Mountain Vegetation

	Alpine		Subalpine				
	Pyramid Mtn	Rocky Hill	Forest	Cliff	Herb-field	Heath/ scrub	Aquatic
PROTEACEAE							
Agastachys odorata			x	-	-	x	
Bellendena montana	x	x					
Lomatia polymorpha			x				
Orites acicularis	x	x					
O. diversifolia						x	
O. milliganii			x				
O. revoluta	x	x	x			x	
Persoonia gunnii	x	x	x			x	
Persoonia sp.			x			x	
Telopea truncata			x			x	
RANUNCULACEAE							
Anemone crassifolia		x				x	
Ranunculus collinus							x
R. decurvus			-	-	x	-	-
R. glabrifolius					x		
R. nanus					x		
R. triplodontus					x		
ROSACEAE							
Acaena montana		x			x		
A. novae-zelandiae			x			x	
Rubus gunnianus	x	x	x		x	x	
RUBIACEAE							
Coprosma moorei	x						
C. nitida	x	x	x	-	-	x	
C. pumila	x	x					
Galium ciliare			-	x	-	-	
RUTACEAE							
Boronia citriodora						x	
SANTALACEAE							
Exocarpos humifusus	x	x					
Leptomeria glomerata		x				x	
SCROPHULARIACEAE							
Euphrasia gibbsiae		x					
E. striata	x	x					
Ourisia integrifolia			-	x	-	-	-
Veronica calycina				x			
STYLIDIACEAE							
Stylidium graminifolium	x	x				x	
THYMELACEAE							
Drapetes tasmanica	x						
Pimelea lindleyana						x	
TREMANDRACEAE							
Tetratheca procumbens	x						
VIOLACEAE							
Viola hederacea	x	x	-	-	x	-	-
WINTERACEAE							
Drimys lanceolata	x	x	x			x	

TABLE 2

SPECIES ASSOCIATION IN THE ALPINE VEGETATION

	P2	P6	P7	P3	P5	P8	P1	P9	P10	P4	P18	R7	R4	P20	P12	R3	P11	P14	P15	P16	P17	R8	R1	R2	R5	P21	R6	P13	P19
Coprosma nitida	-	x	x	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Deyeuxia monticola	x	x	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichosciadeum ranunculaceum	x	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plantago tasmanica	-	x	x	x	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drapetes tasmanica	x	-	x	x	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agrostis venusta	x	-	x	-	x	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Senecio leptocarpus	x	x	-	x	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Richea sprengelioides	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	-	-	-	-	x	-	-	-	-	-	x	-	-	x
Senecio pectinatus	x	x	x	x	x	x	x	x	x	x	x	x	-	-	x	x	-	-	-	-	-	-	x	-	-	-	-	-	-
Exocarpos humifusus	x	x	x	x	x	-	x	x	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helichrysum backhousii	x	x	-	x	x	x	x	x	x	x	x	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bellendena montana	x	x	-	x	x	-	x	-	x	x	x	-	x	x	x	-	x	-	x	-	x	-	-	x	-	-	-	-	-
Orites revoluta	x	x	x	x	x	-	x	x	x	x	x	x	-	x	-	x	x	-	-	-	x	-	-	x	x	x	-	-	x
Olearia ledifolia	x	x	x	x	x	-	-	x	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	x	-	-	-	-
Epacris serpyllifolia	x	x	-	x	x	x	x	x	x	x	-	x	-	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x
Poa gunnii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	-	-	-	x	-	-	-	x	-	-	x	x
Euphrasia striata	x	x	x	x	x	x	x	x	x	x	-	x	x	x	-	x	x	-	x	-	-	-	-	x	-	x	x	x	-
Pentachondra pumila	x	-	x	x	x	-	-	x	x	-	x	x	x	x	x	x	x	-	-	x	x	-	x	x	x	-	x	-	x
Helichrysum milliganii	-	-	x	x	-	-	-	-	x	x	x	x	x	-	x	x	x	x	-	x	x	-	-	-	-	x	x	-	-
Leptospermum rupestre	-	-	-	-	-	-	x	-	-	x	-	x	x	x	x	x	x	-	-	-	-	-	-	-	x	x	-	-	x
Gonocarpus montanus	-	-	-	x	-	-	-	x	x	-	x	-	x	x	x	-	-	-	-	-	-	-	-	-	x	-	-	-	x
Lycopodium fastigiatum	-	-	-	x	-	-	x	-	-	-	x	-	-	-	x	-	x	-	-	-	-	-	-	-	-	x	-	-	-
Campynema lineare	-	-	x	-	-	-	-	-	-	x	x	x	x	-	-	x	x	-	-	-	-	-	x	-	-	x	-	-	-
Gentianella diemensis	x	-	-	x	-	-	x	-	-	-	-	-	-	-	x	x	x	-	x	x	-	-	x	x	x	-	x	x	-
Astelia alpina	-	-	-	-	-	-	x	-	x	-	-	-	x	-	-	x	-	-	x	x	-	-	-	x	x	x	x	x	x
Empodisma minus	-	-	-	-	-	-	-	x	x	x	x	-	-	-	x	x	x	x	x	x	-	x	x	x	-	x	x	x	x
Microcachrys tetragona	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	x
Cyathodes dealbata	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x
Erigeron stellatus	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	-	-	x	x	x	x	x	x	x	x	-
Carpha alpina	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x
Mitrasacme montana	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-	x	-	x	-	x	x	-	-	-
Oreobolus oligocephalus	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	-	-	-	-	-	x	x	-	-	x	-	-
Oreobolus acutifolius	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	-	x	x	-	-	-	x	-	-	-	-

TABLE 2 cont.

SPECIES ASSOCIATION IN THE ALPINE VEGETATION

	P2	P6	P7	P3	P5	P8	P1	P9	P10	P4	P18	R7	R4	P20	P12	R3	P11	P14	P15	P16	P17	R8	R1	R2	R5	P21	R6	P13	P19
Ewartia meredithae	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	x	x	x	x	x	x	x	x	x	-	x	-	-
Sprengelia incarnata	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x	x	x	x	x	x	x	x	-	-	-	-
Baeckea gunniana	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	x	x	-	x	-	x	x	-	x	-	x	-	x	-
Oreobolus pumilio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	x	x	x	x	x	x	-	x	x	-	-	-
Danthonia pauciflora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	-	-	x	-	x	x	-	-	-	-	-
Drosera arcturi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	x	x	x	x	-	x	-	-
Gleichenia alpina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	x	x	-	-	-	-	-	-
Microlaena tasmanica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	x	-	-	-	-	-
Actinotus suffocata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	-	-	x	-	-
Donatia novae-zelandiae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	-	x	-	-
Anemone crassifolia	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	x	x	-	-	-	-
Lycopodium scariosum	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x
Lepidosperma lineare	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-
Uncinia compacta	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-
Drimys lanceolata	-	-	-	x	x	-	x	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-
Diplarrhena latifolia	-	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-	x	x	-	-	-	x	-	-	-	-	-	x	-
Monotoca aff. *linifolia*	-	-	-	-	-	-	x	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Richea scoparia	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-
Celmisia longifolia	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-

ADDITIONAL SPECIES: *Actinotus moorei* R2, R5; *Archeria serpyllifolia* R5; *Athrotaxis selaginoides* R5; *Blechnum penna-marina* P8; *Carpha rodwayi* R1, R2; *Celmisia longifolia* P1, R3; *Coprosma moorei* P16, P17; *Cyathodes petiolaris* P16, R7; *Diselma archeri* R2, R6; *Erigeron pappachroma* P9; *Euphrasia gibbsiae* R1; *Gaultheria hispida* R4; *Gnaphalium traversii* P8; *Gymnoschoenus sphaerocephalus* R8; *Helichrysum acuminatum* P8, P9; *Helichrysum scorpioides* P8; *Hierochloe fraseri* P10, P13; *Hydrocotyle sibthorpioides* P8; *Leptomeria glomerata* R1; *Lissanthe montana* P8; *Luzula* spp. P1, P2; *Milligania densiflora* P5; *Nothofagus cunninghamii* P19, P20; *Olearia pinifolia* P5, P6; *Oreomyrrhis ciliata* P8; *Orites acicularis* P1, P11; *Pernettya tasmanica* P7, P8; *Phyllocladus asplenifolius* P20; *Restio complanatus* R8; *Rubus gunnianus* P8; *Schoenus calyptratus* R3; *Stylidium graminifolium* P17, R8; *Viola hederacea* P8.