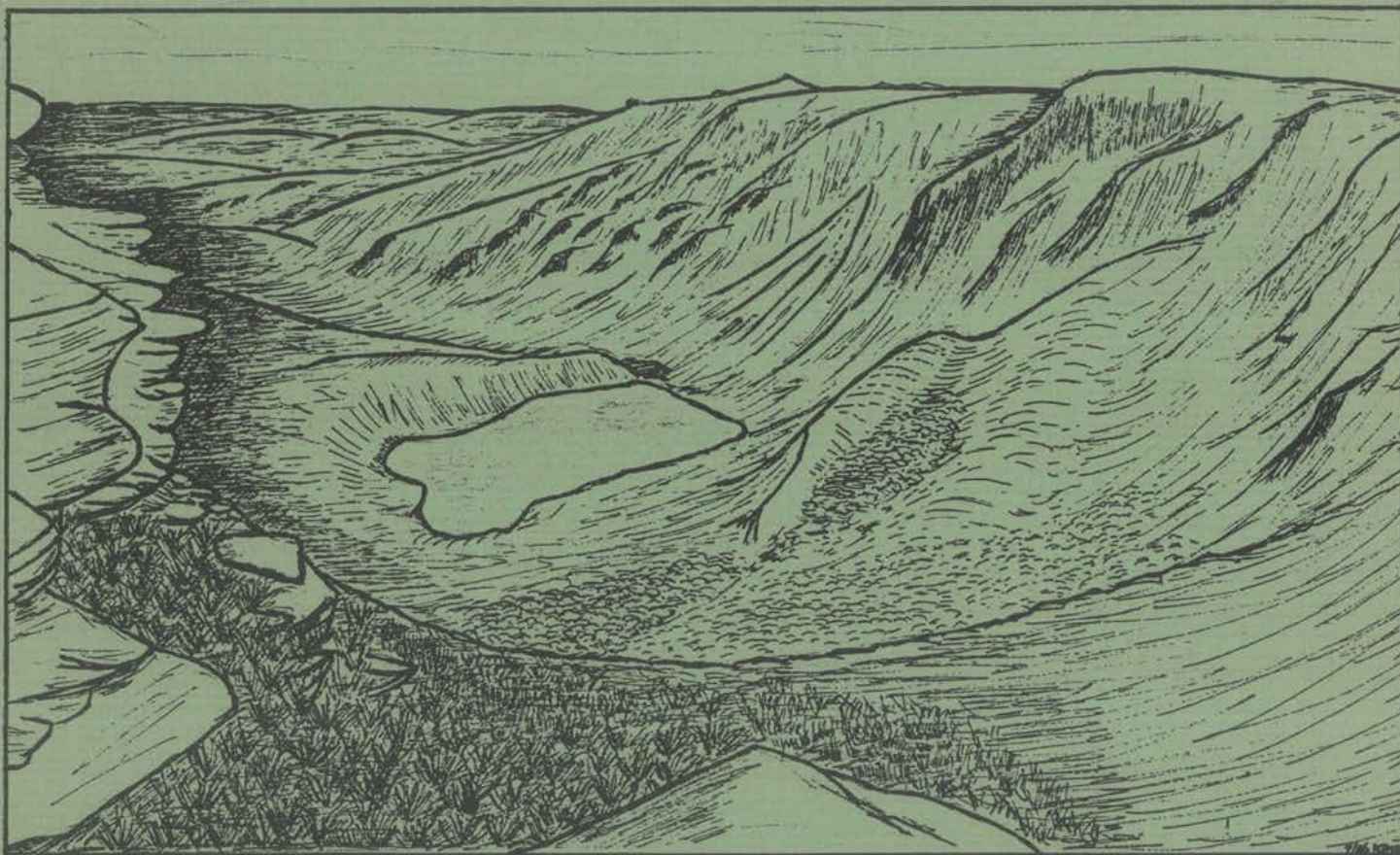


# **Umbrella**

## **Ecological District**



**Survey Report for the**

**New Zealand Protected Natural Areas Programme**

**by**

**K.J.M. Dickinson**

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UMBRELLA ECOLOGICAL DISTRICT

Survey Report for the Protected Natural Areas Programme

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K.J.M. Dickinson

New Zealand Protected Natural Areas

Programme No. 7

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Cover: Gem Lake cirque. View southeastwards from the Whitecoomb Range (c.1400 m)



## FOREWORD

Dr Katharine Dickinson took up the position of Post-Doctoral Fellow at the Botany Department University of Otago in August 1985, to carry out a survey of the Umbrella Ecological District for the Protected Natural Areas Programme. At this time the PNA Programme was under the direction of an interagency Management Committee, which endorsed the survey as an official part of the programme. The Department of Lands and Survey agreed to publish the resulting report.

Dr Dickinson completed the draft report in August 1986, and received comments from members of the Protected Areas Scientific Advisory Committee and the Department of Lands and Survey. These comments were then incorporated in the final text prepared in April 1987, and endorsed by Professor Alan Mark as scientific advisor.

Also in April 1987, the Department of Conservation inherited responsibility for the Protected Natural Areas Programme, and consequently the publication of this report. The Department has a strong commitment to pursue the objectives of the PNA Programme and to secure protection for natural areas as appropriate.

From extensive fieldwork Dr Dickinson has compiled a great deal of valuable information concerning the ecological values of a previously little known district. The chief product of the survey is the identification and description of a network of recommended areas for protection (RAPs). Collectively these are intended to represent the ecological diversity of the district and be a starting point for discussion and consultation, particularly with the landholder involved.

A recommended area for protection is as much a recommendation to the Department of Conservation as from it. Recommendations may be rejected or amended prior to their adoption as departmental proposals. Changes in recommendations may occur following the consultation process, or after consideration of other values the area may possess. The Department will then endeavour to negotiate the proposals resulting from this process with the landholders concerned to achieve the appropriate form of protection for each area.

I have been impressed by the vigour with which Dr Dickinson has carried out both the survey and the preparation of this report. The result is a substantial reference work on the ecological values of the Umbrella Ecological District, and a guide to conservation priorities. This survey report will be of wide interest to landholders, conservation managers from the Department of Conservation and other agencies, scientists and the general public.



Murray Hosking  
Deputy Director-General (Conservation Management)  
Department of Conservation

## ACKNOWLEDGEMENTS

Completion of this P.N.A. survey would have been a great deal more difficult without the help, criticism and encouragement given during all phases of the exercise by my adviser, Professor A.F. Mark. In addition, the knowledge and effort contributed by my field assistant, Mr B.D. Rance was invaluable.

The survey was made possible in the first instance by the award of a University Grants Committee, one-year Post-Doctoral Fellowship. Financial support for a field assistant plus travel expenses was provided by the Miss E.L. Hellaby Indigenous Grasslands Research Trust. The Tennant Fund administered by the Botany Department also supplied some additional funds for field assistance.

The Department of Lands and Survey originally endorsed this P.N.A. survey and undertook the publication, wider distribution and implementation of this report. In particular, I am grateful to Mr A. Perrett and Mr P. Thomas for their assistance.

Although the landholders on whose property I sought access are too numerous to mention I would like to thank them all for their co-operation and advice. Many expressed an interest in the survey which reflected their own interest in the natural values of their land.

Many other people contributed their skills, knowledge and time during the survey and their assistance cannot be underestimated. I would like to thank Mr A.P. Druce, Dr E. Edgar, Dr P. Garnock-Jones, Dr D.R. Given, Dr P.N. Johnson and Ms B.H. MacMillan (Botany Division, D.S.I.R.), Dr J.W. Dawson and Dr B. Sneddon (Botany Department, Victoria University), Dr J. Ward (Botany Department, Canterbury University) and Mr M.J. Heads (Botany Department, Otago University) for their help with plant identification. The zoological information recorded was greatly enhanced by the energy and enthusiasm of Dr B.I.P. Barratt (Invermay Agricultural Research Centre, M.A.F.), Dr C.W. Burns (Zoology Department, Otago University), Mr B.H. Patrick (38 St Albans St, Dunedin) and the late Mr P., and Mrs M. Child (Alexandra). Additional assistance with faunal identification was given by Mr P.M. Johns (Zoology Department, Canterbury University) plus Dr R.R. Forster and Mr A.C. Harris (Otago Museum), and Mr G. Mason (Anthropology Department, Otago University). Unpublished information on birds was made available by Mr G. Loh (Wildlife Service) and Mr M.R.R. Foord (39 Park St, Dunedin), while Mr W.W. Ahlers gave his time to help with the yellowhead survey.

I wish to thank Mr M.W. Stirling for his enthusiastic contribution regarding the geomorphology of the District and Mr H. Ballard who willingly piloted the light aircraft for the aerial survey. I am also grateful to Dr J.B. Wilson who offered his computer package GOLLIWOG and acted as troubleshooter during the analytical phase.

By no means least I am indebted to the staff and students of the Botany Department, Otago University for providing a pleasant and friendly working environment. I am particularly grateful to Mrs P. Fleming for her tenacity, patience and competence in the typing of this report.

## SUMMARY

The Umbrella Ecological District (c. 150,000 ha) Waikaia Ecological Region, was surveyed as part of the Protected Natural Areas Programme during 1985/86. The survey was undertaken in four broad phases: preparation; reconnaissance; detailed study; and selection of recommended areas for protection. It was completed and written up within 12 months.

Detailed study was of areas representative of the District's indigenous plant associations and landforms having the highest natural values available and presenting the greatest contiguous sequences within the District. Fixed-area plots were sampled in forest and non-forest communities except on rock bluffs where species lists and abundance ratings were used. Cover and height of all vascular plants were recorded in the plots together with general descriptions, and recording of environmental parameters were made. Plant and animal collections and observations were also included.

Presence-absence data from all the 270 plots were classified using cluster analysis and displayed as dendrograms. Fifteen community types, and sixteen species classes were differentiated, ranging from mixed beech forest to low-alpine and snowbank communities.

The flora is diverse: 627 vascular plant taxa were recorded of which 536 are indigenous. A voucher collection of c. 1200 specimens has been established. The District contains several species of restricted distribution and appears to be the southeastern limit for many alpine species. Floristic affinities appear closer to the Garvie Mountains to the west than to the Old Man Range to the north.

Fifty-seven bird species are known from the District, 41 being recorded during the present survey. Of these kea and fernbird had not been previously documented. New Zealand falcon are widespread in the upland areas.

The moth fauna of the District is diverse, 218 taxa having been recorded. Probably c. 80% of the alpine species were collected during the survey. The alpine Lepidoptera of the District, particularly the Umbrella Mountains, show strongest links with areas to the west (Garvie Mountains) and east (Lammermoor Range). Many rarely collected and interesting finds were made.

The beetle fauna is also very diverse with many species extremely abundant: 83 were collected from the Whitecoomb Range. Affinities are shared with the Old Man Range, Garvie Mountains and Blue Mountains.

The aquatic habitats of the Whitecoomb Range are relatively undisturbed and unmodified examples of upland southern South Island faunal associations. Gem Lake is one of only very few New Zealand lakes known to be in an unmodified state. As such it constitutes an invaluable scientific baseline.

From the information collected, 20 priority places for protection are identified as having priority for formal protection of their natural ecological values. These areas are complementary to the two existing protected natural areas (Leithen Bush Scenic Reserve - c. 2500 ha and Timber Creek Conservation Covenant - c. 9 ha) within the District. Fourteen are given Priority 1 status, the balance is Priority 2. Individual areas vary from c. 25 ha to c. 1800 ha with a total of 5785 ha assigned Priority One and 475 ha Priority Two. Given the substantial land development in the lowland of the District, most of the area identified is in the uplands.

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## CHAPTER 1

## GENERAL INTRODUCTION

The past decade has seen an increasing awareness of land use conflicts particularly in relation to the rapid disappearance of indigenous ecosystems from many parts of New Zealand. Recognition that indigenous habitats, exclusive of protection vegetation of mountainous regions and offshore/outlying islands, are very poorly represented in the parks and reserves system, spurred the formulation of the Protected Natural Areas (P.N.A.) Programme in New Zealand. Initiated and co-ordinated by the National Parks and Reserves Authority, the programme seeks to uphold the objectives made explicit in the Reserves Act 1977, namely:

"preservation of representative samples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character." (Section 3(1) (b)).

To provide a systematic framework on which to base the P.N.A. Programme, New Zealand has been divided into 84 Ecological Regions comprising 268 Ecological Districts (Biological Resources Centre 1983). Districts have been identified and defined on the basis of unifying features of geology (lithology), landform, climate, soil, vegetation and/or indigenous flora (Simpson 1982). As such, an ecological district is defined as a geographic area possessing a recognisably distinct pattern of characteristic natural ecosystems. An ecological region may be a single, very distinctive ecological district, or more commonly, a group of adjacent districts which have diverse but closely related ecological components and relationships (Simpson 1982).

The P.N.A. Programme was initiated in November 1983 with the establishment of four pilot studies. These surveys, undertaken in a wide range of habitats and land tenures, were designed to test, and if necessary refine, proposed P.N.A. survey methodology developed largely by staff of the Biological Resources Centre (Owen and Park 1983; Park 1983a, 1983b; Law *et al.* 1984). Two North Island areas were chosen representing forest and coastal environments (1) Rodney District having numerous small private holdings, and (2) Motu District with large tracts of Maori-owned land. In the South Island, areas selected were (1) the largely pastoral leasehold tussock grassland and mountainlands of the Mackenzie Ecological Region, inland South Canterbury/North Otago, and (2) the broad plateaux and tundra-like upland vegetation of the Old Man District, Central Otago, again largely pastoral leasehold land. To date, only the last two studies have been published (Espie *et al.* 1984; Brumley *et al.* 1986). Since the initial four pilot studies were undertaken, surveys have been completed for three other Districts within the Heron Ecological Region in Canterbury (Arrowsmith, Hakatere and Two Thumb) plus the Egmont Ecological Region, North Island and Kaikoura Region. Only the last three surveys have so far been published (Harrington *et al.* 1986; Bayfield and Benson 1986; Breese *et al.* 1986).

In all except the Egmont study, survey teams of 5-10 people, generally university students, were employed under the government's Special Employment Scheme. Additional aid was provided in a practical and/or advisory form from the Department of Lands and Survey, Biological Resources Centre and Botany Division of D.S.I.R., Forestry Research Institute of the N.Z. Forest Service and several university scientists.

The P.N.A. survey methodology has been based on the land systems approach (Christian and Stewart 1953). The procedural steps involve the division of ecological districts into land systems, these being defined as an assemblage of land units geographically and/or geomorphologically related, throughout which there exists a recurring pattern of landform, soils and vegetation. Within land systems vegetation-landform combinations (ecological units) are differentiated on the basis of similar biophysical patterns (Law *et al.* 1984). However, the Mackenzie Region and Old Man District surveys differed markedly in their attention to detail. The former, comprising seven ecological districts, was surveyed over one season with a team of nine, whereas two consecutive summers were taken by a team of ten (1983/84) and seven (1984/85) to complete the survey of the single Old Man District. Although two zoologists were employed in the Mackenzie team, limited time and personnel precluded a comprehensive faunal survey of all ecological units, or of all habitats within the units (Espie *et al.* 1984). Even less emphasis was placed on zoology by the Old Man team.

Against the background of these earlier P.N.A. studies the survey of the Umbrella Ecological District was initiated in September 1985. The study was conducted with support from the University Grants Committee in the form of a one-year Post-Doctoral Fellowship, the receipt of which is gratefully acknowledged. The Miss E.L. Hellaby Indigenous Grasslands Research Trust provided funds for a half-time field assistant (B.D.R.) as well as field, transport, computation and initial publication expenses. The draft report was completed in August 1986 and 15 copies supplied to the Department of Lands and Survey. Results were discussed with landholders at this time. The draft was subjected to scientific scrutiny and minor modifications have been included/incorporated in this final version of the report.

The Umbrella Ecological District was chosen for study as the District:

- a. was contiguous with the previously surveyed Old Man District;
- b. had a wide range of indigenous vegetation;
- c. was relatively little known for either flora or fauna;
- d. was known to be undergoing rapid modification through land development;
- e. was assigned top priority rating for P.N.A. survey by Botany Division, D.S.I.R. (Myers 1984);
- f. was relatively easily accessible from Dunedin.

The principal objectives of the Umbrella survey are embodied within the overall aims of the P.N.A. Programme. However, the exercise was also undertaken to establish whether a district survey could be effectively and efficiently achieved by one professionally trained person within a period of 12 months.

The methodology used differed from previous surveys in that the land systems approach was not used. Primary differentiation of areas justifying detailed study was on the basis of indigenous vegetation, particularly its extent, diversity and degree of modification. Nonetheless, landform criteria were incorporated into the general choice of study areas. Sampling within study areas was both detailed and reasonably objective, being undertaken on a fixed-area basis, an approach differing from most of the previous P.N.A. surveys. All higher (i.e. vascular) plants were recorded and information stored on single cards, rather than three as in the Old Man survey. Faunal information was included to the greatest extent possible making maximum use of relevant expertise that was available during the survey period.

From the assembled data on vegetation/flora, fauna and landform, identification of recommended areas for protection were made. These relate to particular localities identified as priorities for protection and conservation management. These places are considered to best represent the natural ecosystems remaining in the Umbrella Ecological District (see Park and Kelly 1986).

## CHAPTER 2

## THE UMBRELLA ECOLOGICAL DISTRICT

2.1 Introduction

The Waikaia Ecological Region comprising the Umbrella and Nokomai Ecological Districts has been little studied for either flora or fauna. The Old Man Range which immediately abuts to the north, and the Rock and Pillar Range further to the east have been the most studied high country areas in Central Otago (Bliss and Mark 1974; Mark 1974; Mark and Bliss 1970). Moreover, the Old Man District has been assessed as part of the P.N.A. programme (Brumley *et al.* 1986), and the Rock and Pillar Range has undergone a similar study as part of a Pastoral Lands Assessment (Lands and Survey Dept. 1983b). As a rule, mid-altitude and lowland areas have been largely neglected, reflecting the greater degree of habitat modification at these elevations.

Written documentation on the ecology of the Umbrella Ecological District is restricted to a small number of unpublished reports and management plans (Ross 1979; Lee 1982; Lands and Survey Dept. 1983a; Johnson 1983a). Two of these relate to the only existing protected areas in the District, Leithen Bush Scenic Reserve (c. 2,500 ha) and the Timber Creek (beech forest) Conservation Covenant (c. 9 ha) both under Department of Lands and Survey jurisdiction. Waikaia Forest and a few small forest remnants near the Argyle Burn were under State forest tenure. Responsibility for these areas has been assumed by the newly-formed Department of Conservation in 1987. The remaining land in the District is held either under Crown lease or is privately owned. A large proportion of land over 800 m is under pastoral lease occupancy.

2.2 Prescription

Criteria: vegetation (red tussock), soils, topography, geology, climate (moist), flora (southeastern limits), fauna.

Area: c. 150,000 ha.

Topography: block-faulted landscape with extensive upland plateaux, the southern continuation of the Old Man Range, with low- to mid-altitude rolling foothill country. Minor glaciation has occurred on the Whitecoomb Range (above 1300 m). Drainage patterns are largely superimposed, some structural (along faults) in places deeply incised. Altitude varies from c. 65 m (Clutha Valley) to 1455 m (Mt Whitecoomb).

Geology: mainly Paleozoic Haast Schist with minor Quaternary sediments.

Climate: cool temperate; annual rainfall c. 500-1500 mm, frequent fogs; NW and SW winds prevail; snow may lie above 1000 m for weeks in winter, patches commonly remain until December.

Soils: mainly hill and steep-land soils from schist with variable cover of loess, thickness dependent on slope; in drier areas of the E soils droughty, weakly to moderately leached with pale-coloured compact subsoils on low terraces; with increasing rainfall a gradation through deep soils from loess on terraces with mottled subsoils and poor winter drainage to moderately to strongly leached soils with yellowish brown friable subsoils and more even moisture conditions, to strongly and very strongly leached steep-land soils from schist at higher elevations; some of these soils podzolised. Poorly drained peaty soils on rolling crests of ranges; small areas of alluvial soils on river flats.

Vegetation/modification: consists mostly of modified lowland tussockland and poorly drained upland, subalpine to alpine tussock grassland (red tussock once extensive in the E and S, some short tussock, large areas of exotic pasture; in alpine zone narrow-leaved snow tussock, slim snow tussock); snowbanks; mixed scrub; extensive upland bogs; some small remnant stands of silver beech in the E, more widespread on the western and southern slopes of Umbrella Mountains (mountain and silver, some red beech); some remnants of lowland mixed shrubland. District mostly grazed (extensive and semi-extensive sheep and cattle) with hares occurring throughout in moderate numbers.

Flora: southeastern limit for many alpine species. Floristic affinities appear closer to Garvie Mountains than to the Old Man Range.

Fauna: Invertebrate fauna abundant and diverse. Affinities with Garvie Mountains and Old Man Range. Aquatic habitats (particularly above 1300 m) largely unmodified, one species of copepod possessing apparently unique features. Several colonies of the endemic land snail *Powelliphanta spedenii* subsp. *spedenii*. Bird fauna particularly abundant in large forest remnants. Yellowheads recorded in Waikaia State Forest and Leithen Bush. Eastern record for keas (breeding not confirmed). New Zealand falcon widespread in upland. Long-tailed bats known from the large forest stands.

### 2.3 Boundary definition:

The Umbrella District is bounded in the east by the Clutha River and in the west by the Waikaia River. It abuts with the Lammerlaw and Manorburn Ecological Districts along the eastern boundary and with the Nokomai District at its western limit. The southern boundary follows the topographic change demarking the foothills of the Umbrella District and the extensive flat, lowland country comprising the Gore Ecological Region. The northern boundary which separates the Umbrella and Old Man Districts follows the Waikaia Bush 'road' where this runs along the Pomahaka/Waikaia drainage divide.

### 2.4 Geology

Basement rock in the District is predominantly of the Paleozoic Haast Schist Group metamorphosed to textural zone IV (schistosity with strong foliation or segregation banding) in the north, zone

III (strong schistosity with either weak or no foliation) in the central areas, and zone II (semi-schistosity or schistosity without foliation) in the south and south-east. In the south-west basement terrain is of the Caples Group which comprises greywacke and argillite, in places semi-schistose with some minor volcanics. These rocks grade northwards into the low-grade metamorphics of the Haast Schist Group.

Deformation of a mid Tertiary erosion surface is evidenced by large scale block-faulting trending NE-SW and smaller scale faulting and warping trending NW-SE.

Tertiary sediments are found in the south-west of the District, generally associated with fault lines, as well as in localised depressions in the upland areas.

Quaternary deposits include alluvium along the Clutha and Waikaia Rivers, and various glacially derived deposits in both the main river valleys and also in the isolated cirques of the Umbrella Mountains. Colluvium mantles both hill and mountain slopes. Localised areas of peat occur up to several metres deep on the plateaux.

## 2.5 Geomorphology

The northern and central portions of the District encompass a block-faulted landscape with two major N-S trending ranges, that of the Whitecoomb Range and Mt Benger. The White Umbrella ridge has faulted off the main Whitecoomb ridge forming a plateau area of moderate altitude. The extensive upland plateaux are the eroded remnants of a mid Tertiary erosion surface which has undergone differential uplift and subsidence plus local tilting and warping. The two main fault blocks constitute local increases in altitude in a general southwards decline in elevation from the extensive plateaux of the Old Man Range. In turn, these locally elevated blocks descend to the relatively homogeneous low to moderate altitude foothills and dissected semi-schist plateaux which comprise the southern portions of the District.

The block-faulted units have different components, that is the plateau summit or crest, probably slightly tilted, and scarp faces. The latter are typified by the eastern slopes below Mt Benger. Extensive colluvial slopes, both ripply (due to extensive solifluction and slumping) and planar, here descend to the Clutha Valley. The slopes are typically lightly incised with many gullies oversteepened in the lower sections of their profile.

The present drainage pattern is largely superimposed. In places channels have exploited structural weaknesses such as faults (e.g. Whitecoomb Creek). Otherwise the system is apparently random. In cases where streams were present prior to uplift and the terrain has been greatly elevated, deeply incised and often gorge-like drainage channels have resulted (e.g. Waikaia River).

Past glaciation is evidenced by isolated cirques in pre-glacial gully heads above 1300 m on the Umbrella Mountains, with associated till and morainic deposits. Summit tors in the northern and central portions of the District testify to past periglacial processes

(cf. McCraw 1965). Present day weathering processes exploit joints and fractures in the rock. These tors do not extend into the semi-schist country. Lowland tors also occur (e.g. near Roxburgh) formed as a result of the differential deep chemical weathering which occurred during the warm Tertiary climate. Subsequent removal of the weathered mantle exposed an uneven surface of schist bedrock (McCraw 1965).

## 2.6 Soils

Soils of the Umbrella District have been documented at a scale of 1:253,440 (N.Z. Soil Bureau 1968). More detailed studies have covered only small lowland portions of the north-eastern (Leamy and Wilde 1971a,b) and southern sectors (Bruce 1984a, b). Survey of the Otago uplands is generally restricted and soils occurring there are certainly of far greater complexity than can be displayed at small scales (cf. Mark and Bliss 1970, McIntosh and Backholm 1981). A generalised summary from N.Z. Soil Bureau (1968) is presented here:

Upland and high country yellow-brown earths cover much of the Umbrella District. Silt loams and stony loams (Carrick soils) in the eastern, central and northern areas grade westwards and southwards into the stony loams and silt loams of the Waikaia steepland soils. The former are derived from schist solifluction detritus, the latter from semi-schist and greywacke parent material. Silt loams and stony silt loams (Leithen Hill soils) occur to the west of Leithen Burn and border with podzolised yellow-brown earths (Maungatua soils) on the Black Umbrella Range. Much of the south-eastern portions of the District are silt loams and stony silt loams derived from schist and loess (Wehenga hill soils).

Lowland yellow-brown earths border much of the middle reaches of the Pomahaka River and its tributaries, as far north as the confluence with Bullock Creek. Texturally, silt loams to stony loams, these Tuapeka hill soils are derived from schist with patches of schist loess. Tuapeka steepland soils (silt loams and stony loams) with elements of Pukekoma hill soils (silt loams and shallow silt loams) occur on Awatere Station and in the Mt Wendon area.

In the southern and western (lowland) portions of the District yellow-brown earths intergrade with yellow-grey earths, often exhibiting a wide variety of textures, being derived from varying combinations of loess, schist and greywacke.

Yellow-grey earths occupy the eastern sections of the District, along the Clutha Valley as far south as Raes Junction and including the mid to lower portions of the steep scarp face east of Mt Bengier. Textures range from stony loams and fine sandy loams (Pukerangi hill soils) west of Ettrick to silt loams and fine sandy loams (Spylaw steepland soils) and are derived from schist, loess and schist colluvium. In the Roxburgh and Coal Creek areas loams to sandy loams occur (Arrow/Blackstone soils).

Soils derived from alluvium (Mataura soils) feature in the Waikaia River valley to the south of Piano Flat, and on the valley floor of the Spylaw Burn.

## 2.7 Climate

The District experiences a cool temperate, humid-subhumid climate with a tendency for droughtiness in the low- to mid-altitude eastern areas. Precipitation varies from c. 500 mm in the north-eastern, lowland sections to c. 1500 mm in the upland country of the central and northern portions of the District. There is a general south-north decrease in precipitation at the least along the Clutha Valley with averages of 845 mm at Raes Junction (altitude 152 m), and 465 mm recorded at Roxburgh Power Station (altitude 110 m) over the period 1951-1980 (N.Z. Meteorological Service, undated). Waikaia (152 m) in the west averaged 866 mm for the same period.

The hill country of the District experiences high precipitation compared to the low altitude areas. In winter a large proportion falls as snow thus precipitation measurements may be unreliable. Much of the Umbrella District high country is under snow for about four months of the year and in sheltered positions drifts may persist until late December. Few precipitation figures are available for the upland areas. However, Mark (1974) monitored four climatic stations over a 4-year period at varying altitudes along the Waikaia Bush 'road' corresponding to the northern boundary of the District. He reported a mean annual precipitation of 2331 mm for one site at 1230 m elevation facing eastwards (leeward), but noted that the result from a summit plateau site at 1360 m (1211 mm) was likely to be a more reliable estimate. Stations placed in the subalpine and montane zones recorded mean annual figures of 1019 mm and 642 mm respectively, indicating a steep altitudinal precipitation gradient.

Frequent fogs have been described on the Old Man Range (Mark 1965). However, frequency appears greater in the upland areas of the Umbrella District. Fogs may occur during all seasons of the year and are very often unaccompanied by rain. This climatic characteristic is a distinctive feature of the District.

The distribution of temperature records is limited. Roxburgh Power Station (110 m altitude) and Moa Flat (410 m) experience mean air values of 16.5 °C and 13.5 °C respectively for the warmest month and 4.4 °C and 3.3 °C respectively for the coldest month (N.Z. Meteorological Service 1983: period 1951-1980), with corresponding annual means being 10.9 °C and 8.9 °C. Mark (1974) reported mean air temperatures of 6.8 °C at 1360 m elevation increasing to 10.3 °C at 610 m in the warmest month and -2.2 °C at 1230 m increasing to -0.1 °C at 610 m in the coldest month. Yearly averages over the four year period at the latter two sites were 3.5 °C and 6.2 °C respectively. Estimated mean potential evapotranspiration at these sites does not appear to vary greatly with altitude (216 mm and 271 mm respectively).

## 2.8 Bioclimatic Zones

The District ranges in altitude from c. 65 m in the Clutha Valley to 1453 m at Whitecoomb summit on the Umbrella Mountains. Five bioclimatic zones may be recognised in the District.

1. Lowland zone This zone has been almost completely modified making its characterisation in terms of the indigenous flora difficult. In the presence of the native plant communities the zonal limit was probably c. 150 m.

2. Montane zone This zone encompasses both forest and non-forest plant associations. It can be characterised by the upper limit of red beech (*Nothofagus fusca*) and Hall's totara (*Podocarpus hallii*) at c. 750 m in forest communities, and by matagouri (*Discaria toumatou*) in non-forest communities to a similar altitude.

3. Sub-alpine zone This zone extends from 750 m to c. 1100 m, the estimated natural tree-line and upper altitudinal limit for silver beech (*Nothofagus menziesii*) and mountain beech (*N. solandri* var. *cliffortioides*). Species from non-forest communities reaching their upper limit within this zone include fescue tussock (*Festuca novae-zelandiae*), *Pernettya macrostigma* and *Leucopogon fraseri*.

4. Low-alpine zone This zone extends to the highest altitude within the District (c. 1455 m), with the exception of snowbanks which can be considered as high-alpine. Characteristic cover is snow tussock grassland with or without codominant shrubs while typical species include narrow-leaved snow tussock (*Chionochoila rigida*) and slim snow tussock (*C. macra*) plus the daisies *Celmisia semicordata* and *C. lyallii*.

5. High-alpine zone This zone embraces the localised areas of snowbank communities which floristically are indicative of higher altitude areas. Characteristic species include the subshrub *Parahebe trifida*, and herbs *Celmisia haastii*, *Raoulia subulata*, *Hectorella caespitosa* and *Ranunculus pachyrrhizus*.

## 2.9 Cultural influences

Much of the Umbrella District and other areas in south-central Otago were identified, and subsequently opened, for pastoral use from the late 1850's onwards. However the vast expanses of tall dense tussockland observed in the first European forays into the area were exploited rather than conserved (McLintock 1949). Within 20 years of settlement, after an unbroken cycle of tussock burning and overstocking, the beginnings of deterioration were noted although the warnings were generally ignored (McLintock 1949). Consequently, the high tussock cover in many places was superseded by bare soil and later by gravel and rock, the situation being aggravated by rabbit grazing. By the 1880's in the Pomahaka headwaters area, between eight and ten thousand rabbits were taken annually. However, aided by a disease which also killed large numbers of rabbits on Moa Flat, the vast proportion were eradicated with poison by 1908 (Bain 1985). Today, hares are widespread throughout the upland areas, rabbits persist in the low- to mid-altitude regions.

Access to the high country was initially on foot or on horseback. In the mid 1940s the advent of aerial topdressing, oversowing, rabbit elimination by aerial poisoning and roading by bulldozer opened the high country to an unprecedented degree (Bain 1985). The majority of land below 1000 m was topdressed and oversown and lowland areas were generally cleared and cultivated with widespread application of fertiliser.

In addition to pastoral land use much of the Umbrella high country has been prospected for gold. The Otago gold rushes of 1861-63 spread to the Pomahaka area when auriferous ground was discovered at Potter's Gully (southern Old Man District). Subsequent exploration spread to the Umbrella Ranges (McLintock 1949). Every creek and gully in the Pomahaka, and Campbells Creek, was mined (Bain 1985) and many of the local names originated with the goldmining era (Chandler 1984). After the initial surge of the gold rush period prospecting

was continued by both Chinese and European miners until the turn of the century. Chinese miners were still working at the junction of the Pomahaka and Little Pomahaka rivers in 1895. Small-scale prospecting continues in the Pomahaka catchment even today.

While the forest remnants present in the District undoubtedly pre-date European settlement, their size and configuration have been affected by their burning practices. Some forest stands have also been exploited for timber. Milling and post splitting were carried out in, at least, the accessible timber stands in Leithen Bush (Lands and Survey Dept. 1983a) and are likely to have been common occupation in other forest remnants. Sawn stumps of beech were observed in both Leithen and Waikaia Bush during the present survey. Wood for fuel was removed from Waikaia Bush from an early stage (Bain 1985). In addition, peat was cut from the upland bogs and used for fuel until about 1940 when it was superseded by coal.

At one time deer were abundant in the Umbrella high country (Bain 1985). Recreational hunting continues in the District today being mainly concentrated in the forest areas which afford cover. Deer numbers have been greatly reduced in the last 10-15 years since the advent of commercial hunting using helicopters. Other wild animals include the possum which is widespread in the District.

## 2.10 Vegetation

The pollen and subfossil wood records indicate that prior to the advent of man much of South Island was forested (Molloy *et al.* 1963). Moreover, Central Otago appears to have remained wooded much later than other South Island areas probably as a result of weather patterns combining to bring strong westerlies and cold southerlies to the region (Dr M.S. McGlone, pers. comm.). Devastating pre-Polynesian fires which destroyed large areas of Central Otago forest from 2500 to 1500 years ago appear correlated with strong, hot north-westerly winds. These fires seem linked to the demise of widespread podocarp forest and an increase in *Nothofagus* species, particularly red beech (*N. fusca*) (Dr M.S. McGlone, unpublished data).

With the coming of Polynesians fire became more common, with the result that the tree-line was artificially depressed and replaced with various tussockland and shrubland communities (Molloy *et al.* 1963). Under Polynesian occupation the Central Otago landscape was transformed. For the large part tree-less, the country assumed an almost prairie-like aspect (McLintock 1949) with forest remnants occupying more moist, fire sheltered situations. Thus, the first Europeans were confronted by vast stretches of tall, dense tussock with a close filling of other species, and in places thick scrub (McLintock 1949).

Following European settlement the widespread practices of burning and grazing substantially modified the non-forest vegetation. The upper limit of fescue tussock was extended, coupled with a recession in the area dominated by narrow-leaved snow tussock. Top-dressing and oversowing encouraged the spread of adventive species which at low- to mid-altitudes successfully displaced a large component of the native flora. Red tussock (*Chionochloa rubra*), which once would have covered much of the eastern and southern areas of the District, was largely restricted to the steep slopes of gullies and poorly drained areas. Subdominant native species were replaced by adventives such as browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum*

*odoratum*), yorkshire fog (*Holcus lanatus*), sheep's sorrel (*Rumex acetosella*) and catsear (*Hypochaeris radicata*).

Shrubland communities survived in sheltered situations or in localities inaccessible to stock, such as on rock bluffs.

Today, the vegetation of the District is substantially modified below 1000 m. Small forest remnants persist in many gullies in the south and western areas of the District. Two relatively large areas of forest, Waikaia State Forest and Leithen Bush, persist. The remaining forest areas are a distinctive feature of the Waikaia Ecological Region. The Umbrella District is further characterised by the extensive areas of wetland overlying deep peat which occupy the broad plateaux in the northern sections.

## 2.11 Fauna

During Polynesian occupation it appears that moas were abundant in the Central Otago area. Moas preferred mixed shrubland and forest habitats rather than open country with forest foods forming a major proportion of their diet (Anderson 1983). In Central Otago natural moa bone deposits and moa hunting camps were concentrated around the lower hill slopes which were clad in a band of forest and shrubs (Anderson 1983).

The early Maori killed the moa in large numbers, with an estimated minimum of 100,000 birds killed in the early period in southern New Zealand (Anderson 1983). Moa hunting in Central Otago appears most specialised since few other choices of game were available (e.g. weka, ducks, rats and the now extinct giant rail). In places moa bone remains are substantial (Anderson 1983). However, Kooyman (1985) in a study of moas and moa hunting in the Clutha Valley (Beaumont to Cromwell) found no large communal kill sites, from which he concluded that moas were hunted individually to provide meat for immediate consumption. One of the larger site deposits sampled, at Coal Creek (carbon-dated as c. 640 years ago), has a wide range of moa species present. Even so, Kooyman (1985) found no clear evidence to suggest permanent Polynesian occupation in the area. He suggests that occupation at the Coal Creek site probably lasted only a few months.

During the early stages of European settlement birdlife was apparently prolific in the District although the abundance rapidly decreased (McLintock 1949). Nonetheless, the birdlife associated with the larger forest areas remained noteworthy well into the twentieth century (Bain 1985).

To the present day the fauna of the Umbrella District have been little studied. The Wildlife Service have recorded the avifauna associated with a number of forest stands in the Waikaia Bush, Leithen Bush, Argyle Burn and Pomahaka River areas. Since the inception of the present survey Waikaia State Forest has also been monitored as part of a national yellowhead survey (Foord 1985), which was supplemented with the current study.

Otherwise faunal information on the District has been largely unpublished, being collected by interested individuals making forays into the more accessible parts (e.g. Mt Benger, southern Old Man Range). Attention has been concentrated on the apparently less modified and more diverse Old Man Range. Consequently, data collected during the present survey make use, where possible, of unpublished information already collected.

## CHAPTER 3

## METHODS

The P.N.A. survey of the Umbrella Ecological District was undertaken in four broad phases: preparation, reconnaissance, detailed study and selection of recommended areas for protection. On completion of the draft report the selected natural areas were discussed with each of the land occupiers affected (11/12 August 1986).

### 3.1 Preparation

Land within the District is held under a variety of tenures. Occupiers of properties held under Crown Lease were contacted in writing by the Department of Lands and Survey on the author's behalf prior to commencement of fieldwork. All property owners or lessees on whose land access was desired were subsequently approached in person. Co-operation was sought regarding freedom of access, vehicle accessibility, available hut accommodation and information or observations relevant to the natural values of the area. Where possible, the aims and objectives of the P.N.A. programme were discussed, with particular reference to the Umbrella Ecological District.

### 3.2 Reconnaissance

The entire Ecological District was rapidly field surveyed during the period October-December 1985. All roads and most access tracks within the District were traversed by vehicle or on foot. In conjunction with topographic maps and aerial photographs notes and observations were made on the extent and degree of modification of native vegetation. Observations on landform, fauna and flora were also recorded. Where time permitted plant and invertebrate collections were made.

This preliminary investigation resulted in the identification of those areas justifying detailed study. Where possible, study areas were chosen such that:

- (a) the range in native vegetation types within the District was represented;
- (b) the range in landforms within the District was represented;
- (c) when considered on a District basis high natural values were present;
- (d) for vegetation types high in natural values the greatest contiguous sequences within the District were represented;
- (e) study area limits were defined by catchment boundaries;
- (f) where a particular vegetation type(s) of relatively high natural value within the District was isolated and/or of limited extent, the largest areas of least modification were studied.

Identification of areas requiring detailed study based on ground reconnaissance information was complemented by a subsequent aerial survey. The majority of the District was covered by light aircraft in December 1985 at a flight level of c. 175-300 m. Each study area was assessed in comparison with areas of similar vegetation and environment present within the District. As a result, the choice of such areas was modified where necessary.

### 3.3 Detailed study

#### 3.3.1 Vegetation

Vegetation types present within each study area were subjectively defined on the basis of their dominant species plus flora. Each type was sampled using fixed-area plots. Sample site cards specially formulated for the P.N.A. Programme were used as the basis for documentation of vegetation. As such, plant species were recorded in the height tiers: 0-<0.1m; 0.1-<0.4m; 0.4-<2 m; 2-<5 m; 5-<12 m and >12m. (Note: the tier 0.1-<0.4 m was used in non-forest communities to include slim snow tussock, which often approaches, but infrequently exceeds, 0.4 m. The tier was also used in the forest communities except in Leithen and Waikaia Bush where the stratum 0.1-<0.3 m was used.) Cover for each species, in each height tier, was assessed on a 1-6 scale: (1 = <1%; 2 = 1-<5%; 3 = 5-<25%; 4 = 25-<50%; 5 = 50-<75%; 6 = >75%). In forest communities the height range, mean height and total cover were recorded for all height tiers >0.3 m. In non-forest types general height and cover were recorded only for the highest tier present. Cover was also recorded for the categories total bryophyte, total lichen, litter, dead (attached) plant material, wood, bare ground and rock.

The environmental parameters altitude, aspect, slope and general topography were recorded and sketched for all sites together with general notes on the habitat, its extent and degree of modification. Plant species not recorded within the plot but present elsewhere within the vegetation type were also noted.

Sampling design differed between forest and non-forest vegetation types as follows:

##### 3.3.1.1. Forest Communities

The two largest forest remnants within the Umbrella Ecological District, Waikaia State Forest and Leithen Bush, were sampled in October 1985. Plots 10 m x 10 m, were placed at 0.5 km intervals, on transects approximately parallel with either the Waikaia River or Leithen Burn. In Waikaia Forest, for reasons of time, the transect followed the road with plots displaced 10 m from the roadside in an uphill direction. Sampling was also undertaken along transects parallel to the lateral drainage channels in both forest areas. Plots were placed at altitudinal intervals of 50 m, 75 m or 100 m on the western and eastern banks. The larger intervals were chosen where change in plant species composition and/or cover appeared slight.

Other forest remnants chosen for study elsewhere in the District were sampled using a 10 m x 10 m plot randomly located within a subjectively placed 50 m x 50 m plot. The larger plots were located so as to adequately represent the species diversity occurring within the forest stand.

In all cases plant species not present within the sampled plots but occurring in the immediate vicinity were recorded. In addition, species occurring between plots were noted together with general observations on habitat.

### 3.3.1.2 Non-forest communities (excluding bluff vegetation)

Plant species, their height and cover, were recorded within a 2 m x 2 m plot randomly located within a subjectively placed 20 m x 10 m plot chosen to represent the community. Communities which covered large areas with little apparent vegetation change were sampled at 100 m intervals of altitude. Plant species not recorded within the larger plots but present elsewhere within the community type were noted.

### 3.3.1.3 Rock bluff vegetation

Vegetation occurring on sites deemed inaccessible or unsuitable for quadrat sampling were documented by species lists. Where the vegetation type covered a large area species were assigned general categories of abundance (r = rare; o = occasional; a = abundant; ld = locally dominant; cd = codominant; d = dominant).

### 3.3.2 Flora

During both the reconnaissance and detailed study phases a full range of plant specimens was collected as the basis for an Umbrella Ecological District voucher collection. Plant species were confirmed and those of uncertain status subsequently identified. Several persons familiar with particular groups assisted with identification as follows:

#### Botany Division, D.S.I.R.

Mr A.P. Druce (wide range of groups)  
 Dr E. Edgar (*Poaceae*, *Luzula*)  
 Dr D.R. Given (*Celmisia*)  
 Dr P.N. Johnson (wide range of groups but most particularly  
                                   *Carex*, *Hydrocotyle* and *Schizeilema*)  
 Ms B.H. MacMillan (*Acaena*, *Epilobium*)

#### Botany Department, Victoria University, Wellington

Dr J.W. Dawson (*Anisotome*, *Aciphylla*)  
 Dr B. Sneddon (*Colobanthus*)

#### Botany Department, University of Canterbury, Christchurch

Dr J. Ward (*Raoulia*)

#### Botany Department, University of Otago, Dunedin

Mr M.J. Heads (*Coprosma*, *Drapetes*)  
 Professor A.F. Mark (wide range of groups)

Voucher specimens are housed in the Botany Department Herbarium, University of Otago (OTA).

Nomenclature follows Allan (1961) for dicotyledons, Cheeseman (1925) for *Poaceae*, Moore and Edgar (1976) for other monocotyledons, or more recent updates (Edgar 1971, Edgar and Connor 1978, 1983, 1987). Brownsey *et al.* (1985) are followed for pteridophytes.

Following species identification all plot records were corrected where necessary. Presence-absence and cover data of species in the 10 m x 10 m forest plots and both the 20 m x 10 m and 2 m x 2 m non-forest quadrats were entered on to computer files. The cover rating of each species was taken as the maximum recorded over all height tiers in which it occurred. The data were manipulated using the computer package GOLLIWOG (Dr J.B. Wilson, unpublished).

An inverse cluster analysis employing the "City-block" distance measure and flexible sorting strategy ( $\beta = -0.25$ ), and excluding double-zero matches was used to differentiate species groups. The quadrats were sorted according to their species composition with a normal cluster analysis also using City-block distance measure and flexible sorting strategy. Species with frequencies of occurrence  $\leq 1$  were omitted from the analyses. Site and species groupings were displayed as dendrograms and two-way tables for both the presence-absence and quantitative data for each of the two sizes of non-forest quadrat. Data from the 10 m x 10 m forest plots were included in each data set for analysis purposes.

### 3.3.3 Fauna

#### 3.3.3.1. Invertebrates

Specimens were collected during both the reconnaissance and detailed survey phases by day and by night. Collections were subsequently identified by individuals having expertise in particular groups. Two field trips (14/15 December 1985, 8/9 March 1986), involving several invertebrate experts were made to the Whitecoomb Range. Detailed reports are presented later in this publication. Participants were:

Invermay Agricultural Research Centre, M.A.F.

Dr B.I.P. Barratt (Coleoptera)

Zoology Department, University of Otago, Dunedin

Dr C.W. Burns (Aquatic fauna)

Mr B.H. Patrick, 38 St Albans St, Dunedin (Hemiptera, Lepidoptera, Orthoptera)

Additional help with identification was provided by:

Otago Museum, Dunedin

Dr R.R. Forster (Arachnida)

Mr A.C. Harris (Hymenoptera, Odonata)

Anthropology Department, University of Otago, Dunedin

Mr G. Mason (Mollusca)

Zoology Department, University of Canterbury, Christchurch

Mr P.M. Johns (Chilopoda, Diplopoda, Diptera, Orthoptera)

All invertebrate records obtained during the present survey were supplemented by information already existing for the District.

Specimens collected are housed with the individuals/institutions named above. In the case of Coleoptera duplicate specimens have been deposited with the New Zealand Arthropod Collection at Entomology

Division, D.S.I.R., Auckland together with Diptera, Hemiptera and Hymenoptera sorted from pitfall trap catches.

#### 3.3.3.2 Vertebrates

Notes and observations of the avifauna were made throughout both the reconnaissance and detailed study phases. In November 1985 a survey of yellowheads was conducted in the Waikaia State Forest and Leithen Bush areas (Dickinson *et al* 1985). The survey formed part of a national programme co-ordinated in this particular area by the N.Z. Forest Service, Invercargill.

Additional faunal information was provided by Mr G. Loh, Wildlife Service, Dunedin, the late Mr P. Child, and Mrs M. Child of Alexandra. In addition, data were extracted from the atlas of bird distribution in New Zealand (Bull *et al*. 1985).

#### 3.4 Selection of Recommended Areas for Protection

On the basis of information gathered during the course of Phases 1 and 2, and its analysis, the location and boundaries of recommended areas for protection were delineated. These areas were chosen so as to adequately represent the diversity of vegetation and landforms present within the District. Areas selected were characterised as follows:

##### Priority 1

Generally, vegetation and landform types which in combination presented the most representative, diverse, least modified and largest examples of the indigenous ecosystems remaining in the District. Where possible, proposed boundaries coincided with catchment limits and covered the greatest altitudinal range available. These recommendations are of top priority for protection.

##### Priority 2

Generally, areas which contained indigenous ecosystems already represented in Priority 1 proposals but which were either lower in natural value, less diverse, or smaller in area. Priority 2 areas are viewed as substitutes for Priority 1 recommendations should the protection of the latter be unachievable. In some cases no adequate priority 2 substitutes are available.

## CHAPTER 4

## RESULTS

4.1 Flora

The Umbrella Ecological District covers a wide range of habitats which is reflected in a diverse flora. The range spans communities from forest and shrubland to those of tussock grassland, wetland and several low-alpine types. During the course of the survey 627 vascular plant taxa were recorded, of which 536 are indigenous. A full species list is given in Appendix I (see also Appendix II). Considering the major plant groups the flora comprises 50 pteridophytes (8%), 7 gymnosperms (1%), 407 dicotyledons (65%) and 163 monocotyledons (26%). A voucher collection consisting of c. 1200 specimens, and representing almost all of the listed taxa been deposited in the Botany Department herbarium, University of Otago (OTA). Duplicate specimens where available are housed in the Botany Division herbarium, D.S.I.R., Lincoln (CHR).

Previously poorly known botanically, the Umbrella Ecological District contains a number of species of restricted distribution and moreover, appears to be the southeastern limit for many alpine species. The latter include *Aciphylla pinnatifida*, *Caltha obtusa*, *Celmisia hectorii*, *C. laricifolia*, *C. verbascifolia*, *C. walkeri*, *Colobanthus buechananii*, *Dracophyllum muscoides*, *Hectorella caespitosa*, *Luzula pumila*, *Pernettya alpina*, *Phyllachne rubra* and *Raoulia hectorii* (see Appendix I). In some respects floristic affinities appear closer to the Garvie Mountains than to the Old Man Range (e.g. *Hebe dilatata*, *Pimelea poppelwellii*) but confirmation is difficult due to limited information on the distribution of distinctive species in the Old Man P.N.A. report (Brumley *et al* 1986).

Species present within the District and listed by Given (1981) as rare (R), local (L) or of indeterminate (I) status are the sedges *Carex kirkii* (I), *C. lachenalii* (I), the shrubs *Carmichaelia compacta* (R), *Hebe poppelwellii* (R) and *Teucrium parvifolium* (R), plus the subshrub *Parahebe trifida* (R). With the exception of *T. parvifolium* and *C. compacta* all are species of alpine regions. *Parahebe trifida*, a species previously known from only a few sites on the Old Man Range, Garvie, Hector and Eyre Mountains (Allan 1961) is both widespread and abundant in snowbanks in the alpine zone of the Umbrella District. As a consequence, it is recommended that *P. trifida* merits substitution of "rare" status with "local". In contrast, *Hebe poppelwellii* was found only on the main Whitecoomb Range above Gem Lake (c. 1400 m) and near Stronach Hill summit (1330 m). *Carex lachenalii* was recorded in wetland sites in all the high altitude catchments, Whitecoomb Range, Gem Lake and Pomahaka, whereas *C. kirkii* was recorded only infrequently.

The verbenaceous shrub *Teucrium parvifolium* was recorded only as a single plant in Devil's Gorge on the Pomahaka River. Given (1981) noted that at most localities where this species occurs, colonies are small. The nearest locations for the species known to the author are as a single plant, recorded from Gorge Creek, southeastern Old Man Ecological District (Mr P.E. Marsh, pers. comm.) and erratic occurrence in the Lower Clutha River Valley between Beaumont and Tuapeka Mouth (Johnson 1983b).

*Carmichaelia compacta* was recorded twice but only as single plants. Known elsewhere from the mid Clutha Valley, the species was found among the rock bluffs above Lake Roxburgh and on the Coal Creek rock bluff in the northeastern part of the District. Several other species feature only in the eastern, driest portions of the District, notably the shrubs *Hebe pimeleoides* var. *rupestris* (rock bluffs above Lake Roxburgh), *Kunzea* (*Leptospermum*) *ericoides* (Clutha Valley) and the climber *Scandia geniculata* (Coal Creek and Lake Roxburgh rock bluffs).

Other lowland species of particular note include the climber *Fuchsia perscandens* (Coal Creek rock bluff, McKay Creek and Pomahaka Tributary). According to Allan (1961) recorded occurrences extend only as far south as 42°, however several localities for this species have since been identified in Otago (Mrs J. West, pers. comm.). The small tree *Olearia* aff. *odorata* forms distinctive, apparently even-aged woodland stands particularly in the lower Pomahaka catchment, as in the vicinity of McKay Creek where it is often associated with forest margins and shrubland. Although many stems were badly scarred and their centres rotten, growth rings were counted in four individual (basal diameter 14-22 cm). In all cases rings numbered less than 100 (range c. 70-90) implying that the woodland could post-date European occupation. Nevertheless, the stands may still be an artefact of Polynesian burning. In association with *Olearia odorata* two specimens of *O. hectorii* (c. 4 m tall) were recorded in the catchment of the Pomahaka Tributary (GR: 023 008 NZMS1S152). Unrecorded elsewhere in the District, *O. hectorii* is reputedly of local distribution (Poole and Adams 1964) to the south of 42° (Allan 1961).

Kowhai (*Sophora microphylla*) occurs in small groves or as isolated trees in the southern, eastern and central portions of the District. The largest stands were found on the northern slopes of Dusky Hill and in shrublands near Lake Roxburgh. The primitive pteridophyte *Tmesipteris tannensis*, was found only once, also on the northern slopes of Dusky Hill, growing under rocks in broadleaf/marbleleaf (*Griselinia littoralis*/*Carpodetus serratus*) dominated forest.

Many of the lowland species mentioned above were found in isolated patches of scrub which, mainly for topographic reasons, had escaped clearance and fire. Some areas accessible to stock, were grazed.

Beech remnants are a distinctive feature of the Umbrella Ecological District (see Chapter 2). Former distribution may be implied from the presence of forest dimples - mounds and associated hollows produced by the uprooting of trees. Undoubtedly the best examples observed in the District were in Timber Creek. Less pronounced dimples were seen above the Pomahaka River, near to McKay Creek, and also adjacent to Archies Creek, east of Falkans Faces. Logs of Hall's totara (*Podocarpus hallii*) were found on the margins of silver beech forest in Timber Creek (altitude c. 820 m) and at Awatere within a tussock-shrubland community (c. 670 m). In neither instance was Hall's totara found currently growing in the vicinity. Indeed, it now appears to be confined to Waikaia State Forest and Leithen Bush. The other gymnosperms snow totara (*Podocarpus nivalis*), celery pine (*Phyllocladus aspleniifolius* var. *alpinus*) and bog pine (*Halocarpus bidwillii*) were found at a small number of localities. Snow totara and celery pine cohabited within, and on the margins of, the Argyle Burn beech remnant (c. 900 m). Snow totara was also found

on rock bluffs within the eastern Whitecoomb Range (c. 1070 m) and Gem Lake catchments (c. 1130 m). Celery pine was recorded on the upper margins of Waikaia Forest (c. 900 m) on rock bluffs above Post Office Creek. Bog pine occurs in small patches generally associated with the distinctive cushion bog species *Donatia novae-zelandiae*. Five localities for bog pine were recorded, two in the western Whitecoomb Range catchment (c. 1050 m) and three on the White Umbrella ridge (c. 1050 m). The largest area covers about 2 hectares. Peat exposures adjacent to Whitecoomb Creek (c. 1030 m) contain bog pine remnants suggesting that this species was formerly more widespread in the District. *Donatia novae-zelandiae* was found at a number of localities with and without bog pine. The former species generally formed large cushions, in some cases approaching 10 m diameter, often in close association with *Dracophyllum prostratum*. The large cushion size indicates that the plants are generally old (Lough *et al.*, in submission).

The genus *Hebe* is represented by several species of particular note including the two already mentioned (i.e. *H. pimeleoides* var. *rupestris* and *H. poppelwellii*). *Hebe dilatata* was recorded in the Gem Lake cirque. The species (*incertae sedis* Allan 1961) is known from the type collected from the Garvie Mountains and a few isotypes (Allan 1961), and was documented by the Old Man District survey team in fellfield on the upper Garvie Mountains (Brumley *et al.* 1986).

*Hebe* sp.(?*subulata*) is widespread through the high altitude areas. Probably belonging to the *H. hectorii* complex, the type specimen of *H. subulata* Simpson has not been found and the name remains of uncertain status (Allan 1961). Plants appear distinct from both *H. hectorii* and *H. lycopodioides*. The Umbrella specimens appear to fit Simpson's descriptions for *H. subulata*, but given the lack of a type, the species name is not used here.

*Hebe* aff. *rakaiensis* occurs throughout the mid- to high-altitude areas. Apparently closest to *H. rakaiensis* (Dr P. Garnock-Jones, pers. comm.) the species occupies habitats indicative of *H. odora* rather than the wetland sites typical of *H. pauciramosa* or the gully/rocky sites of the true *H. rakaiensis*. The largest populations of *Hebe propinqua* are at Awatere (c. 700 m) where it is codominant with several other shrub species, for example *H. aff. rakaiensis* and *Cassinia vauvilliersii*. Elsewhere in the District *H. propinqua* was found only as isolated specimens on a rock outcrop above Leithen Burn (c. 800 m), on the margins of the Argyle Burn beech remnant and in the Little Pomahaka catchment and headwaters of Whitecoomb Creek.

The shrub, *Pimelea poppelwellii*, has its type locality on the southern Garvie Mountains but apparently was not recorded during the Old Man District survey (Brumley *et al.* 1986, p. 153). The species is locally abundant in the Umbrella District in the eastern Whitecoomb Range and Gem Lake cirques (c. 1300 m). Records were also made near to the Argyle Burn in the vicinity of the beech forest remnant (c. 950 m), and on the Waikaia Tors (c. 1200 m).

The rock tors and bluffs present on the high ridges and plateaux are extremely variable in both abundance and richness of plant species. Many rocks are species-poor, even those inaccessible to stock. Nevertheless, several tors/bluffs are the sites for species of restricted distribution. The most striking example is *Gingidia enysii* var. *peninsulae* which is locally plentiful, and apparently

confined to the Waikaia Tors (c. 1130 m) but known elsewhere only from Banks Peninsula (Dawson 1961). It must be noted however, that Webb (1977) concluded that the variation shown by *G. enysii* is continuous and that varietal status of any of the forms is unwarranted, thus meriting some caution regarding the above seemingly anomalous distribution.

One plant of what is thought to be *Aciphylla inermis* (Dr J.W. Dawson pers. comm.) was found on a rock bluff within the Timber Creek catchment (c. 900 m). An undescribed variety of *Anisotome haastii* is widespread on mid- to high-altitude rock bluffs throughout the District. Specimens have some features of *A. capillifolia* but the segments are too broad (Dr J.W. Dawson, pers. comm.). Mr J. Speden has collected very similar specimens from the Garvie Mountains (Dr J.W. Dawson, pers. comm.). Also confined to rock bluffs or less commonly loose rock areas, *Aciphylla lecomtei* is particularly abundant, and seemingly confined to the southern Umbrella Mountains, often in association with edelweiss (*Leucogenes grandiceps*) and the microphyllous shrub *Helichrysum selago*, the latter also being confined to this portion of the range.

The Umbrella District is particularly interesting with regard to the distribution of *Celmisia* species. Seventeen were found including four (*C. hectorii*, *C. laricifolia*, *C. verbascifolia*, *C. walkeri*) which were not previously known east of the Garvie Mountains. *C. hectorii* mainly occurs as extensive sheets on boulderfields in the Gem Lake and eastern Whitecoomb Range catchments (c. 1350 m). *C. laricifolia* is uncommon in the same catchments as is *C. walkeri* which occurs in the eastern Mt Whitecoomb catchment and also extends south along the main range as far as Stronach Hill (1330 m). Only one specimen of *C. verbascifolia* was found on the ridge above Gem Lake (c. 1430 m).

*Celmisia prorepens* is plentiful on the northern Umbrella Mountains, but abundance decreases markedly southwards with only a few records at Awatere (c. 620 m). In contrast, *C. densiflora* is frequent, particularly in the southern mid- to high-altitude areas. However, in many instances differentiation of *C. densiflora* and *C. prorepens* was difficult where they coexisted, leading to some doubts as to their separate status (Mr A.P. Druce, pers. comm.). Almost all of the many records for *Celmisia semicordata* are of variety *aurigans* but one specimen from a modified tussockland above Leithen Burn (c. 950 m) has been ascribed to variety *strictus*. Several *Celmisia* hybrids were also found (see Appendices I and II).

The occurrence of the herb *Anisotome imbricata* var. *prostrata* at several high altitude sites, often in snowbanks, has been confirmed (Dr J.W. Dawson, pers. comm.) contrary to Dawson (1961). The small herbs *Abrotanella caespitosa* and *A. inconspicua* both occur within the Umbrella District, the former occupying wetland sites as is usual. An additional undescribed species, *A. aff. inconspicua*, similar to that previously collected from the Rock and Pillar range (Bliss and Mark 1974) was found on the main

Whitecoomb Range but was not recorded further north where the true *A. inconspicua* occurs in association with other cushion species, as in the Old Man District (Brumley *et al.* 1986).

Of the family Poaceae, two as yet undescribed species were found in the Umbrella District. One is related to *Poa lindsayi* but has larger, less silky spikelets and wider leaves (*Poa tonsa*). The second is related to *P. kirkii* but is more robust with noticeably longer anthers, *Poa intrusa* (Dr E. Edgar, pers. comm., Edgar 1986).

Eighteen *Uncinia* species were identified from the District. Of these, *U. purpurata* has been poorly collected with only a few localities previously known (Moore and Edgar 1976).

#### 4.1.1. Problems of identification

Although the majority of plant specimens were identified satisfactorily to species level some collections proved difficult to determine with certainty. Instances arose where reproductive material was necessary for positive identification (e.g. *Cardamine* spp., *Carex* spp., *Epilobium* spp., *Galium* spp. and *Uncinia* spp.). In most cases however, a specimen could be associated with either of one or two species. Ultimately these identifications were marked by a query e.g. *Uncinia* ?*angustifolia*, *U.* ?*rupestris* or otherwise indicated as an undetermined species (e.g. *Uncinia* sp.).

Nevertheless, some species groupings were necessary particularly for analysis purposes. Those grouped were: *Agrostis subulata* and *A. pallescens*; *Blechnum minus* and *B. procerum*; *Acaena* spp. (excluding *Acaena caesiiglauc*); *Hebe odora* and *Hebe* aff. *rakaiensis*; *Thelmytra longifolia* and *T. venosa*; *Phormium cookianum* and *P. tenax*; *Pterostylis banksii* and *P. australis*; *Colobanthus buechananii*, *C. acicularis*, *C. apetalus*, *C. strictus*, *C. affinis*, *C. canaliculatus*; *Hydrocotyle novae-zeelandiae* var. *novae-zeelandiae* and var. *montana*.

Some difficulties were encountered even with good reproductive material. For example, some specimens of *Brachyglottis southlandica* were transitional between *B. bellidioides* and *B. southlandica* in size, and even approached *B. haastii* in the degree of hairiness. Moreover, many plants observed by Mr A.P. Druce in the Gem Lake area appeared distinct from North Island specimens of supposedly the same taxa (see Appendix II).

Some monocotyledons posed particular problems in the field with several grass specimens only being differentiated under closer and expert scrutiny.

The genus *Coprosma* posed problems particularly between *C. propinqua*, *C. parviflora* and *C. ciliata*. Other species have only been depicted informally in published form (Eagle 1982). Similarly, *Blechnum* spp. remain poorly differentiated and are under further investigation (Brownsey 1985).

A species list for the District is given in Appendix I. In addition species observed by Mr A.P. Druce in the Umbrella Mountains, 8-9 March 1986 are given in Appendix II.

#### 4.2 Vegetation

Differentiation and interpretation of community types was based on the presence-absence data for the 10 m x 10 m forest plots, and 20 m x 10 m non-forest plots. These data were chosen as:

- (a) in most cases, species richness within the 2 m x 2 m plot was markedly less than within the surrounding 20 m x 10 m area ( Fig. 4.1) implying that the former was below the minimum area needed to adequately document non-forest communities (values for species richness will be discussed with other aspects of the communities);
- (b) all forest sites had been sampled using 10 m x 10 m plots;
- (c) floristic composition (i.e. presence-absence data) was considered the more important differentiator of community types as the quantitative data were likely to have been influenced by management practices particularly grazing, and for the non-forest communities, burning, including time since the most recent fire.

Interpretation of community (quadrat) and species groups recognised using cluster analysis was confined to 17 and 16, respectively (Fig. 4.2). Coarse differentiation of community groups in order of decreasing dissimilarity may be summarised as follows:

- Two group level - Separation of forest (Groups 1-4) from non-forest (5-17) vegetation types.
- Three group level - Separation of grassland communities generally dominated or codominated by narrow-leaved snow tussock (*Chionochloa rigida*), red tussock (*C. rubra*) or blue tussock (*Poa colensoi*) and usually <1200 m elevation (Groups 5-9), from wetland, snowbank and tussock communities usually >1200 m elevation (10-17).
- Four group level - Separation of wetland/cushionfield sites (Groups 14-17) from high-altitude tussock and snowbank communities (10-13).
- Five group level - Separation of snowbank sites (Group 13) from high-altitude tussock communities (10-12).
- Six group level - Separation of relatively species-poor red-silver beech (*Nothofagus fusca*-*N. menziesii*) forest (Groups 1, 2) from other forest types (3, 4).
- Seven group level - Separation of low- to mid-altitude (<1200 m) tussock communities often with a prominent shrub element (Groups 5-7) from narrow-leaved snow tussock and/or blue tussock dominated grassland communities (8-9).
- Eight group level - Generally, a separation of species-poor comb sedge (*Oreobolus pectinatus*) cushionfield and bog pine-cushionfield communities (Groups 14, 15) from other wetland and flush communities (Groups 16, 17).

- Nine group level - Separation of the most species-rich wetland community (Group 17) from Group 16, a community dominated by various combinations of comb sedge, *Dracophyllum prostratum*, other sedges and cushion species.
- Ten group level - Separation of the species-poor beech forest (Group 1) from mixed beech forest (Group 2).
- Eleven group level - Separation of high-altitude tussockland dominated or codominated by narrow-leaved snow tussock and/or slim snow tussock (*Chionochloa macra*) (Groups 10, 11) from tussock communities with affinities to herbfield and/or snowbank communities (Group 12).
- Twelve group level - Differentiation of Groups 8 and 9. In subsequent discussion these mid-altitude tussock grasslands are considered in aggregate.
- Thirteen group level - Separation of Groups 10 and 11. Again these groups (tussock communities) are treated in combination.
- Fourteen group level - Separation of the remaining forest groups (3 and 4). Group 4 is dominated by silver beech, with red beech and mountain beech (*Nothofagus solandri* var. *cliffortioides*) absent.
- Fifteen group level - Separation of lowland sites, often where shrubs are codominant on forest margins and where red tussock dominates (Groups 5, 6), from narrow-leaved snow tussock communities with prominent shrub and adventive elements (Group 7).
- Sixteen group level - Differentiation of species-poor comb sedge dominated cushionfield communities (Group 14) from communities dominated or codominated by bog pine (*Halocarpus bidwillii*) and *Donatia novae-zelandiae* (Group 12).
- Seventeen group level - Differentiation of generally lowland red tussock communities (Group 6) from lowland communities on forest margins (Group 5).

The community groups differentiated using cluster analysis did not consistently conform with association names assigned in the field at the particular sample site. Field description generally followed the nomenclature initially proposed by Atkinson (1962) which was subsequently modified and extended in Atkinson (1985) and recommended for use in P.N.A. surveys (Law *et al.* 1984). Application in the present survey differed from Atkinson (1985) in that some of the two-part names incorporated into the original classification (Atkinson 1962) have been retained. Where appropriate, the second-most important growth form having >20% cover was added as a prefix

to the main structural class name (e.g. moss-sedgeland; shrub-tussockland). For P.N.A. purposes this format was considered substantially more informative.

The lack of total conformity between the classification groupings and field descriptions of the vegetation was not surprising. Atkinson classification is based on the abundance of canopy species whereas the cluster analysis was performed with all species, excluding those occurring only once, weighted equally. As stated in Section 4.2 (c), presence-absence data were considered the most appropriate for community recognition (analysis) purposes given the objectives of the P.N.A. Programme. Nevertheless, lack of agreement between field assessments and community groups caused some difficulties. Similar problems were also encountered during the course of the P.N.A. survey of the Heron Ecological Region (Harrington *et al.* 1986).

The range of formal (i.e. Atkinson) vegetation type names for each of the communities recognised are indicated as part of the community description.

#### 4.2.1 Plant Communities

The 15 individual communities (quadrat groups) that have been recognised from the cluster analysis may be characterised according to their species richness and the percentage frequency of each species class (Figs. 4.1 and 4.2, respectively). In the following descriptions of each of the 15 communities the 16 species classes (A-P) are fully described only once; for that community (quadrat group) in which the percentage frequency reaches its maximum. Percentage frequency of each species within each of the original 17 communities differentiated is given in Appendix III.

##### (A) FOREST COMMUNITIES

All forest sites sampled fall within quadrat Groups 1-4, and all were assigned as "forest" under the Atkinson (1962) classification. Generally, these groups are associated with high percentage frequencies in species Class A, and to a lesser extent in Class J. All other species classes are poorly represented (Fig. 4.2).

##### Group 1. Open Red-Silver Beech Forest.

Dominated by silver and red beech, usually with a very open understorey consisting of only a few shrub and herb species. Species richness is low (mean =  $12.1 \pm 2.1$ ) compared to the other forest groups differentiated (Fig. 4.1). The largest percentage frequency of species is within Class A with a smaller proportion from Class J. All other species classes occur at frequencies <2%.

This community occurs in the northern portion of Waikaia State Forest at low to moderate altitudes (c. 380-430 m).

##### Group 2. Mixed Beech Forest.

Similar to Group 1 but with a greater proportion of Class A species and less from Class J. Species Class A includes all three local beech species, silver, red and mountain, combined with several small trees and shrubs: marbleleaf, broadleaf, weeping mapou (*Myrsine divaricata*), pepper tree (*Pseudowintera colorata*), lancewood (*Pseudopanax crassifolius*), Hall's totara (*Podocarpus hallii*) *Coprosma colensoi* and *C. rhamnoides* plus the hooked sedge

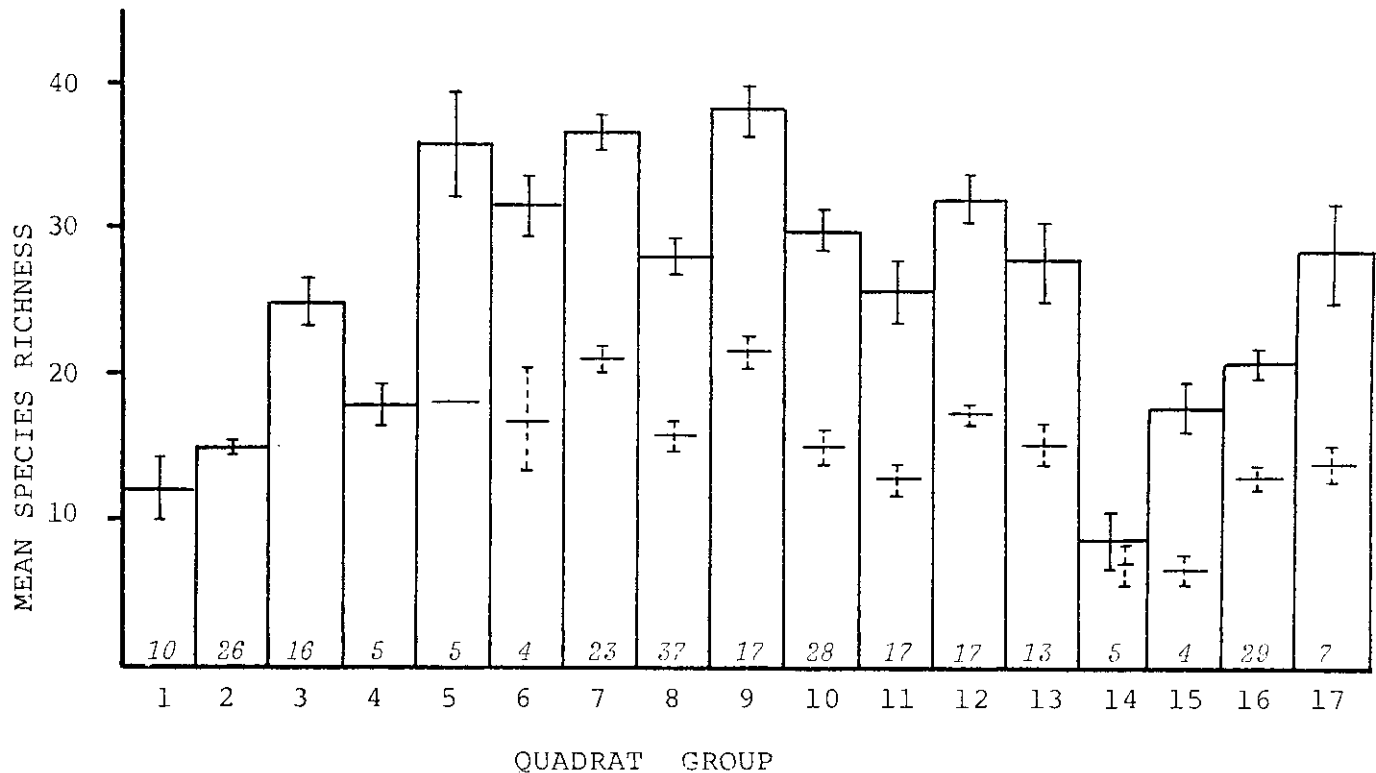


Fig. 4.1: Mean species richness together with standard error for each of the quadrat groups differentiated by cluster analysis (1 to 17). Number of sites classified into each quadrat group are given in *italics*.

Standard errors are given for forest stands (Groups 1-4) based on 10 m x 10 m plots. For non-forest communities (Groups 5-17) means and standard errors are given for both 20 m x 10 m (solid lines) and 2 m x 2 m (dashed lines) plots.

Note: Only one 2 m x 2 m plot was recorded in Group 5.

*Uncinia angustifolia* and the ferns *Grammitis billardierei* and *Hymenophyllum multifidum*.

All sites are located in either Waikaia State Forest or Leithen Bush over a moderate altitudinal range (c. 300 m-600 m).

#### Group 3. Rich Beech Forest.

The most species-rich (mean  $24.8 \pm 1.6$ ) community differentiated among the forest stands. It is characterised by species Class A as well as jointly with Group 4, the highest representation of Class J within any quadrat group. Species within Class J include the small trees *Olearia arborescens*, koromiko (*Hebe salicifolia*), mountain ribbonwood (*Hoheria glabrata*) and three-finger (*Pseudopanax colensoi*) together with the shrubs *Coprosma ciliata*, *C. linariifolia*, *C. propinqua* and *C. pseudocuneata*, the climber, bush lawyer (*Rubus cissoides*), the ferns *Blechnum minus*, *B. fluviatile* and spleenwort (*Asplenium richardii*), orchids - *Chiloglottis cornuta* and *Corybas trilobus*; hooked sedges (*Uncinia filiformis*, *U. clavata*) and other herbaceous species *Epilobium pedunculare*, *Lagenifera strangulata*, *Microlaena avenacea*, *Nertera dichondrifolia*, *Stellaria parviflora* and *Viola filicaulis*.

Sites included are from Waikaia State Forest as well as Leithen Bush, Awatere and the Argyle Burn beech remnant, over a wide altitudinal range (c. 200-800 m).

#### Group 4. Silver Beech Forest.

A community represented by only five quadrats and characterised by a low representation in species Class A compared with Groups 1 to 3. Mean species richness is  $17.8 \pm 1.5$ . Red and mountain beech are absent. Species Class G achieves maximum frequency and consists of only four species, the small trees celery pine (*Phyllocladus aspleniifolius* var. *alpinus*), shrubs snow totara (*Podocarpus nivalis*) and *Hebe rakaiensis* plus the herb *Oreomyrrhis ramosa*. However, only snow totara and celery pine are confined to this particular quadrat group.

Four of the sites are from the Argyle Burn beech remnant, the fifth from the Timber Creek remnant, all at moderately high altitudes (c. 750-950 m).

### (B) TUSsock GRASSLAND COMMUNITIES

These are separated into two broad divisions. Firstly, Quadrat Groups 5 to 9 cover a range of tussock grassland communities. Groups 5-7 generally are low- to mid-altitude sites, with tussock and various shrub species often codominant whereas Groups 8 and 9 cover a range from mid- to high-altitudes where narrow-leaved snow tussock and/or blue tussock dominate, often with a prominent adventive component.

Species Classes O and P are well represented here in comparison to other quadrat groups. Species richness is generally high when compared with the forest and wetland vegetation types.

Secondly, Quadrat Groups 10 to 12 generally include mid- to high-altitude tussock communities dominated by narrow-leaved snow tussock, slim snow tussock or their hybrids. Mean species richness ranges from 25 to 32, in comparison to a range of 28 to 38 for Groups 5-9.

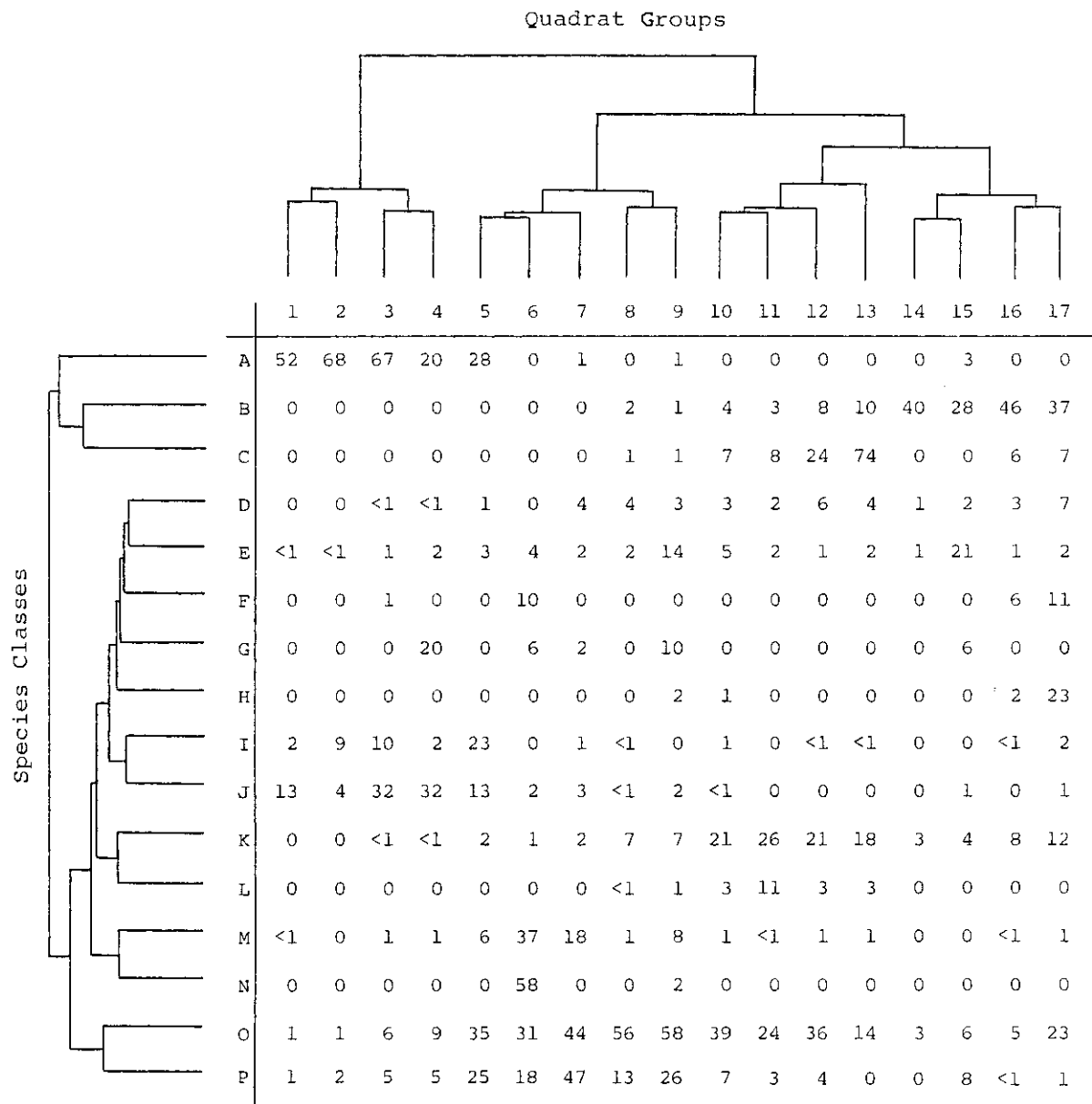


Fig. 4.2: The percentage frequency of each species class (A to P) within the 17 quadrat groups differentiated using cluster analysis. Dendrograms depicting the degree of dissimilarity between community groups, and species classes, are also shown.

Dominant species classes are K and O, with percentage frequencies in the latter being in the lower part of the range covered by Groups 5-9. Species Classes K and L are both maximised within quadrat Groups 10-12. Groups 10 and 11 are more similar to one another than to Group 12 and are treated as a single community.

#### Group 5. Forest Margins.

Assigned variously to shrubland, scrub or modified tussockland in the field, this is a relatively species-rich community (mean =  $35.8 \pm 3.6$  species). Occupying only a small number of sites, generally on the margins of beech forest, the community has prominent woody and tussock elements.

Species Classes A, I, O and P have >20% representation within this community, but of these only Class I achieves its greatest percentage frequency here. This class includes species indicative of both forest and tussock communities. It includes mainly herbaceous species such as the fern ally *Lycopodium varium*, filmy ferns (*Hymenophyllum sanguinolentum*, *H. bivalve*), spleenwort (*Asplenium flaccidum*), *Phymatosorus diversifolius*, *Blechnum discolor* and *Histiopteris incisa*, together with the herbs *Brachycome radicata*, *Nertera ciliata*, *Ranunculus hirtus*, *Geranium sessiliflorum* and *Uncinia rupestris*. The woody species *Leucopogon colensoi*, fool's beech (*Gaultheria antipoda*), pokaka (*Elaeocarpus hookerianus*) and *Fuchsia excorticata* are also included.

The community occurs at moderate altitudes (c. 500 m-850 m), on the margins of Waikaia State Forest, Leithen Bush and on Awatere Station.

#### Group 6. Lowland Red Tussockland.

Consistently described as tussockland according to Atkinson (1962) this is a relatively species-rich group (mean =  $31.5 \pm 2.1$  species) present at four sites and dominated or codominated by red tussock but with a large proportion of adventives. Species Classes M, N and O have >20% representation and of these, the first two attain their highest frequencies in this community. Class N consists of three adventive species, an eyebright (*Euphrasia nemorosa*), red clover (*Trifolium pratense*) and lotus (*Lotus pedunculatus*), while Class M includes manuka (*Leptospermum scoparium*), red tussock, fescue tussock (*Festuca novae-zeelandiae*), bracken fern (*Pteridium esculentum*) and several herbs: *Gonocarpus micranthus*, *G. aggregatus*, white clover (*Trifolium repens*), *Celmisia* aff. *graminifolia*, *Hydrocotyle novae-zeelandiae*, *Gunnera dentata* and *G. prorepens*.

All four sites were sampled on Awatere Station at relatively low altitudes (c. 300-600 m).

#### Group 7. Modified Tussock/Shrubland.

This community group encompasses a range of tussock and shrub combinations. Atkinson type names range from shrubland through to modified tussockland.

A relatively species-rich group (mean =  $36.6 \pm 1.3$ ) with the majority of species present in Classes M, O and P, all others having percentage frequencies of  $\leq 4\%$ . Classes O and P occur at >40%

frequency with the latter achieving its peak within this community. Class P includes the shrubs *Coprosma cheesemanii*, *C. parviflora*, *inaka* (*Dracophyllum longifolium*), mountain tauhini (*Cassinia vauvilliersii*), *Hebe* aff. *rakaiensis* and *Gaultheria crassa*, the subshrubs, *Pernettya macrostigma*, *Leucopogon fraseri* and *Pimelea oreophila*, the grasses *Deyeuxia avenoides* and *Rytidosperma gracile*, and hooked sedges (*Uncinia aucklandica* and *U. rubra*). Other herbs include flax (*Phormium* spp.), and eyebright (*Euphrasia zelandica*), *Gunnera monoica*, *Lagenifera cuneata*, creeping everlasting daisy (*Helichrysum filicaule*), annual gentian (*Gentiana grisebachii*) and a mountain daisy (*Celmisia densiflora*).

The majority of sites are located on Awatere Station at moderate altitudes (c. 530-710 m), with two on the margins of Leithen Bush (c. 700 m) and a third at the headwaters of the Little Pomahaka catchment (c. 850 m).

#### Groups 8 and 9. Mid- to High-altitude Tussock Grassland.

A species-rich (means  $28.0 \pm 1.1$  and  $38.1 \pm 1.8$  respectively) tussockland community generally with shrubs subdominant or absent. Described predominantly as tussockland or modified tussockland under the Atkinson system the community is characterised mainly by species Classes O and P, with the former reaching its peak here. Class O includes a large proportion of the generally widespread species typical of tussockland communities throughout much of the District. Species include the grasses, narrow-leaved snow tussock, blue tussock and *Erythranthera pumila* together with the adventive grasses, browntop (*Agrostis capillaris*) and sweet vernal (*Anthoxanthum odoratum*). Herbs include a buttercup (*Ranunculus lappaceus*), Maori onion (*Bulbinella angustifolia*), mouse-ear chickweed (*Cerastium fontanum*), *Plantago novae-zelandiae*, *Pratia angulata*, *Oreomyrrhis colensoi*, cranesbill (*Geranium microphyllum*), everlasting daisy (*Helichrysum bellidioides*) and catsear (*Hypochaeris radicata*) together with the subshrub, snowberry (*Gaultheria depressa*) plus the ferns *Blechnum penna-marina* and prickly shield fern (*Polystichum vestitum*).

With the exception of species Class E in quadrat Group 9 all other classes occur with frequencies of  $\leq 10\%$ . Sites cover a wide range of localities at moderate- to high-altitude from White Umbrella Ridge (c. 1000 m) and Timber Creek (c. 1100 m) to the Gem Lake (c. 1100 m), and Little Pomahaka catchments (c. 950-1200 m). This emphasises the wide distribution of this community type within the Umbrella Ecological District.

#### Groups 10 and 11. High-altitude Tussock Grassland.

Described mainly as tussockland according to the dominant canopy life form, the field sites had prominent secondary components comprising variously herbfield, shrubland or mossfield with no particular consistency apparent in the grouping of quadrats on the basis of Atkinson names. Species richness is moderately high being  $29.6 \pm 1.4$  and  $25.4 \pm 2.2$ , respectively, for the two groups.

Species frequency exceeds 20% in only two classes, K and O, the former peaking in Group 11. Class K includes a large number of species, for example: the shrubs turpentine scrub (*Dracophyllum uniflorum*), *Hebe* sp. (?*subulata*), *Hymenanthera alpina*; the subshrubs

mountain daisies *Celmisia brevifolia*, *C. hectorii*, *C. lyallii*, *C. semicordata* var. *aurigans* and *C. viscosa*, *Brachyglottis revoluta*, *Drapetes dieffenbachii* and *D. villosus*; the herbs *Astelia linearis*, *A. nivicola* and *Coprosma pumila*; the cushion species *Dracophyllum muscoides*; the sedges *Carpha alpina*, *Uncinia caespitosa*, *U. fusco-vaginata*; the dwarfed rush *Luzula pumila*; grasses *Agrostis subulata*/*A. pallescens*, slim snow tussock, *Hierochloa novae-zelandiae*, and the summergreen fern *Polystichum cystostegia*.

Class L species also peak in Group 11, but at a frequency of only 11%. Species included here are the rare and regionally endemic shrub *Hebe poppelwellii*, the subshrubs *Chionohebe densifolia* and *Celmisia laricifolia*, and herbs *Brachyglottis bellidioides*, *Myosotis pygmaea* and *Taraxacum magellanicum*, and a cushion, *Raoulia hectorii*.

Sites are from a range of mid- to high-altitude localities throughout the District, including Timber Creek (c. 1150 m), Leithen Burn headwaters (c. 1000 m), Gem Lake catchment (c. 1250-1430 m), and Pomahaka headwaters (c. 1200-1300 m).

#### Group 12. Slim Snow Tussock Grassland

This community is dominated by slim snow tussock but also has some species that are typically associated with snowbank communities (hence the high representation in species Class C) and rocky fellfield. Atkinson type names range from cushionfield and herbfield to tussockland. Frequencies of >20% occur in species Classes C, K and O with <8% in all other classes. No maximum values for percentage frequency are present within this community. Group 12 differs from Groups 10 and 11 in that species Class C is represented by a relatively high percentage frequency. Species richness ( $31.8 \pm 1.7$ ) is similar to Groups 10 and 11.

It occurs at high altitude, including snowbank margins, and was sampled within the Pomahaka (altitude c. 1300-1400 m) and Little Pomahaka (c. 1200-1400 m) catchments, as well as on the Whitecoomb Range (c. 1400 m).

#### (C) HIGH ALPINE ZONE COMMUNITIES

This embraces only one Quadrat Group.

#### Group 13. Snowbank.

Although Atkinson did not include snowbank as a community type in his classification, this is a very distinctive community in the District. It has moderate species richness ( $27.5 \pm 2.7$ ) and occurs in areas of prolonged snow lie. The community is dominated by species from Class C and to a lesser degree Class K. The former consist of 12 species which include the subshrubs *Parahebe trifida* and *Pernettya alpina*, herbs *Celmisia haastii*, *Drapetes* aff. *lyallii*, *Epilobium tasmanicum*, *Montia australasica*, *Ranunculus pachyrrhizus* and *Raoulia subulata*, together with the sedges *Carex hectorii* and *C. pyrenaica* var. *cephalotes*.

Sites are located in a range of early to late snowbanks in the high altitude catchments of Whitecoomb East, Gem Lake, Pomahaka and Little Pomahaka at c. 1400 m where snow persisted until late December in 1985.

## (D) WETLAND/BOG COMMUNITIES

Generally occupying high-altitude sites (c. 1100-1400 m), quadrat Groups 14 to 17 are distinguished from all others by the high representation of species in Class B. Groups 14 and 15 are of low mean species richness ( $8.4 \pm 1.9$  and  $17.5 \pm 1.6$ , respectively) compared with Groups 16 and 17 ( $20.6 \pm 1.1$  and  $28.1 \pm 3.4$ , respectively).

Group 14. Comb Sedge Cushionfield.

Described generally as cushionfield under the Atkinson system, type names vary according to the proportion of herbs and bryophytes present at particular sites.

This is a very species-poor community based on five quadrats and the only one in which species richness in the 2 m x 2 m plot ( $6.8 \pm 1.4$ ) was similar to that recorded in the 20 m x 10 m sample area ( $8.4 \pm 1.9$ ). Generally the plots are dominated or codominated by the comb sedge, *Oreobolus pectinatus* and/or the trailing subshrub *Dracophyllum prostratum*. No species class reaches its peak in this community although Class B at 40% frequency ranks second only to the frequency present in quadrat Group 16. The remaining species classes have frequencies of  $\leq 3\%$ .

All sites are at relatively high altitudes, being located in the Whitecoomb (c. 1000 m) and Little Pomahaka (c. 1200-1300 m) catchments and on the White Umbrella ridge (c. 1100 m).

Group 15. Bog Pine Shrubland.

Described variously as combinations of shrubland, moss or cushionfield according to the dominant growth forms.

This is a community of limited extent, being based on four quadrats and characterised mainly by species from Class E which achieve peak frequency here. Diagnostic species within this class are bog pine (*Halocarpus bidwillii*) which dominates in all plots, the cushion species *Donatia novae-zelandiae*, the subshrub *Myrsine nummularia*, the herb *Forstera tenella*, the sedge *Oreobolus strictus* plus *Gaimardia setacea*. Other species which occur in Class E, but not within the distinctive bog pine community, are mainly herbs of generally permanently wet sites within tussockland communities: *Anemone tenuicaulis*, *Anisotome aromatica* var. *flabellifolia*, *Dolichoglottis lyallii*, *Epilobium chlorifolium*, *E. glabellum* and *Hypolepis millefolium*.

The bog pine sites occur within the Whitecoomb catchment and also on the White Umbrella ridge at a moderately high altitude (c. 1100 m).

Group 16. Sedgeland.

Under the Atkinson classification this community may be named as either sedgeland, mossfield, cushionfield or herbfield, or combinations thereof, depending on growth form dominance.

A wetland community which, with the exception of Class B species has frequencies of  $\leq 8\%$  in all classes yet is significantly richer in species ( $20.6 \pm 1.1$ ) than Group 14. Class B reaches its maximum

frequency here and includes a range of species indicative of wetland communities such as the trailing subshrub *Dracophyllum prostratum*, the undescribed cushion species *Drapetes* 'bog', the herbs *Abrotanella caespitosa*, a buttercup (*Ranunculus gracilipes*), a sundew (*Drosera arcturi*), *Plantago uniflora* and an annual eyebright (*Euphrasia dyeri*), together with the sedges *Carex gaudichaudiana* and *Carex lachenalii*, as well as the rushes *Rostkovia magellanica* and *Luzula leptophylla*.

The sites sampled are located in the high-altitude catchments of the Whitecoomb Range, together with the Gem Lake, Pomahaka, Little Pomahaka and Whitecoomb Creek catchments.

#### Group 17 Rich sedgeland.

In a similar manner to Group 16 this community may be described variously as sedgeland, cushion, moss or herbfield under the Atkinson system.

However, this is a species rich group (mean =  $28.1 \pm 3.4$ ) in comparison to Groups 14 to 16. Three species classes reach their peak frequency within this community, but only one, Class H, exceeds 20%. Two other classes, B and O, have >20% frequency, the remainder occur at frequencies <15%.

Class H consists of only five species, the sedge *Carex echinata*, a grass *Rytidosperma buechananii* and three herbs - *Hydrocotyle heteromeria*, *Microseris scapigera* and *Nertera balfouriana*.

Species Classes D and F are poorly represented in all 15 communities but reach their peaks, albeit <15%, within Group 17. Class D is poorly defined but includes a large number of species. These range from those typical of permanently moist sites such as the small grass *Erythranthera australis* to species of generally well drained tussock grasslands such as the subshrub *Pimelea pseudolyallii*, the herb *Raoulia glabra* and the grass *Rytidosperma nigricans*, together with plants of rocky ground such as edelweiss (*Leucogenes grandiceps*).

By contrast, Class F includes only five species, all herbs of flushes: a speargrass (*Aciphylla pinnatifida*), a rush (*Juncus articulatus*), *Montia fontana*, a buttercup (*Ranunculus cheesemani*) and *Schizeilema cockayneana*.

All seven sites where this community occurred are at high altitudes (>1200 m) in the Whitecoomb, Gem Lake and Little Pomahaka catchments.

#### (E) ROCK BLUFFS/TORS

Records of the vegetation of rock bluffs were not included in the cluster analysis (see Chapter 3) since sampling of plots was not possible. Rock bluffs and tors varied greatly in size and degree of accessibility which affected the number of species recorded. Some rock areas (including gorges) were relatively rich, exceeding 100 species, e.g., the low- to mid-altitude sites of McKays Creek, the Pomahaka Tributary (both c. 450 m), Devil's Gorge (c. 300 m) and Lake Roxburgh shrublands (c. 180 m). The gorge at the headwaters of the Pomahaka River (c. 1200 m) was also particularly rich in species with an excess of 100 recorded.

Further details relating to particular rock areas are given in Chapter 5.

### 4.3 Fauna

The wide range in habitats present within the Umbrella Ecological District not only supports a diverse flora, but also a diverse and interesting fauna. The zoological information collected during the present survey has gone part-way towards filling the void in knowledge of particularly the invertebrate fauna of the Umbrella Mountains. Undoubtedly, many species remain unrecorded, but the data already indicate that the Umbrella Ecological District possesses a distinctive fauna with many species reaching their eastern or western limits within it. Faunal affinities, in a similar manner to the flora, appear greatest with populations on the Garvie Mountains to the west and the Old Man Range to the north as well as shared characteristics with those on the Lammermoor Range and Blue Mountains to the east.

With the exception of the avifauna and Mollusca the faunal information is presented here as separate reports written by individuals with expertise in particular groups, notably: Mr B.H. Patrick for Lepidoptera, Cicadidae and Acridae; Dr B.I.P. Barratt for Coleoptera with additional arthropod information provided by Mr P.M. Johns; and that on aquatic fauna by Dr C.W. Burns.

These separate contributions may be summarised as follows: a total of 218 Lepidoptera taxa are listed for the District. The alpine moth fauna is particularly diverse with probably 80% of the total species present being recorded during the present survey. Many affinities are shared with the Garvie Mountains and Lammermoor Range and several of the species recorded are not found in 'nuclear' Central Otago. Moreover, the Lepidoptera of the Umbrella Mountains is both richer and different from that of the Old Man Range.

Coleoptera were the most intensively studied on the Whitecoomb Range where 83 species were recorded with the majority (73) occurring in the Gem Lake cirque. The beetle fauna is very diverse with many species being extremely abundant. Again, affinities are shared with the Old Man Range and Garvie Mountains as well as the Blue Mountains.

The aquatic habitats of the Whitecoomb Range are relatively undisturbed and unmodified examples of upland southern South Island freshwater faunal associations. Gem Lake is one of only a very small number of New Zealand lakes known to be in an unmodified state and thus constitutes a very valuable, and important, scientific baseline. In addition, populations of the endemic copepod *Boeckella dilatata* are apparently unique, displaying unusual features of giantism, large clutch size, resting eggs and red pigmentation.

#### 4.3.1 Birds

A national bird distribution mapping scheme based on the 10,000-yard national grid map (Lands and Survey Dept. map series NZMS1 and NZMS 18) was conducted over the period 1969-79. The resulting data were incorporated into an atlas from which bird distribution information may be extracted (Bull *et al.* 1985).

The Umbrella Ecological District is covered by 21 grid squares, in which a total of 53 species were recorded in the ten-year period (Table 4.1). Fifty-seven species are known from the District of which 41 were recorded during the present survey (Table 4.1). Of these, kea and fernbird did not feature in the atlas compilation. In addition, a kaka was sighted in Leithen Bush in 1952-53 (Lands and Survey Dept. 1983a) but have not been recorded since. Red-crowned parakeets were last sighted positively in 1967, also in Leithen Bush (Lands and Survey Dept. 1983a) and possibly by Wildlife Service staff in Waikaia Bush (National Habitat Register) in 1980. Red-crowned parakeets were not recorded from the Umbrella District during the national mapping scheme although it is acknowledged that unsighted parakeet species are extremely difficult to differentiate (Bull *et al.* 1985).

The most widespread species within the District, occurring in >90% of the grid squares, are the Australasian harrier, spur-winged plover, southern black-backed gull, skylark, hedgesparrow, blackbird, yellowhammer, chaffinch and redpoll. Restricted species, occurring in <20% of the grid squares include the little shag, Australasian bittern, New Zealand shoveler, New Zealand falcon, chukor, pheasant, banded dotterel, red-billed gull, yellow-crowned parakeet, shining cuckoo, long-tailed cuckoo, yellowhead and tui (Table 4.1).

Undoubtedly, the larger areas of forest habitat support a more diverse and abundant bird fauna than other habitats within the District, or even within the numerous small forest remnants. Conservation of large forest stands is considered essential for the long-term survival of the indigenous birdlife (East and Williams 1984). There is some indication that the small stands can be considered as islands in which species and their number are a function of the size of the remnant and its degree of isolation from other similar habitats (Mr G. Loh, pers. comm.). However, the concept needs further study before conclusions can be drawn for the District.

Waikaia and Leithen Bush appear to remain as strongholds in the District for the yellow-crowned parakeet and the South Island robin, both species of scattered and restricted distribution nationally. However, yellowheads, previously known from Leithen Bush, were not confirmed during the present survey despite efforts to locate them (Dickinson *et al.* 1985). Yellowheads have disappeared from many parts of the South Island and there are fears that their numbers are continuing to decline (Gaze 1985). Foord (1985) located a total of 12 yellowheads on seven separate occasions while traversing various sections of Waikaia Forest to the east of the Waikaia River. All were recorded in the northern portion of the forest. Three yellowheads were also recorded in the forest to the west of the Waikaia River during a supplementary survey (Dickinson *et al.* 1985).

Kea were noted on several occasions in upland areas of the District (see Table 4.1). Breeding could not be confirmed although it is likely that they are occasional visitors from the Garvies-Hectors region (see Appendix IV). Keas have been seen on a number of occasions particularly in the mid- to upper reaches of the Pomahaka Valley (Mr J.G. Norman, pers. comm.) and a single individual

TABLE 4.1: Birds of the Umbrella Ecological District. The number of 10,000-yard grid squares in which each species was recorded (after Bull *et al* 1985) is given. 21 squares cover the District.

\* = recorded during the present survey

| SPECIES                             | No. of squares                                 |
|-------------------------------------|------------------------------------------------|
| * Black shag .....                  | <i>Phalacrocorax carbo</i> ..... 15            |
| Little shag.....                    | <i>Phalacrocorax melanoleucos</i> ..... 4      |
| * White-faced heron.....            | <i>Ardea novaehollandiae</i> ..... 15          |
| Australasian bittern.....           | <i>Botaurus stellaris poiciloptilus</i> ... 3  |
| * Paradise shelduck.....            | <i>Tadorna variegata</i> ..... 16              |
| Mallard.....                        | <i>Anas platyrhynchos</i> ..... 10             |
| Grey duck.....                      | <i>Anas superciliosa</i> ..... 7               |
| New Zealand shoveler.....           | <i>Anas rhynchotis</i> ..... 2                 |
| * Australasian harrier.....         | <i>Circus approximans gouldi</i> ..... 20      |
| * New Zealand falcon.....           | <i>Falco novaeseelandiae</i> ..... 3           |
| Chukor.....                         | <i>Alectoris chukar</i> ..... 1                |
| * California quail.....             | <i>Lophortyx californica</i> ..... 6           |
| Pheasant.....                       | <i>Phasianus colchicus</i> ..... 3             |
| * Pukeko.....                       | <i>Porphyrio porphyrio melanotus</i> ..... 5   |
| * South Island pied oystercatcher.. | <i>Haematopus ostralegus finschi</i> ..... 17  |
| * Spur-winged plover.....           | <i>Vanellus miles novaehollandiae</i> ..... 19 |
| * Banded dotterel.....              | <i>Charadrius bicinctus</i> ..... 2            |
| * Pied stilt.....                   | <i>Himantopus himantopus leucocephalus</i> 10  |
| * Southern black-backed gull...     | <i>Larus dominicanus</i> ..... 20              |
| * Red-billed gull.....              | <i>Larus novaehollandiae scopulinus</i> ... 1  |
| Black-billed gull.....              | <i>Larus bulleri</i> ..... 12                  |
| Black-fronted tern.....             | <i>Sterna albobriata</i> ..... 7               |
| * New Zealand pigeon.....           | <i>Hemiphaga novaeseelandiae</i> ..... 7       |
| Feral pigeon.....                   | <i>Columba livia</i> ..... 5                   |
| # Kaka.....                         | <i>Nestor meridionalis</i> ..... 0             |
| * Kea.....                          | <i>Nestor notabilis</i> ..... 0                |
| * Yellow-crowned parakeet...        | <i>Cyanoramphus auriceps</i> ..... 4           |
| * Red-crowned parakeet.....         | <i>Cyanoramphus novaezealandiae</i> ..... 0    |
| * Shining cuckoo.....               | <i>Chrysococcyx lucidus</i> ..... 2            |
| * Long-tailed cuckoo.....           | <i>Eudynamis taitensis</i> ..... 4             |
| * Morepork.....                     | <i>Ninox novaeseelandiae</i> ..... 5           |
| Little owl.....                     | <i>Athene noctua</i> ..... 6                   |
| New Zealand kingfisher...           | <i>Halcyon sancta vagans</i> ..... 5           |
| * Rifleman.....                     | <i>Acanthisitta chloris</i> ..... 8            |
| * Brown creeper.....                | <i>Finschia novaeseelandiae</i> ..... 8        |
| * Skylark.....                      | <i>Alauda arvensis</i> ..... 21                |
| * New Zealand pipit.....            | <i>Anthus novaeseelandiae</i> ..... 16         |
| * Hedgesparrow.....                 | <i>Prunella modularis</i> ..... 20             |
| * Fernbird.....                     | <i>Bowdleria punctata</i> ..... 0              |
| * Yellowhead.....                   | <i>Mohua ochrocephala</i> ..... 4              |
| * Grey warbler.....                 | <i>Gerygone igata</i> ..... 18                 |
| * Pantail.....                      | <i>Rhipidura fuliginosa</i> ..... 15           |
| * Yellow-breasted tit.....          | <i>Petroica macrocephala macrocephala</i> 10   |
| * New Zealand robin.....            | <i>Petroica australis</i> ..... 8              |
| * Song thrush.....                  | <i>Turdus philomelos</i> ..... 18              |
| * Blackbird.....                    | <i>Turdus merula</i> ..... 20                  |
| * Silvereye.....                    | <i>Zosterops lateralis</i> ..... 18            |
| * Bellbird.....                     | <i>Anthornis melanura</i> ..... 14             |
| Tui.....                            | <i>Prothemadera novaeseelandiae</i> ..... 3    |
| * Yellowhammer.....                 | <i>Emberiza citrinella</i> ..... 19            |
| * Chaffinch.....                    | <i>Fringilla coelebs</i> ..... 20              |
| Greenfinch.....                     | <i>Carduelis chloris</i> ..... 15              |
| * Goldfinch.....                    | <i>Carduelis carduelis</i> ..... 17            |
| * Redpoll.....                      | <i>Carduelis flammea</i> ..... 20              |
| * House sparrow.....                | <i>Passer domesticus</i> ..... 16              |
| * Starling.....                     | <i>Sturnus vulgaris</i> ..... 18               |
| * Australian magpie.....            | <i>Gymnorhina tibicen</i> ..... 11             |

# reported in Leithen Bush, 1952-53.

+ Leithen Bush -last positive sighting 1967 (Lands and Survey Dept. 1983a); Waikaia Bush -possibly sighted 15/2/80 by Wildlife Service staff (National Habitat Register).

Note: Fernbird, kea and New Zealand falcon were recorded in the following map square numbers which did not feature as records in the national mapping scheme (Bull *et al* 1985).

| Species            | Map Square Number        |
|--------------------|--------------------------|
| Fernbird           | 2828                     |
| Kea                | 2930 3031                |
| New Zealand falcon | 2829 2927 2928 2929 2930 |

was observed as far south as Daws Spur, southern Stronach Range in the winter of 1980 (Mr G.D. Eason, pers. comm.). The species was recorded on the Whitecomb Range, McGregor Country and in the Little Pomahaka headwaters during the District survey.

The atlas of bird distribution recorded New Zealand falcons in only three of the 10,000-yard grid squares (Table 4.1). However, the species appeared widespread in mid- to high-altitude areas of the District during the present survey especially in, and around, the Umbrella Mountains. New Zealand falcons are known to breed here as well as on the Old Man Range although they appear absent along the Clutha River (Fox 1978). The breeding range of the species has shrunk in the last 30 years with an apparent retreat from lowland to upland habitats. Only c. 3000 to 4500 breeding pairs now remain in the country (Fox 1978).

Banded dotterel were recorded once in the headwaters of the Little Pomahaka, and are likely to breed in the high altitude areas (Appendix IV). Other species breeding in the alpine zone of the District include Paradise shelduck, southern black-backed gull and South Island pied oystercatcher.

Additional observations during the present survey included black shag in the Pomahaka Valley and around Lake Roxburgh; white-faced heron, pied stilt and pukeko in the south-west of the District; and California quail in the north-east.

Two fernbirds were recorded once in November 1985 in the area of dense red tussock on the lowland of Awatere Station (c. 330 m). The species tends to prefer habitats consisting of low dense ground vegetation and emergent shrubbery (Best 1979). In studies of fernbird territories near Invercargill Barlow (1983) estimated that their area varied from 530 m<sup>2</sup> to 2870 m<sup>2</sup>. Nevertheless, very little is known of the species. There is some suggestion that fernbirds may use suitable habitats at several different locations (Mr G. Loh, pers. comm) which might explain the single record at Awatere despite several visits to the tussock area.

#### 4.3.2 Mollusca

Species of Mollusca were not intensively collected during the survey. Nonetheless, the finding of both live specimens and empty shells of the endemic land snail *Powelliphanta spedenii* subsp. *spedenii* was significant. Shells were found near the outlet of Gem Lake (c. 1300 m), in the Argyle Burn forest remnant (780 m to 960 m) (S152 GR: 904 007) and also on the rock bluffs above Post Office Creek (c. 1050 m). In the latter case two live specimens were seen as well as three shells in varying states of disrepair. It is possible that southern black-backed gulls could have transported the shells found at Gem Lake as some were severely damaged. Live specimens could not be found despite a concerted effort. Little is known of the species distribution (Meads *et al.* 1984) and the survey findings presented here add significantly to the knowledge previously available. Habitat modification appears to be one of the greatest threats to the survival of *Powelliphanta* species (Meads *et al.* 1984).

### 4.3.3. Lepidoptera of the Umbrella Ecological District B.H. Patrick, 38 St Albans St, Dunedin

#### 4.3.3.1. Annotated species list

This list records the species found during the survey from October 1985 till April 1986. The following locality codes are used for areas within the District:

|                           |                             |                          |
|---------------------------|-----------------------------|--------------------------|
| AS = Awatere Station      | MC = McKay Creek            | SR = Stronach Range      |
| BU = Black Umbrella Range | MF = Millers Flat roadside  | TC = Timber Creek        |
| CR = Crown Rock           | NR = Nobbie Range           | WB = Waikaia Bush        |
| GL = Gem Lake             | PH = Parasol Hill           | WC = Mt Whitecoomb       |
| LB = Leithen Bush         | PR = Pomahaka River         | WR = Whitecoomb Range    |
| MB = Mt Benger            | SO = Southern Old Man Range | WU = White Umbrella area |

Altitude and other information is noted for the more interesting species.

#### NEPTICULIDAE

*Stigmella* sp. 1 WB larvae mine *Olearia arborescens* leaves.  
*Stigmella* sp. 2 TC PR larvae mine *O. hectorii* and *O. virgata* var. *rugosa*.  
*Stigmella* sp. 3 MB 1100 m. In shrubland. May be *Cassinia* species.  
 October.  
*Stigmella erichtitus* (Watt) PR MF larvae mine *Senecio minimus*.  
*Stigmella lucida* (Philpott) WB larvae mine silver beech.

#### HEPIALIDAE

*Aoraia* sp. 1 AS WR MB a large species (wingspan 10 cm) with brachypterous females. An eastern Otago species, emerging in March. 670 to 1440 m.  
*Aoraia senex* (Hudson) GL WR WU SO MB a species of moss and cushion-bogs, again with short-winged females, 1160 to 1140 m.  
*Aoraia* sp. 2 GL ) 1300 m. Caught flying at dusk - early March.  
*Aoraia* sp. 3 GL )  
*Wiseana umbraculata* (Guenée) MF PR WB  
*Wiseana copularis* (Meyrick) LB MF  
*Wiseana jocosa* (Meyrick) PR and LB in November.

#### GRACILLARIIDAE

*Caloptilia selenitis* (Meyrick) WB larvae on silver beech.  
*Acrocercops panacicorticis* (Watt) WB larvae mine *Pseudopanax* stems.

#### PSYCHIDAE

*Reductoderces* sp. 1 MB GL the larval cases were found on tors where the larvae feed on algae. The pale green elongated cases have been found from high-alpine areas of the Remarkables to Evansdale near Dunedin at sea-level in broadly a straight line. Apterous females and fragile diurnal males. 1000 to 1400 m. December.

*Reductoderces* sp. WB smaller cases, but similar to last species. They are found on tree-trunks mainly. A complex of species as yet not resolved.

*Mallobathra scoriota* Meyrick WB the case-larvae of this southern species feed on mosses etc. on the forest floor. Adults diurnal in September.

*Mallobathra obscura* Philpott WB similar to last species. November.

*Liothula omnivora* Fereday LB WB PR

#### SCYTHRIDAE

*Scythrís nigra* Philpott WR north end of the range at 1250 m. Larvae on *Hebe odora* group. Species previously only known from Maungatua and Swampy Summit in east Otago. Adults in December.

#### ELACHISTIDAE

*Elachista thallophora* Meyrick MB 950 m. GL 1160 m. November and December.

#### CARPOSINIDAE

*Heterocrossa cryodana* Meyrick PH 970 m. MB 950 m. November.

#### CHOREUTIDAE

*Asterivora barbigera* (Meyrick) GL 1250-1400 m. Diurnal adults around the larval food-plant, *Celmisia semicordata*, in December.

*Asterivora ?symbolaea* (Meyrick) GL 1400 m and WR north end at 1250 m. Larvae feed on *Celmisia densiflora*. Adults small and diurnal.

*Asterivora* sp. AS larvae mine *Brachyglottis southlandica*.

#### GLYPHIPTERIGIDAE

*Circica bactrias* (Meyrick) MF swept off *Carex* in wet areas during November and December.

*Circica barbata* (Philpott) MB 950 m and GL 1160 m. Another diurnal species, this time of *Chionochoa* swards. November and December.

*Circica oxymachaera* (Meyrick) WR north end at 1250 m and GL 1160 m. December.

#### YPONOMEUTIDAE

*Plutella* sp. GL 1400 m. a snow-bank species of western ranges of Central Otago. March.

*Protosynaema quaestuosa* Meyrick GL 1300 m. December. larvae on *Carex*

*Protosynaema steropucha* Meyrick AS

#### COLEOPHORIDAE

*Coleophora frischella* (Linnaeus) PR world-wide pest of clover.

#### TINEIDAE

*Sagephora phortegella* Meyrick AS 500 m.

## OECOPHORIDAE

- Helioestibes electrica* Meyrick MF diurnal adults in shrubland.  
*Atomotricha chloronota* Meyrick WB in forest in September.  
 Brachypterous females.  
*Gymnobathra calliploca* Meyrick LB November.  
*Gymnobathra parca*? (Butler) WR 1100 m and GL 1160 m. November and December.  
*Gymnobathra cenchrias* (Meyrick) WB and LB in November.  
*Gymnobathra omphalota* Meyrick WB in November.  
*Gymnobathra* sp. SO, WR north end at 1250 m in December. This bright yellow species with brachypterous females, has been found also on Longwoods, Takitimus, Hectors and the Hokonui Hills in grassland-shrubland.  
*Leptocroca asphaltis* (Meyrick) LB in November.  
*Tingena hastata* (Philpott) GL 1435 m in December. An uncommon southern species with a litter-feeding larva and a brachypterous female.  
*Tingena lassa* (Philpott) MB SH 500 m. October on rock faces. Southern species.  
*Tingena leviata* (Philpott) GL 1400 m in December. Southern species.  
*Tingena phegophylla* (Meyrick) LB in November.  
*Tingena chlorodelpha* (Meyrick) NR 670 m in November.  
*Trachypepla galaxias* Meyrick MF in December.  
*Proteodes profunda* Meyrick LB larvae on *Nothofagus*. Adult in October.  
*Izatha convulsella* (Walker) MF in November.  
*Endrosis sarcitrella* (Linnaeus) NR cosmopolitan species.

## TORTRICIDAE

- Capua semiferana* (Walker) PH AS  
*Ctenopseustis obliquana* (Walker) WB  
*Epichorista hemionana* (Meyrick) WC and GL 1260 to 1450 m. Widespread species with larvae on various herbs. March.  
*Epichorista siriana* (Meyrick) WR 1400 m. March.  
 'Eurythecta' *phaeoxyla* Meyrick MB 500 m bred from introduced *Geranium*.  
*Gelophaula tributaria* (Philpott) WC and GL 1250 to 1400 m. A common colourful diurnal species over patches of *Celmisia* on this and adjacent mountains. December.  
*Gelophaula aridella* Clarke GL 1400 m. Only recorded elsewhere from the Hunter Mts. and Garvie Mts. One in December.  
*Gelophaula* sp. PH 940 m, BU 1080 m, SO 1300 m and AS 670 m. Another pretty species, this time only known from the Rock and Pillar Range and the Lammermoors. Late January till early March.  
*Harmologa oblongana* (Walker) MF bred from *Olearia lineata*.  
*Harmologa petrias* Meyrick MB 950 m and GL 1160 m. Larvae feed on *Cassinia* and the adults are diurnal. A southern and mainly eastern species that was caught in November and December.  
*Harmologa sanguinea* (Philpott) MB 1100 m. A very attractive reddish day-flying moth with larvae on *Hebe* shrubs. Another southern species that occurs from Fiordland to east Otago.  
*Harmologa* sp. PR 500 m near Jordan Creek. A distinct new species beat out of *Olearia* aff. *odorata* in March.  
*Harmologa* sp. MF an adult bred from *Hymenanthera alpina*. The distinct species has been found also at Beaumont and on Mt Cargill near Dunedin.

*Planotortrix excessana* (Walker) WB

*Pyrgotis consentiens* Philpott MB 1000 m and WR (north end) 1250m.

Larvae of this species feed on the buds of *Hebe odora*.

The adults are orange-coloured and diurnal and emerge in December. The species is found in eastern Fiordland, Stewart Island and eastern Otago, this record being its west-most in Otago.

'*Tortrix*' *flavescens* (Butler) WB November and LB.

'*Tortrix*' *sphenias* (Meyrick) WB November record of this uncommon species.

'*Cnephasia*' *microbathra* Meyrick LB in November. This species was recently bred from a small species of stemless tree fern (*Cyathea colensoi*). A very uncommon species.

#### SATYRIDAE

*Argyrophenga antipodum* Doubleday PR and WR Tussock butterfly.

*Argyrophenga janitae* Craw GL 1260 m. So far this the south-eastern most record of the species. Attached to unmodified *Chionochloa* areas.

#### NYMPHALIDAE

*Bassaritis itea* (Fabricius) MF Yellow Admiral butterfly.

*Bassaritis gonerilla* (Fabricius) WR and WB Red Admiral butterfly.

#### LYCAENIDAE

*Lycaena salustius* (Fabricius) BU 1080 m. Common Copper butterfly.  
Also GL.

*Lycaena boldenarum* White SR 450 m. Boulder Copper butterfly.

*Zizina otis orleyi* (Felder and Rogenhofer) MF Common Blue butterfly.

#### PIERIDAE

*Pieris rapae* (Linnaeus) WR MF PR White butterfly.

#### PTEROPHORIDAE

*Platyptilia repletalis* (Walker) GL 1160 m in December.

*Stenoptilia orites* (Meyrick) BU 800 m. November. The larvae of this Plume Moth species feed on the flowers of *Brachyglottis bellidioides*.

#### PYRALIDAE

*Orocrambus aethonellus* (Meyrick) SR 900 m, PH 970 m and GL 1250-1300 m and NR. This genus of moths are associated with grasses and sedges as larvae. This common diurnal species was found in November and December.

*Orocrambus flexuosellus* (Doubleday) WR MF LB WB PR SO WC

*Orocrambus heliotes* (Meyrick) GL 1300 m in December over wetland. This beautiful orange diurnal species is very local in distribution. Also found in January on SO at 1275 to 1300 m.

*Orocrambus machaeristes* Meyrick WR northern end at 1250 m. A dark coloured fast-flying diurnal species that occurs over areas of *Poa*.

- Orocrambus melitastes* (Meyrick) SR 800 to 900 m, GL 1300 m  
November and December and PH
- Orocrambus ramosellus* (Doubleday) MF PR WB
- Orocrambus scoparioides* Philpott SO and GL 1300 to 1400 m.  
A diurnal wetland species that is found in upland bogs of Fiordland and Central Otago. Orange adults appeared in December and January.
- Orocrambus tritonellus* (Meyrick) SH and WR 900 m. In November.  
Diurnal.
- Orocrambus vittellus* (Doubleday) WB
- Orocrambus* sp. SO and WR north end 1250 to 1275 m. A distinct species of tall tussock areas that was first found on the Lammermoors. The long narrow wings are clearly marked in brown and white with the adults appearing in December and January.
- Tawhitia glaucophanes* (Meyrick) SO 1275 m. A fine sooty-black diurnal species that frequents rocky areas on the crest of mountains. Curiously not found on the Umbrella Mts yet. January.
- Glaucobaris helioctypa* (Meyrick) GL 1300 m. Bogland in December.
- Glaucobaris leucorantha* (Meyrick) WB In November.
- Tauroscopa gorgopis* Meyrick GL 1430 to 1440 m. Another sooty-black species that frequents ridge crests, where it flies low and fast in the sunshine during December.
- Tauroscopa trapezitis* Meyrick WR north end at 1250 m. Similar to the above species but much less common and less widely distributed. This is the first record for this and adjacent mountains. Adult in December.
- Deana hybreasalis* (Walker) WB MC
- Mnesictena flavidalis* (Doubleday) PR WB LB
- Mnesictena notata* (Butler) TC Larvae recently reared from  
*Acaena* spp.
- Antiscopa elaphra* (Meyrick) AS and WB
- Eudonia arena* (Meyrick) AS 670 m.
- Eudonia chalara* (Meyrick) PR PH BU WR 900 to 970 m. Tussock areas in November.
- Eudonia characta* (Meyrick) WB March.
- Eudonia critica* (Meyrick) GL 1160 m. Around rock face in December.
- Eudonia cyptastis* (Meyrick) MB 950 m. November in wet grassland.
- Eudonia deltophora* (Meyrick) AS 670 m and GL 1300 m.  
Grasslands in March.
- Eudonia feredayi* (Knaggs) PH 970 m, AS NR WB and GL 1400 m.  
November to March.
- Eudonia legnota* (Meyrick) SR 900 m. MB 950 m and GL 1300 m.  
A species of bogland, emerging in November and December.
- Eudonia melanaegis* (Meyrick) NR 670 m and LB.
- Eudonia octophora* (Meyrick) WB
- Eudonia oreas* (Meyrick) WB a species of rock faces.
- Eudonia organaea* (Meyrick) SR NR WR LB GL 500 to 1300 m.  
Dark-coloured. Diurnal species of wet areas but not bogland. November and December.
- Eudonia paltomacha* (Meyrick) MB 950 m in December in wetlands.
- Eudonia philerga* (Meyrick) NR and WB
- Eudonia psammitis* (Meyrick) MC SR PR WB SO. Up to 1400 m.  
In snowbanks.
- Eudonia quaestoria* (Meyrick) GL 1435 m. In December. A rare southern species that is mainly found in eastern Otago areas.

- Eudonia sabulosella* (Walker) MC MB PH GL WB MF A ubiquitous grassland species.
- Eudonia steropaea* (Meyrick) SR 900 m. November.
- Eudonia submarginalis* (Walker) SO WB LB
- Eudonia trivirgata* (Felder and Rogenhofer) SR 900 m and GL 1300 to 1400 m. Grassland species was found in November and December.
- Eudonia xysmatias* (Meyrick) SR 910 m, WC 1400 m, WR GL 1150 to 1400 m, and MB 1130 m. A central Otago species of moss-bogs and snow-banks. The diurnal adults were found in November and December.
- Scoparia autochroa* Meyrick SO 1370 m. A diurnal bronzey-coloured species that has a restricted distribution. So far only occurring in eastern Otago, southern Southland and eastern upland parts of Central Otago. Early January.
- Scoparia claranota* Howes WR (north end) and GL 1160 to 1250 m. A neatly-marked southern species of upland grassland areas. In December.
- Scoparia exilis* Knaggs PR dry bare areas.
- Scoparia fumata* Philpott GL 1160 to 1435 m. A southern upland species. December.
- Scoparia minusculalis* Walker WB
- Scoparia niphospora* (Meyrick) WB 350 m, WC 1300 m, and SO 1300 m. A generally upland grassland species, found here in March.
- Scoparia nomeutis* (Meyrick) SO and GL 1160 to 1435 m. A snow-bank species. December.
- Scoparia panopla* Meyrick WB 500 m. In March. Generally found in eastern South Island upland grasslands.
- Scoparia petrina* (Meyrick) WB 350 m and WU ridge at 1100 m. In March.
- Scoparia rotuella* (Felder and Rogenhofer) WB Larvae often found on *Epilobium*.
- Scoparia ustimacula* Felder and Rogenhofer WB
- Scoparia* sp. aff. *panopla* Meyrick SO 1300 m. A snow-bank or cushion-bog species so far only known from South Rough Ridge and Old Man Range. Flies in late February and March.
- Scoparia* sp. aff. *subita* (Philpott) SR 900 m, WC 1300 m and GL 1435 m. November and December. A pretty diurnal species of ridge-crests and snow-banks. Occurs on the Rock and Pillars, Lammermoors and Old Man Range.
- Scoparia* sp. MB 1030 to 1130 m. Late October to November. A distinct species that was discovered here but has since been found on Mt Teviot and the Lammermoors. A species of cushion-bog and snow-bank areas.
- Scoparia* sp. aff. *claranota* Howes SO 1300 m. March in grassland. Found in many Central Otago mountains and the Takitimu Mts.

#### GEOMETRIDAE

- Chloroclystis inductata* (Walker) WB
- Chloroclystis filata* (Guenee) AS, SO 1370 m. Tasmanian species now ubiquitous.
- Chloroclystis nereis* (Meyrick) MB 950 m, PH 970 m, WR and GL 1250 to 1435 m. A diurnal greyish species that has larvae feeding within the flower-heads of *Celmisia* spp. Common in November and December.

- Pasiphila cotinaea* (Meyrick) PR 610 m. A rare species that was bred for the first time. The foodplant was *Olearia* aff. *odorata* and the larva greenish. Species known from Masterton and Alexandra. April emergence.
- Pasiphila halianthes* (Meyrick) WR north end at 1250 m. From *Hebe* shrubland in December. A main divide species that has been collected on the Garvie and Blue Mountains as well.
- Epicyme rubropunctaria* (Doubleday) NR and AS at 670 m. Larvae on *Pernettya*.
- Austrocidaria cedrinodes* (Meyrick) AS 670 m. Larvae on *Coprosma* spp. March.
- Austrocidaria gobiata* (Felder and Rogenhofer) WB LB
- Austrocidaria similata* (Walker) WB
- Hydriomena deltoidata* (Walker) WB LB
- Hydriomena subrectaria* (Guenee) WB September, of this uncommon species.
- Epiphryne xanthospis* (Meyrick) WB 500 m. In March. A rare species not recorded further east in Otago.
- Epyaxa rosearia* (Doubleday) AS TC
- Leastia corularia* (Guenee) WB TC PR
- Helastia cinerearia* (Doubleday) PR
- Helastia* sp. MB 500 m. October. A distinct bluish-grey species that has been found in many parts of Central Otago. Larvae on lichens.
- Helastia semifissata* (Walker) WB
- Helastia* sp. aff. *cymozeugta* (Meyrick) AS and MF November. At the former site bred for the first time, the food-plant being *Hymenanthera alpina*.
- Helastia* sp. (upland version of *cinerearia*) WB November.
- Dasyuris anceps* (Butler) SO 1370 m and GL 1430 m. Grey and orange diurnal species with larvae on *Anisotome*. December and January.
- Dasyuris austrina* Philpott GL and WC 1300 to 1450 m. December to March. A fast flying diurnal species that sun-bathes in rocky areas, mainly near snow-banks. Larvae on *Anisotome*. Adults similar to *anceps*.
- Dasyuris hectori* (Butler) GL 1430 m. Larvae on an undescribed variety of *Anisotome haastii* in cirque basin. A magnificent black and white species that is never common or easy to catch. Not recorded from many areas of Central Otago as yet.
- Dasyuris leucobathra* (Meyrick) CR 1200 m and GL 1320 to 1420 m. November and December. Again, diurnal adults, but this time coloured black, white and yellow. Also not known from many areas east of the main divide. Larvae are on *Anisotome* also.
- Dasyuris transaureus* Howes PH 970 m. This beautiful yellow and black species was found in November. It is day-flying and found over tussockland where the larvae feed on *Anisotome aromatica*.
- Dasyuris callicrena* (Meyrick) WR north end at 1250 m. A nice black and white diurnal species with larvae on *Hebe odora*. December.
- Notoreas chioneres* Prout SR 1325 m, MB 1100 m, WR 1300 to 1440 m GL. November to March. A pretty yellow and black diurnal species with larvae feeding on *Drapetes*. A southern, mainly Central Otago species. Also SO.

- Notoreas isomoera* Prout SO 1300 to 1400 m., WR 1250 to 1440 m and WU 1100 m. March. An attractive diurnal orange and black species, which has larvae feeding on *Drapetes*. Occurs from South Canterbury to south-east Otago, east of the main divide.
- Notoreas ortholeuca* Hudson SO 1300 to 1400 m and WR 1350 to 1440 m. December to March. A small black and white diurnal species whose larvae bore into the cushion *Drapetes* species. Found in central and western Otago.
- Notoreas paradelpha* (Meyrick) MB 950 to 1150 m, PH 970 m, SO 1275 m, WR 1100 to 1475 m. This yellow and black species is found from November till early January over tussockland where the larval foodplant *Pimelea* occurs. Again it is day-flying.
- Notoreas perornata* (Walker) MB 1100 m, CR 1200 m, WC and WR (north end) 1100 to 1430 m. Found from November to March, this orange and black diurnal species has larvae that also feed on *Pimelea*.
- Asaphodes abrogata* (Walker) TC and AS March.
- Asaphodes aegrota* (Butler) WB
- Asaphodes beata* (Butler) WB
- Asaphodes cinnabari* (Howes) GL 1160 m. In December. A very pretty species that is known from very few localities, mainly northern Southland and the Lammermoors. The green and orange adults fly freely in the sunshine over damp grassland where the larvae feed on various herbs.
- Asaphodes clarata* (Walker) SO 1400 m. In March. Another mainly upland species, orange in colour, that frequents herb-fields.
- Asaphodes dionysias* (Meyrick) SO WR WU all 1100 to 1440 m. WB 500 m. January to March. A species that is found in very wet tussock areas adjacent to bogs. Females are brachypterous and the species is found on many Central Otago mountains. Larvae on herbs.
- Asaphodes* sp. SO 1370 m. A smaller and narrower-winged version of the last species and is found right in the bog-lands, often quite commonly. Curiously missing from the Umbrella Mountains as it occurs on Remarkables, Garvies, Old Woman and Old Man Ranges.
- Asaphodes recta* (Philpott) WB 500 m. March. A rare Central Otago species.
- Asaphodes sericodes* (Meyrick) SO WU WR 1100 to 1400 m. March. A relatively large and pale species that like *dionysias* is found in areas beside wetlands. Another Central Otago species of alpine areas.
- '*Notoreas*' *anthracias* (Meyrick) WR 1250 to 1400 m. December. This grey and white diurnal species has larvae on smaller *Dracophyllum* species.
- '*Notoreas*' *insignis* (Butler) SO and probably present on Umbrella Mountains. January. A fine diurnal species, orange in colour and often seen over grassland where the larvae feed on *Poaceae*. 1250 to 1370 m.
- '*Notoreas*' *orphnaea* (Meyrick) SO BU WC GL 1200 to 1445 m. Late November till early January. This magnificent sooty-black species flies in the daytime (sometimes in mist) over the highest grasslands. Found in Otago and western Southland.

'*Notoreas*' *brephosata* (Walker) MB 1000 m, SO and WR 1300 to 1440 m. Late October till March. With its pretty orange under-wings and habit of settling on tracks and rocky areas, this species is one of our most conspicuous alpine moths. Larvae on *Epilobium*.

'*Notoreas*' *zopyra* (Meyrick) GL 1430 m and SO 1300 m. December and January. A more compact version of the last species with blue-grey forewings and orange hind-wings. Less common also, and the larvae feed on everlasting daisy.

*Arctesthes* *siris* (Hudson) SO 1250 to 1370 m. January to March. A neatly marked little species that frequents snow-banks and wet cushion-bog. A limited distribution in alpine Central Otago, but surprisingly absent from the many wetland areas of the Umbrella Mountains.

*Sestra* *humeralia* (Walker) WB Larvae on ferns.

*Ischalis* *fortinata* (Guenee) WB Larvae on ferns.

*Pseudocoremia* *rudisata* (Walker) PR 500 m. Bred from *Olearia* aff. *odorata*.

*Pseudocoremia* *leucelaea* (Meyrick) LB WB

*Pseudocoremia* *productata* (Walker) LB WB AS

*Pseudocoremia* *suavis* Butler LB WB

*Declana* *floccosa* Walker WB LB

*Xyridacma* *veronicae* Prout AS Larvae on *Hebe* aff. *rakaiensis* GL 1300 m. March.

*Dichromodes* *gypsotis* Meyrick MB 500 m. Larvae feed on lichens on rocks. Not a common species. The small adults are green and grey-black.

#### ARCTIIDAE

*Nyctemera* *annulata* (Boisduval) PR WR The diurnal Magpie Moth.

*Metacrias* *huttoni* (Butler) GL and WR north end. 1250 to 1430 m. December. The yellow and black males are day-flying while the females are brachypterous. The hairy black larvae are conspicuous by day feeding on various herbs and grasses.

#### NOCTUIDAE

*Agrotis* *ipsilon aneituma* (Walker) WB, GL 1250 to 1350 m. SO 1250 m. Ubiquitous.

*Homohadena* *fortis* (Butler) MF MB Larvae on *Hymenanthera alpina*.

*Ichneutica* *cana* Howes WR and GL 1100 to 1435 m. November to December. A fine large grey species that seems confined to Otago mountains.

*Ichneutica* *ceraunias* Meyrick WR north end 1250 m and GL 1430 m. Clearly marked orangey-brown species with larvae on *Chionocholea*. December.

*Ichneutica* *dione* Hudson GL 1400 m. One doubtful adult female in a pitfall trap. Only eastern record I know of. Uncommon species.

*Persectania* *aversa* (Walker) SR LB WB SO GL grassland species.

*Tmetolophota* *alopa* (Meyrick) WB AS March.

*Tmetolophota* *arotis* (Meyrick) WB In December.

*Tmetolophota* *atristriga* (Walker) PR WB

- Tmetolophota propria* (Walker) WB  
*Tmetolophota unica* (Walker) GL 1435 m. Grassland species in December.  
*Aletia longstaffi* (Howes) SO 1250 m, GL 1430 m. Often diurnal, this grey species seems confined to southern New Zealand. March and April.  
*Aletia obsecrata* Meyrick GL 1435 m. December. An upland species.  
*Graphania agorastis* (Meyrick) GL 1380 m. December. Often in wetlands.  
*Graphania disjungens* (Walker) GL 1430 m. December.  
*Graphania homoscia* (Meyrick) AS 670 m. March. Larvae on *Cassinia*.  
*Graphania morosa* (Butler) WB  
*Graphania mutans* (Walker) SR WB LB PR  
*Graphania nullifera* (Walker) WR 1250 to 1400 m. Our largest noctuid with larvae boring into the tap-root of *Aciphylla scott-thomsonii*.  
*Graphania paracausta* (Meyrick) WR 700 m and GL 1435 m. November to December.  
*Graphania rubescens* (Butler) SH WB  
*Meterana dotata* (Walker) WB 350 m. March. Associated with *Nothofagus*.  
*Meterana meyricki* (Hampson) GL 1250 m. March. This beautiful species with its bright pink hindwings was bred from eggs found on the larval host, *Pimelea poppelwellii*.  
*Meterana praesignis* (Howes) WB October. Associated with *Nothofagus*.  
*Meterana tartarea* (Butler) WB March. Larvae on *Coprosma* spp.  
*Schrankia costaestrigalis* (Stephens) WB March.  
*Rictonis comma* (Walker) LB  
*Rhapsa scotosialis* (Walker) PR

#### 4.3.3.2 Analysis of the Lepidoptera found during a survey of the Umbrella Ecological District.

A total of 218 taxa are listed from the Ecological District which probably represents about half the actual total. Intensive light-trapping, especially in the forest areas, would be needed to reveal the presence of many species. The number of alpine species at 103 is probably 80% of the fauna and compares well with the totals known from adjacent mountains (see table). The Lammermoor-Rock and Pillar region is particularly diverse in comparison with other regions. From the table it can be seen that 92 of the district's alpine species are found on the Umbrella Mountains. Six are found only on the southern end of the Old Man Range and five only on Mt Benger.

Considering the lowland fauna first it is obvious that much of the District is severely modified and contains many exotic plants. This is reflected in the depauperate fauna of pasture areas. The few native species that have adapted to this vastly changed ecosystem are very common but unlike pasture areas further north, there are very few exotic moth species. The beech forested valleys and their associated shrublands contain the most diverse component of the lowland fauna. As can be seen from the list below, the rare species found were mainly located in forested areas or attached to the *Olearia* woodland. The lowlands also produced the first breeding records for three species (see below) and a fourth

(Noctuidae) has yet to emerge. Significantly both hosts have proved to be rich in moth species, feeding exclusively on them, in recent years.

Species bred for the first time:

*Pasiphila cotinaea* ex. *Olearia* aff. *odorata*  
*Helastia* sp. aff. *cymoseucta* ex. *Hymenanthera alpina*  
*Harmologa* nsp. ex. *Hymenanthera alpina*

(Noctuidae larva from *Olearia* aff. *odorata* has yet to emerge.)

Rare lowland species that were found in the Umbrella Ecological District:

*Asaphodes recta* Waikaia Bush  
*Epiphyrne xanthospis* Waikaia Bush  
*Pasiphila cotinaea* Pomahaka River  
*'Cnesphasia' microbathra* Leithen Bush  
*Circica bactrias* nr. Millers Flat

(Plus the two undescribed species of *Harmologa*)

In contrast to the lowlands, the alpine fauna can be adequately sampled in the daytime as so many species are either diurnal or easily disturbed during the daytime amongst the short vegetation. Many alpine localities within the District were sampled but by far the most effort was directed at the Gem Lake area of the Umbrella Mountains. The District includes the southern end of the Old Man Range which is characterized by the presence of broad flat moss-bogs backed by steep snow-banks. The fauna has much in common with the northern parts of the range but is significantly different to be treated separately. Restricted species that it shares with the Umbrellas are unnamed species of *Orocrambus* and *Gelophaula*, both also found on the Lammermoors too. Neither occurs on northern parts of the Old Man Range. To the east of the Umbrella Mountains and separated by the Pomahaka River is Mt Benger. Its alpine fauna can be regarded as a transition between that of the Umbrellas and the Lammermoors, although it is by no means as rich as either, but does have some interesting species. The composition of the alpine fauna of the District as usual is dominated by the families Pyralidae and Geometridae. The former with larvae mainly feeding on the bases of grasses and the latter being mainly herb-feeders. Both families contain many beautifully coloured diurnal species. The moth fauna of the Umbrella Mountains is important for a number of reasons. Firstly, it contains an apparently endemic species of *Aorata* that is crepuscular in early March. The taxonomy of this group will be clarified during the next few years and it is possible more species will be recognised from the material collected

from Gem Lake. Secondly, like the Garvie Mountains to the west, the Umbrella Mountains have many species not found in 'nuclear' Central Otago. These, as the lists below show, fall into many categories; species reaching their eastern most limits, their western most limits or species found across northern Southland to eastern Otago from western alpine areas where they are more typical.

Table of Numbers of Alpine Species Recorded From Adjacent Mountains

| Alpine Area   | Total<br>No. | Endemic | Geometridae | Pyrallidae | Tortricidae |
|---------------|--------------|---------|-------------|------------|-------------|
| Umbrella Mts  | 92           | 1       | 21          | 29         | 7           |
| Old Man Ra.   | 74           | 2       | 18          | 28         | 7           |
| Garvie Mts    | 95           | 0       | 35          | 22         | 10          |
| Rough Ridge   | 54           | 0       | 13          | 20         | 9           |
| Blue Mts      | 90           | 2       | 21          | 21         | 8           |
| Lammermoor Ra | 169          | 0       | 41          | 52         | 15          |
| Rock & Pillar | 162          | 2       | 41          | 47         | 15          |

Vagrant species to alpine areas have been excluded.

Alpine species apparently absent from Umbrella Mountains, but abundant on Old Man Range:

*Tawhitia glaucophanes*  
*Arctesthes siris* and *A. catapyrrha*  
*Asaphodes* nsp. (high alpine bog species)  
*Asaphodes declarata*  
*Aoraia senex*  
*Hierodoris* nsp. (black and white sp.)  
*Oxythecta austrina*  
*Delogenes limodoxa*  
*Orocrambus cultus*  
*Orocrambus harpophorous*  
*Orocrambus dicrenellus*  
*Scoparia* nsp. (high alpine bog species)  
*Gelophaula palliata*  
*Epichorista tenebrosa*  
*Aletia panda* and *Orophylla unicolor*

Plus two species of autumn emerging Tortricidae and a species of Gelechiidae that is brachypterous in both sexes, all of new genera.

Of these, the following are not found on the Lammermoor-Rock and Pillar Ranges:

*Aoraia senex*  
*Asaphodes declarata*  
*Asaphodes* nsp.  
*Orocrambus cultus*  
*Scoparia* nsp.  
*Gelophaula palliata*

Plus the species of Gelechiidae and one of the Tortricidae species.

A list of species found in east Otago reaching their apparent western limit on the Umbrella Mountains for Otago:

*Scythris nigra*  
*Argyrophenga janitae*  
*Pyrgotis consentiens* (appears in eastern Fiordland)  
*Scoparia quaestoria* (appears in southern Fiordland)  
*Scoparia autochroa* reaches its limit on southern Old Man Range.

A list of western Otago species reaching their eastern limit in Otago on the Whitecoomb Range:

*Ichneutica dione*  
*Gelophaula aridella*  
*Tauroscopa trapezitis*

A list of species providing a connecting link between western alpine areas and eastern Otago areas, but absent from much of Central Otago. (Species found mainly across northern Southland including Umbrellas.)

*Asterivora barbigera*  
*Pasiphila halianthes*  
*Asaphodes cinnabari*  
*Dasyuris leucobathra*

A list of alpine species that were found on Umbrella Mountains but are absent from Rock and Pillar-Lammermoor Ranges:

*Meterana meyricki* (occurs coastally in Catlins)  
*Pasiphila halianthes*  
*Dasyuris hectori*  
*Plutella* nsp.  
*Tauroscopa gorgopis*  
*Tauroscopa trapezitis*  
*Asterivora barbigera*  
*Ichneutica dione*  
*Gelophaula aridella*

The alpine moth fauna is significantly richer and different from the adjacent Old Man Range, in fact 38% of the Umbrella Mountains fauna is not so far known from the Old Man Range despite the latter range being by far the most visited by entomologists. In summary then the alpine fauna of the Umbrella District particularly the Umbrella Mountains shows strongest links to areas to the west and east, while the southern end of the Old Man Range shows affinities to both the Umbrellas and northern parts of the Old Man Range. As the species check-list and numerous lists show, many rarely collected and interesting finds were made in the District.

Key sites in the district for invertebrates are:

1. Low altitude hill-sides of *Hymenanthera*, i.e. near Millers Flat.
2. *Olearia* woodland in gullies of the Pomahaka and its tributaries.
3. Damp shrubland at about 1100 m on southern slopes of Mt Benger.
4. The broad flat wetlands on alpine areas of Mt Benger, southern Old Man Range and Umbrella Mountains. Cushion vegetation and the adjacent damp grasslands included.
5. Shrubland and herb-field on Awatere Station.
6. Beech forested areas of Leithen Bush and Waikaia Bush and other such areas of reasonable size.
7. The entire Gem Lake area from cirque to surrounding ridges and tors through to the bogs and shrubland below the lake.
8. Bog pine areas on the White Umbrella ridge.
9. Tors on Mt Benger and Mt Whitecoomb.
10. *Hebe* dominated shrubland and herb-field at about 1250 m on the northern end of the Umbrella Mountains.
11. Grassland and herb-field on the Black Umbrella Range, i.e. Crown Rock.

4.3.4. Cicadidae and Acrididae on the Umbrella Ecological District  
B. H. Patrick, 38 St Albans St, Dunedin.

CICADIDAE

*Kikihia angusta* (Walker) PH Common grassland cicada of the South Island.

*Kikihia* sp. PH AS MC a recognised but as yet undescribed green species of southern shrublands.

ACRIDIDAE

*Sigaüs obelisci* Bigelow GL 1300 to 1430 m. A fine species that is confined to this and adjacent mountains. Found on cushion vegetation and bare rocky areas.

*Sigaüs campestris* (Hutton) MB SR PH GL and WB above 500 m. This grasshopper species is mainly a low-alpine species. It is distributed through the south-eastern South Island.

*Paprides dugdali* Bigelow MB SR and WB above 500 m. Another attractive low-alpine species that again is found in the south-east.

*Alpinacris tumidicauda* Bigelow MB GL SO 1100 to 1430 m. A colourful Central Otago alpine species that was common here.

#### 4.3.5 Coleoptera from the Umbrella Ecological District B.I.P. Barratt, Invermay Agricultural Research Centre, M.A.F.

##### 4.3.5.1 Collection methods

The beetles collected for this survey of the Umbrella Ecological District of the Waikaia Ecological Region were obtained by:

1. pitfall trapping at Gem Lake from 15 December 1985 to 9 March 1986; 10 traps were set in total with five at the top of the cirque in a rocky substrate with sparse vegetation above Gem Lake and five on a 'shelf' about 20 m below the cirque in dense cushion vegetation. The traps were emptied and reset on 15 January 1986. The preservative used in the traps was a concentrated solution of picric acid with detergent added as a wetting agent.
2. pitfall trapping at Island Block near State Highway 87; five traps were set in a steeply east-facing grazed shrubland/pasture environment near wet seepages. The traps were set on 16 November 1985, emptied and reset on 21 December 1985, 18 January 1986 and uplifted on 19 March 1986. These traps were located at this site primarily to provide material for part of a Lower Clutha Survey carried out by Entomology Division D.S.I.R. for Ministry of Works and Development (M.W.D.).
3. hand-collecting and vegetation beating at each of the sites above when visits were made to service traps as given above.
4. hand-collecting by K.J.M. Dickinson, B.D. Rance and B.H. Patrick when they visited these and other sites within the region.

##### 4.3.5.2 Specimen Holdings

A representative collection of the Coleoptera collected is held in the private collection of B.I.P. Barratt and duplicate specimens in alcohol have been deposited with the New Zealand Arthropod Collection at Entomology Division, D.S.I.R., Auckland along with Diptera, Hemiptera and Hymenoptera sorted from pitfall trap catches. Spiders have been given to the Otago Museum, Dunedin and some groups of myriapods, Orthoptera, Blattellidae and Diptera to Mr P.M. Johns at Canterbury University, Christchurch as appropriate.

##### 4.3.5.3 Discussion of Coleoptera

In general terms the beetle fauna of the Whitecoomb Range (WR), where most of the collecting was carried out, was found to be very diverse and many species were extremely abundant. Hand-collecting at Gem Lake on 14-15 December 1985 and 8-9 March 1986 was most rewarding with 44 species being collected. Pitfall trapping at this site for almost three months added only another 29 species to the list.

As expected, the fauna of the WR shares affinities with the Old Man Range (OMR) to the north, with which it is more or less contiguous; the Garvie Mountains (GM) to the west, from which it is separated by the Waikaia Valley, and the Blue Mountains (BM)

to the east, from which it is separated by the Tapanui plains. Surveys similar to this one have been carried out recently in the higher altitude environments of both of the latter ranges whereas only hand-collecting on the OMR has been undertaken. However, on this basis, it is considered reasonable to make some comparisons between these areas. This has been done where appropriate in the following discussion. The lower altitude Island Block site will be treated separately at the end of the discussion.

The carabid beetle fauna of the WR was dominated in pitfall trap catches by *Megadromus sculpturatum* (gp.) Blanch. Only a single specimen of *Neoferonia* sp. was collected by hand on Mt Whitecoomb although this species was abundant on both BM and GM. On these latter ranges the most commonly occurring *Megadromus* species were *M. sp. nr. sandageri* (Broun) and *M. sandageri* (Broun) respectively. On the OMR *Mecodema lucidum* Cast. is common and this species also occurs on the GM. *Holcaspis* was only represented by two species in the WR material in comparison with four and three on the BM and GM respectively. A megadropine species, which was abundantly collected by hand and in pitfalls on the WR, had only been collected previously by me on the OMR where a single specimen was found. This is not the same species as found on the GM although the GM and OMR share another unnamed species from this group in common.

The zoline *Oofteris pygmeatus* Broun was found to be very common on the WR as it is on the OMR. The other species of *Oofteris* found here has also been collected from the GM. Two specimens of the unconfirmed *?Hygranillus* sp. were found together beneath a rock feeding on a decomposing hepialid larva. This rather interesting group of carabid beetles are tiny, often unpigmented and blind beetles which are normally found in soil. They are thought to feed on soil microfauna.

Of the scarab beetles, *Scythrodus squalidus* Broun, also on the OMR and GM and many other Central Otago ranges, may be near the eastern limit of its distribution here on the WR. However, it was abundant here and many larvae were encountered beneath rocks. Of particular interest was *Prodontria capito* Broun; all of the 17 specimens collected (two by hand and the rest in pitfalls) were mottled with brown markings on the pronotum particularly around the lateral and basal margins, and on the elytra, which were streaked and mottled to varying degrees. The genitalia correspond with *P. capito* Broun. Given (1952) mentions the occurrence of specimens of this species with red-brown markings on the elytra (but not pronotum) but the localities were not given. It is possible that this population is sufficiently isolated to have become genetically distinct.

Seven species of byrrhids were collected including the large distinctive *Peailophorus lewisi* Broun known also from the OMR and GM as well as other Central Otago ranges. Most of the others are probably species of *Epichorius*, a large and poorly known group. Click beetles (Elateridae) were abundant, especially *Ctenicera* sp. 6 which I have also found in abundance on the Lammermoor-Lammerlaw ranges, but not as yet elsewhere.

Only two species of tenebrionids of the genus '*Pheloneis*' were collected on the WR and only a single specimen of each. This was also true for the GM whereas five species were found on the BM. This may reflect a requirement in this group for a more moist environment since the more easterly and certainly the coastal ranges of Otago appear to be well represented by this group.

Chrysomelid beetles were frequent in numbers of species and specimens on the WR. There were five species of *Allocharis* in the Gem Lake area including *A. limbata* Broun for which the type locality is Mt Maungatua. Another similar species was present which has also been found on the GM and Hectors. A larger species, *Allocharis* sp. nr. *robusta* Broun, found on the BM was not found here. A larger black species, collected also on the OMR, was very common in the Gem Lake area. *Adoxia* was another genus well represented and all except sp. 6 have been collected elsewhere.

The Curculionidae (weevils) were found to be of interest on the WR because of the abundance of certain groups. *Liparogetus sulcatissimus* Broun, one of the rhytirrhine species, two of the *Peristoreus* species and one of the species of *Irenimus* were represented by very large numbers in pitfall collections, and found frequently by hand, especially in December. Two of the rhytirrhine species and the three species of *Peristoreus* had not been found during the recent surveys of the GM and BM. Of the larger weevils, it was not unexpected that both *Anagotus lewisi* (Broun) and *A. latirostris* (Broun) were found on the WR since the former is present on the BM and the latter on the GM. *A. latirostris* may also occur on the BM, but the record has not been confirmed. *Lyperobius cupiendus* Broun was collected from *Aciphylla pinnatifida*, a plant which was not common in the Gem Lake area, although *Anisotome* species were abundant and these may constitute an alternative food supply. *Lyperobius hudsoni* Broun was not found despite its occurrence on the OMR and GM.

At the Island Block site there were no beetle species collected (of those which could be fully identified) of particular significance. This is perhaps indicative of the modified state of the vegetation. The area was grazed by sheep throughout the summer and the ground vegetation is composed mainly of exotic pasture species. However, a varied assembly of native shrubs persists there, and had more time been available to sample these, a more varied and interesting coleopteran fauna may have been revealed.

#### 4.3.5.4 Species List for Coleoptera arranged by locality (ID: B.I.P. Barratt)

##### Whitecoomb Range : Gem Lake

##### CARABIDAE

- Neocicindella parryi* (White) (1430 m)
- Migadopine sp. 1 (1420-1430 m)
- Agonum* sp. 2 (1420 m)
- Notagonum feredayi* (Bates) (1300-1400 m)
- ?*Hygranillus* sp. 1 (1420 m) Feeding on dead hepialid larva.
- Holeaspis impiger* Broun (1420 m)
- Holeaspis egregialis* (Broun) (1430 m)

*Mecodema sculpuratum* (gp.) Blanch. (1300-1440 m)  
*Megadromus* sp. nr. *sandageri* (Broun) (1300-1430 m)  
*Ooapterus* sp. 8 (1420 m)  
*Ooapterus pygmeatus* Broun (1420 m)  
*Scopodes cognatus* Broun (1400-1420 m)

## LEIODIDAE

*Zeadolepus* sp. 2 (1430 m)

## SCYDMAENIDAE

?*Neuraphoconnus* sp. 1 (1430 m)

## STAPHYLINIDAE

*Aleocharine* sp. 12 (1430 m)  
*Aleocharine* sp. 13 (1430 m)  
*Tachyporine* sp. 3 (1430 m)

## HYDROPHILIDAE

*Adolepus* sp. nr. *helmsi* Sharp (1430 m)

## SCARABAEIDAE

*Prodontria capito* Broun (1430 m)  
*Scythrodes squalidus* Broun (1300-1420 m)  
*Pyronota festiva* (F.) (1400 m)

## BYRRHIDAE

*Byrrhid* sp. 13 (1300-1420 m)  
*Byrrhid* sp. 14 (1420 m)  
*Byrrhid* sp. 8 (1300-1430 m)  
*Byrrhid* sp. 15 (1400-1430 m)  
*Byrrhid* sp. 2 (1430 m)  
*Epichorius* NZAC sp. 32 (1440 m)  
*Pedilophorus lewisi* Broun (1300-1430 m)

## ELATERIDAE

*Ctenicera* sp. 6 (1300-1400 m)  
*Ctenicera* sp. 8 (1430 m)  
*Elatichrosis castanea* (Broun) (1300-1400 m)

## CORYLOPHIDAE

*Holopsis* sp. 3 (1300-1430 m)

## COCCINELLIDAE

*Coccinellid* sp. 4 (1430 m)  
*Coccinella 11-punctata* L. (1430 m)

## TENEBRIONIDAE

'*Pheloneis*' *dunedinis* (Sharp) (1300 m)

## MELANDRYIDAE

Melandryid sp. 3 (1430 m)

## CHRYSOMELIDAE

*Allocharis limbata* Broun (1300-1430 m)

*Allocharis* sp. nr. *limbata* Broun (1440 m)

*Allocharis* sp. 1 (1420-1430 m)

*Allocharis* sp. 8 (1300-1430 m)

*Allocharis* sp. 12 (1400-1430 m)

*Adoxia* sp. 4 (1300-1430 m)

*Adoxia* sp. 6 (1420 m)

*Chaetocnema* sp. cf. *littoralis* (Broun) (1430 m)

*Chaetocnema* sp. nr. *nitida* (Broun) (1430 m)

## CURCULIONIDAE

*Cryptorhynchine* sp. 12 (1430 m)

*Lyperobius ?cupiendus* Broun (1400 m) on *Aciphylla pinnatifida*

*Bryocatus amplus* Broun (1430 m)

*Bryocatus* sp. 3 (1430 m)

*Bryocatus* sp. 11 (1430 m)

*Bryocatus* sp. 14 (1430 m)

*Bryocatus* sp. 15 (1430 m)

*Eugnomine* sp. 4 (1400 m) on *Cardamine uniflora*

*Pactolotypus* sp. 1 (1350 m) in dead *Aciphylla* stems

*Peristoreus* sp. 11 (1400-1430 m)

*Peristoreus* sp. 10 (1300-1430 m) under mat *Celmisia hectorii*

*Peristoreus* sp. 9 (1300-1430 m) on *Celmisia hectorii* and

*C. semicordata* var. *aurigans*

*Tychine* sp. 12 (1430 m)

*Liparogetus sulcatissimus* Broun (1420-1430 m)

?*Gromilus* sp. 4 (1430 m)

?*Gromilus* sp. 5 (1430 m)

*Rhytirhine* sp. 2 (1420 m)

*Rhytirhine* sp. 3 (1420-1440 m)

*Rhytirhine* sp. 1 (1430 m)

*Listronotus bonariensis* (Kuschel) (1430 m)

*Catoptes robustus* Sharp (1300-1440 m)

*Irenimus* sp. 13 (1300-1440 m) on *Ranunculus gracilipes*

*Irenimus* sp. 16 (1300-1440 m)

*Nicaeana cinerea* Broun (1300-1430 m) on turpentine scrub and

*Phyllachne colensoi*

*Zenagraphus metallescens* Broun (1430 m)

*Sitona discoideus* Gyllenhal (1300 m)

*Hylastes ater* (PY.) (1430 m)

Whitecoomb Range

(3 km SE of Gem Lake)

## CARABIDAE

*Holcaspis egregialis* (Broun) (1230 m)

*Mecodema minax* Britton (1230 m)

## ELATERIDAE

*Ctenicera* sp. 6 (1230 m) Beaten from *Hebe* sp.

## CURCULIONIDAE

*Irenimus* sp. 20 (1230 m) Beaten from *Hebe* sp.

Whitecoomb Range : Mt Whitecoomb

## CARABIDAE

*Notagonum feredayi* (Bates) (1400 m)

*Mecodema minax* Britton (1450 m)

*Neoferonia* sp. (1450 m)

## ELATERIDAE

*Ctenicera* sp. 6 (1400 m)

## SCARABAEIDAE

*Prodontria capito* Broun (1450 m)

## TENEBRIONIDAE

'*Pheloneis*' *nigritulus* (Broun) (1450 m)

## CURCULIONIDAE

*Lyperobius cupiendus* Broun (1300 m)

*Rhytirhinine* sp. 2 (1450 m)

*Catoptes robustus* Sharp (1450 m) Beneath *Pimelea* mat.

*Irenimus* sp. 13 (1450 m) on *Chionohebe densifolia* (3)

*Irenimus* sp. 21 (1400 m)

*Anagotus lewisi* (gp.) (Broun) (1400 m)

*Anagotus latirostris* (Broun) (1450 m)

Parasol Hill

## CARABIDAE

*Oregus aereus* White (970 m)

*Mecodema sculpturatum* (gp.) Blanch. (970 m)

## CHRYSOMELIDAE

*Adoxia* sp. 3 (970 m)

Waikaia Bush

## CARABIDAE

*Megadromus* sp. nr. *sandageri* (Broun) (300 m)

## ELATERIDAE

*Metablax acutipennis* (White) (650 m)

?*Silene* sp. 1 (650 m)

Pomahaka River

## ELATERIDAE

*Elatichrosis castanea* (Broun) (850 m)

## CURCULIONIDAE

*Catoptes brevicornis* (Broun) (850 m)Stronach Range

## CHRYSOMELIDAE

*Adoxia* sp. 1 (900 m)Black Umbrella Range : Crown Rock

## ELATERIDAE

*Ctenicera* sp. 6 (1200 m)

## CHRYSOMELIDAE

*Allocharis* sp. nr. *limbata* Broun (1200 m)Leithen Bush

## OEDEMERIDAE

*Selenopalpus* sp. (600 m)Lower Clutha : Island Block

## CARABIDAE

*Notagonum feredayi* (Bates) (100 m)

## STAPHYLINIDAE

Aleocharine sp. 8 (100 m)

Aleocharine sp. 9 (100 m)

Aleocharine sp. 10 (100 m)

Staphylinine sp. 2 (100 m)

## PSELAPHIDAE

*Sagola ?duplicata* Broun (100 m)

## HYDROPHILIDAE

Hydrophilid sp. 3 (100 m)

## SCARABAEIDAE

*Pyronota festiva* (F.) (100 m)*Odontria striata* White (100 m)

## ELATERIDAE

*Conoderus* sp. 1 (100 m)

## MELYRIDAE

*Acantharthrus* sp. nr. *planifrons* (Broun) (100 m) Beaten from  
*Olearia lineata* and *Coprosma* sp.

## LATHRIDIIDAE

*Melanopthalma* sp. cf. *zealandica* Belou (100 m) Beaten from  
*Olearia lineata* and *Coprosma* sp.

Lathridiid sp. 2 (100 m) Beaten from *Coprosma* sp.

## COCCINELLIDAE

*Scymus* (= *Veronicobius*) sp. 3 (100 m) Beaten from *Coprosma* sp.  
*Coccinella leonina* F. (100 m)

## TENEBRIONIDAE

*Mimopeus opaculus* (Bates) (100 m)

## COLYDIIDAE

?*Corellus* sp. 2 (100 m)

## CHRYSOMELIDAE

*Chaetocnema* sp. 2 (100 m)

## Reference

Given, B.B. (1952) Part I. The Adult Beetles. In: *Revision of the Melolonthinae of New Zealand* Entomology Division, D.S.I.R., Bulletin 102, 172 pp.

#### 4.3.6 Arthropods of the Umbrella Ecological District (identified by Mr P.M. Johns)

##### DIPLOPODA (millipedes)

###### DALODESMIDAE

*Erythrodemus* nsp. 1420 m Gem Lake. This is currently a monotypic genus. This is the first example of another species within the genus. The other species is in high rainfall forests of Westland.

*Blysmopeltis* nsp. 1420 m. Gem Lake.

*Icosidesmus* sp. 1420 m. Gem Lake.

*Eumastigonus* sp. 1420 m. Gem Lake.

*Prociliosoma leiosomum* (Hutton) 1420 m. Gem Lake. Pill millipede.

##### CHILOPODA (centipedes)

###### CRATEROSTIGMIDAE

*Craterostigmus* nsp. 1420 m. Gem Lake.

###### HENICOPIDAE

*Lamyctes emarginatus* 1420 m. Gem Lake.

##### BLATTODEA (cockroaches)

###### BLATTIDAE

*Celatoblatta quinquemaculata* 1300-1440 m. Gem Lake.

*Celatoblatta* sp. 1400 m. Gem Lake. A black species first discovered on the Blue Mountains and found on the Garvie Mountains.

##### ORTHOPTERA

###### STENOPELMATIDAE (wetas)

*Hemiandrus focalis* (Hutton) 1420 m. Gem Lake.

*Hemideina maori* (Pict. and de Sau.) 1080 m. Black Umbrella Range.

###### RHAPHIDOPHORIDAE

genus et. sp. indet. Gem Lake.

##### DIPTERA (true flies)

###### TIPULIDAE (crane flies)

*Gynoplistia* sp. 1 1420 m. Gem Lake. Male winged, female brachypterous.

*Gynoplistia* sp. 2 1420 m. Gem Lake.

?*Metalimnophila* sp. 1420 m. Gem Lake. As for *Gynoplistia* sp. 1.

###### MYCETOPHILIDAE (fungus gnats)

?*Mycetophila* sp. 1420 m. Gem Lake. Second known brachypterous species for New Zealand. The other is in N.W. Nelson high country.

## HYMENOPTERA and ODONATA (ID: Mr A.C. Harris)

A male specimen of *Degithina decepta* was collected from the northern Whitecoomb Range (c. 1400 m) in November.

The large dragonfly, *Uropetala carovei*, was also collected in November, from Parasol Hill (c. 960 m). The species was seen on several occasions in the mid-altitude tussockland communities.

4.3.7. Arachnida (ID: Dr R.R. Forster)

Limited information on the spiders of the District is available. No specimens could be identified to species level and many not to generic level, reflecting the general situation regarding spider taxonomy. The majority of specimens sorted from pitfall trap catches in the Umbrella District were wolf spiders, *Lycosa* spp., and trapdoor spiders, *Cantuarina* spp. *Mamoea alta* was also recorded.

4.3.8. Report on the Aquatic Fauna of the Umbrella Ecological District in the Waikaia Ecological Region  
 Carolyn W. Burns, Department of Zoology, Otago University, Dunedin.

4.3.8.1 Methods

Samples were collected from Gem Lake and approximately 17 ponds within a 2 km radius of Gem Lake on 8-9 March 1986. The planktonic animals were collected by means of a sweep net on a pole, or by hurling a weighted plankton net from the shore. Samples were preserved immediately in 4% formaldehyde; no attempt was made to sample the bottom fauna although some benthic animals were recorded in samples, particularly from very shallow ponds.

In addition, samples collected by K.J.M. Dickinson in boggy ponds near Black Hut, White Umbrella ridge (S152 GR: 894 008) on 26 March 1986 were preserved and examined.

Animals were identified from the following keys: Winterbourn and Gregson (1981), Chapman and Lewis (1976), Edmondson (1959).

Although the samples were not collected quantitatively, some indication of the relative abundances of the various species can be obtained from the following key: (refer to Table 4.2).

|   |   |            |                                                   |
|---|---|------------|---------------------------------------------------|
| R | = | Rare       | ≤2 in whole sample                                |
| O | = | Occasional | >2 in whole sample, and<br>≤5 in a 5 ml subsample |
| C | = | Common     | 6-10 in a 5 ml subsample                          |
| F | = | Frequent   | 11-20 in a 5 ml subsample                         |
| A | = | Abundant   | >20 in a 5 ml subsample                           |

The locations of ponds which were sampled, including Gem Lake, are shown in Fig. 4.3.

4.3.8.2. Results and Discussion

No snails (Mollusca) or ostracods (Crustacea), both of which commonly occur in ponds, were collected. Their absence may be due to the method of sampling which favoured planktonic organisms (snails are benthic and ostracods are semi-benthic), to the time of year, or to the limited sampling. However, it is surprising that not one individual of these normally well-represented groups was found. Further sampling in mid-summer is needed to resolve their presence or absence. The pH of the Waikaia bog pond water was 4.5. It is possible that low pH could contribute to an absence of shelled molluscs, but it is unlikely to explain the absence of ostracods, some of which are characteristically found in sphagnum and peat bogs.

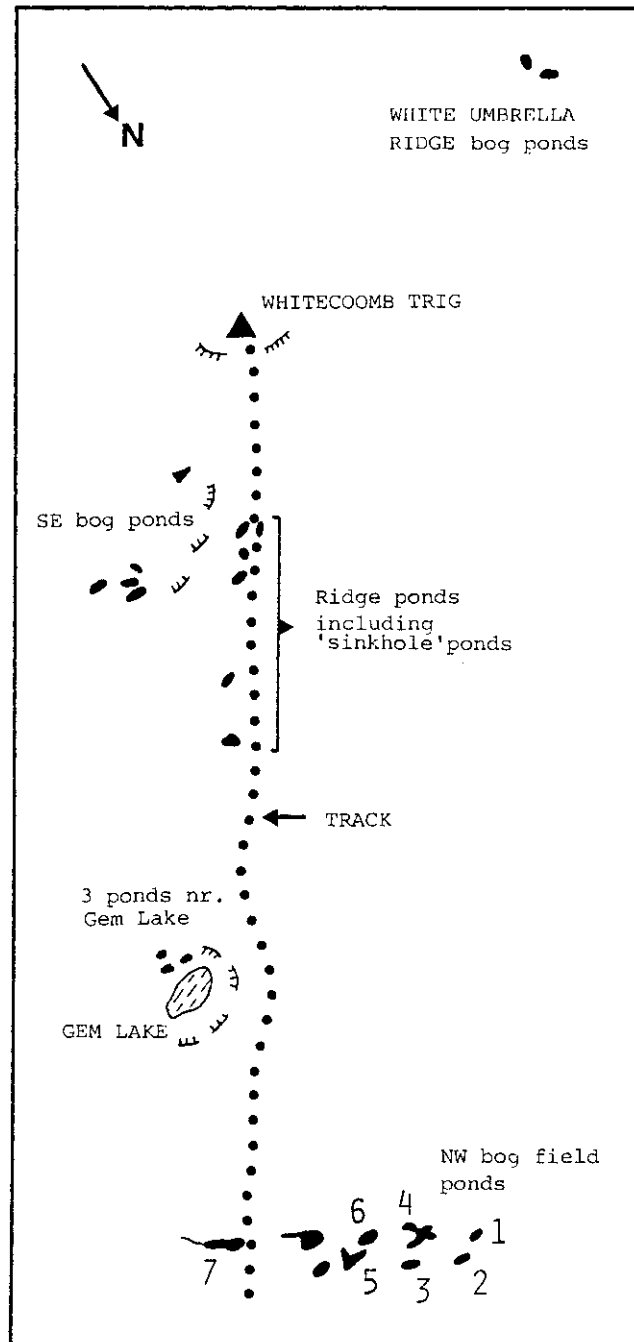
TABLE 4.2: Umbrella Mountains aquatic fauna (see text).

| SPECIES                                               | Gem<br>Lake<br>8/3/86 | Six NW<br>bog field<br>ponds<br>8/3/86 | Six<br>ridge<br>ponds<br>9/3/86 | Three<br>other ponds<br>nr. Gem L.<br>8/3/86 | Two White<br>Umbrella<br>ridge ponds<br>26/3/86 | Two SE<br>bog<br>ponds<br>9/3/86 |
|-------------------------------------------------------|-----------------------|----------------------------------------|---------------------------------|----------------------------------------------|-------------------------------------------------|----------------------------------|
| ROTIFERA                                              |                       |                                        |                                 |                                              |                                                 |                                  |
| <u>Asplanchna</u> sp.                                 | O                     |                                        |                                 |                                              |                                                 |                                  |
| <u>Brachionus</u> sp.                                 | F                     |                                        |                                 |                                              |                                                 |                                  |
| <u>Trichocerca</u> sp.                                | R                     |                                        |                                 |                                              |                                                 |                                  |
| <u>Keratella</u> sp.                                  |                       | O,O,F,O,F                              | R                               | O                                            | C,O                                             | R                                |
| <u>Polyarthra</u> sp.                                 |                       |                                        | O                               |                                              | O                                               |                                  |
| CRUSTACEA                                             |                       |                                        |                                 |                                              |                                                 |                                  |
| <u>Alona?guttata</u> Sars                             |                       | O                                      | A,A,O                           | R,R                                          |                                                 |                                  |
| <u>Alona</u> spp.                                     |                       |                                        | O,O                             | R                                            | A<br>O,O,O<br>sd (A)(B)(C)                      |                                  |
| <u>Ceriodaphnia dubia</u><br>Richard                  | O                     | A,C,F,A,O                              | R                               |                                              |                                                 | O                                |
| <u>Chydorus sphaericus</u><br>(O.F. Müller)           | C                     | F,F,C,O,<br>F,R                        | A                               | O                                            | O                                               | O                                |
| <u>Daphnia (Ctenodaphnia)</u><br><u>carinata</u> King | O                     |                                        |                                 |                                              |                                                 |                                  |
| <u>Echinisca schauinslandi</u><br>(Sars)              |                       |                                        |                                 |                                              | O,O                                             |                                  |
| <u>Boeckella dilatata</u><br>Sars                     | A                     | F,A,A,<br>C,F,A                        | A,A,C,<br>A,A                   | A,O                                          |                                                 | A                                |
| <u>Microcyclops</u><br><u>monacanthus</u> (Kiefer)    |                       | O                                      | O                               |                                              |                                                 |                                  |
| Cyclopoid                                             |                       | O,O,O                                  | C                               |                                              | R                                               | R                                |
| Harpacticoid                                          | R                     | R                                      | O                               |                                              |                                                 |                                  |
| ARACHNIDA                                             |                       |                                        |                                 |                                              |                                                 |                                  |
| <u>Piona</u> sp.                                      |                       | R,R,R,R,R                              |                                 |                                              | R,O                                             |                                  |
| INSECTA                                               |                       |                                        |                                 |                                              |                                                 |                                  |
| <u>Anisops</u> sp.                                    |                       |                                        |                                 |                                              | R,C                                             |                                  |
| <u>Sigara</u> sp.                                     |                       | R,O                                    |                                 |                                              | O,R                                             |                                  |
| chironomidae larvae                                   | O                     | O,R,R,<br>R,O,O                        | R,R,R                           | R                                            | O,O                                             | R                                |
| <u>Microvelia macgregori</u><br>(Kirkaldy)            |                       |                                        | R                               |                                              |                                                 |                                  |
| Plecoptera larvae                                     |                       | R                                      |                                 |                                              |                                                 |                                  |
| <u>Austrolestes colensonis</u><br>(White)             |                       |                                        |                                 |                                              | R,O                                             |                                  |
| <u>Rhantus pulverosus</u><br>(Stevens)                |                       | R                                      |                                 |                                              | R                                               |                                  |
| Helodidae larvae                                      |                       | O                                      |                                 |                                              |                                                 |                                  |
| Ephemeroptera                                         |                       |                                        |                                 |                                              | R                                               |                                  |
| ANNELIDA                                              |                       |                                        |                                 |                                              |                                                 |                                  |
| <u>Oligochaeta A</u>                                  | O                     |                                        | C                               | R                                            |                                                 |                                  |
| <u>Oligochaeta B</u>                                  | R                     | R                                      |                                 |                                              |                                                 |                                  |
| NEMATODA                                              |                       |                                        |                                 |                                              |                                                 |                                  |
| Nematoda                                              | R                     | R,R,R<br>O,R                           | O,O,R                           | O,R,R                                        | R<br>weedy                                      | R                                |
| No. spp.                                              | 12                    | 16                                     | 14                              | 8                                            | 16                                              | 7                                |

New Zealand's freshwater invertebrate fauna is noted for its low diversity of species. This factor, coupled with the limitations of the sampling programme, contribute to the low total numbers of species recorded (Table 4.2.). Several features are noteworthy, however:

1. *Daphnia carinata*, the largest planktonic cladoceran in New Zealand, was found only in Gem Lake.
2. *Echinisca schauinslandi* is an endemic species of a cosmopolitan genus of small macrothricids which inhabit marshy pools and the margins of lakes. While formerly recorded only from a few ponds in Central Otago and near Sutton, Otago, it has recently been found in permanent and temporary ponds in glacial moraine near Lakes Tekapo and Ohau (Burns *et al.* 1984).
3. *Microcyclops monacanthus* is one of two endemic cyclopoid copepods in New Zealand. It had been found formerly only in some coastal ponds in Otago and Canterbury, and in inland slightly saline habitats in Otago (Chapman and Lewis 1976) until Burns *et al.* (1984) recorded it in morainic ponds near Lakes Tekapo and Ohau.
4. *Alona* spp. The identification of *Alona* species was difficult largely because none of the specimens collected fitted the descriptions of the only four species that have been described so far from New Zealand. At least five different species were collected, three of them from the bog ponds on the White Umbrella ridge.
5. *Boeckella dilatata* is an endemic calanoid copepod of limited distribution in the southern South Island where it occurs in large and small glacially-formed lakes. Recently, it was found (Jamieson 1985) in a pond on the top of the Blue Mountains, its easternmost distribution. Several features are noteworthy about the *B. dilatata* populations in the Whitecoomb Range ponds:
  - a. Giantism. Compared with the same species elsewhere, the Whitecoomb Range specimens are enormous, averaging 1.3-1.5 times the length of specimens of the same species in Lake Hayes.
  - b. Clutch size and resting eggs. The average size of a clutch carried by mature females generally, ranges from about 4.2 (L. Hayes) to 6.5 (L. Aviemore). The average clutch for the Whitecoomb Range females was 14.8. Furthermore, the eggs were not subitaneous (hatch immediately) but resting eggs which would allow the population to overwinter even when the ponds dried up or were iced over. This is the first record of resting eggs being produced by *B. dilatata* despite its having been the subject of intensive study and collection (e.g. Jamieson 1985).
  - c. Colour. Generally *B. dilatata* adults are bluish or lack colour. The individuals in the Whitecoomb Range ponds were a bright scarlet to deep red in colour. Intense pigmentation is common in the large Australasian species, *B. triarticulata*, but has been reported only once before in *B. dilatata* in some Fiordland lakes (Stout 1975). Several hypotheses to account for the presence and adaptive advantages of pigmentation in Northern Hemisphere species have been the subject of experimentation and debate.

Fig.4.3: Schematic representation of sampling site location on the Whitecoomb Range, Umbrella Mountains and on White Umbrella ridge. (NOT TO SCALE)



#### 4.3.8.3. Conclusion

The Whitecoomb Range wetland habitats, in particular Gem Lake and the North West Bog Field ponds (Fig. 4.3), are relatively undisturbed and unmodified examples of subalpine southern South Island fresh water faunal associations. The remarkable *B. dilatata* populations have already provided valuable scientific information relevant to the biogeography and ecology of New Zealand's endemic crustaceans. Protection of "type habitats" of these giant copepods is of scientific importance.

The presence of *Daphnia* in Gem Lake implies that this lake has not been stocked with introduced fish. Very few lakes, all of them small, now remain in New Zealand in an unmodified state. The widespread introduction of exotic fish into virtually all of New Zealand's lakes has meant that fresh water biologists have no baseline against which to measure the effects of introduced fish on our native invertebrates. Every effort must be taken to prevent the introduction of fish to Gem Lake; its values as a scientific baseline far outweigh any potential recreational benefits that might be advanced for stocking the lake as a recreational fishery.

I thank Jennifer Oats for sorting through most of the samples; all identifications were made, or checked, by me.

#### 4.3.8.4 References

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- Jamieson, C.D. (1985) *On the distribution of three Boeckella species*. Ph.D. thesis, Otago University. 244 pp.
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## CHAPTER 5

## RECOMMENDED AREAS FOR PROTECTION

In the following descriptions each recommended area for protection is considered separately and in order of decreasing area with Priority One natural areas preceding those ranked as Priority Two. The District's two existing protected natural areas are briefly described in the first instance.

Format of description is standardised as follows: the assigned recommended area for protection number (Priority One are 1 to 14; Priority Two are 15 to 20); followed by the title given to the area identified.

The relevant map of the NZMS1 series plus the grid reference corresponding to the centre of the recommended area for protection is given. In addition, the aerial photograph covering the recommendation is referenced.

For example:

|        |               |              |
|--------|---------------|--------------|
| UMB 11 | Devil's Gorge | S161 976 872 |
|        |               | SN 5693 E/18 |

Descriptions of vegetation and flora, landform and fauna are followed by a general discussion evaluating the natural values of each recommended area for protection. Finally, the area, altitude range, aspect, plot card numbers, relevant references, and land tenure are briefly summarised.

The descriptions are each accompanied by a map outlining the recommended area whereas their general locations are shown in the frontispiece (page iii).

### 5.1. EXISTING PROTECTED AREAS

There are currently two protected natural areas in the Umbrella Ecological District, one a scenic reserve, the other a conservation covenant under the Reserves Act, 1977. Neither features in the account of scenic and allied reserves of the Otago Land District (Allen 1978). The Register of Protected Natural Areas in New Zealand (Lands and Survey Dept. 1984) lists the Leithen Bush Scenic Reserve, gazetted in 1978, as covering 1342 ha. This reserve, administered by the Department of Lands and Survey, has since been expanded to include tussockland communities surrounding the forest areas and now covers c. 2400 ha (Mr A. Perrett, pers. comm.). A management plan exists for the original area as gazetted (Lands and Survey Dept. 1983a). A D.S.I.R. report incorporated into the management plan recommends extension of the reserve along the eastern and western ridges to encompass the headwaters of the Leithen Burn. This recommendation is further endorsed by the present survey (see UMB 04). The Reserve occupies a small deeply incised catchment trending north to south. Steep colluvial slopes border the Leithen Burn above which a series of ridges and spurs lead to the Black Umbrella Range.

The forest and non-forest communities within the enlarged scenic reserve were documented during the current survey. This information provided important data for comparison with other sites surveyed within the District (refer plot cards 288 to 308). The majority of forest sites recorded (17 out of 19) were included in Group 2 of the cluster classification (mixed beech forest). The remaining two sites were included in Group 3 (rich beech forest). Canopy associations of red beech, red and silver beech, plus red and mountain beech were recorded. Hall's totara was recorded but not as a canopy species, although the Leithen Bush management plan records red beech as being co-dominant on shallow stony soils or spurs with Hall's totara and broadleaf. Broadleaf was not recorded in the 0.3-2m tier in the present survey. Understorey species are richest and most abundant in flushes and in gullies.

The Leithen Bush Scenic Reserve has also been recorded as a faunal habitat of outstanding value in the Wildlife Service National Habitat Register as a result of the presence of yellowheads, yellow-crowned parakeets, New Zealand robins and long-tailed bats (Lands and Survey Dept. 1983a). Invertebrates were not mentioned in the management plan. However, several species were recorded during the course of the present study (see Sect. 4.3).

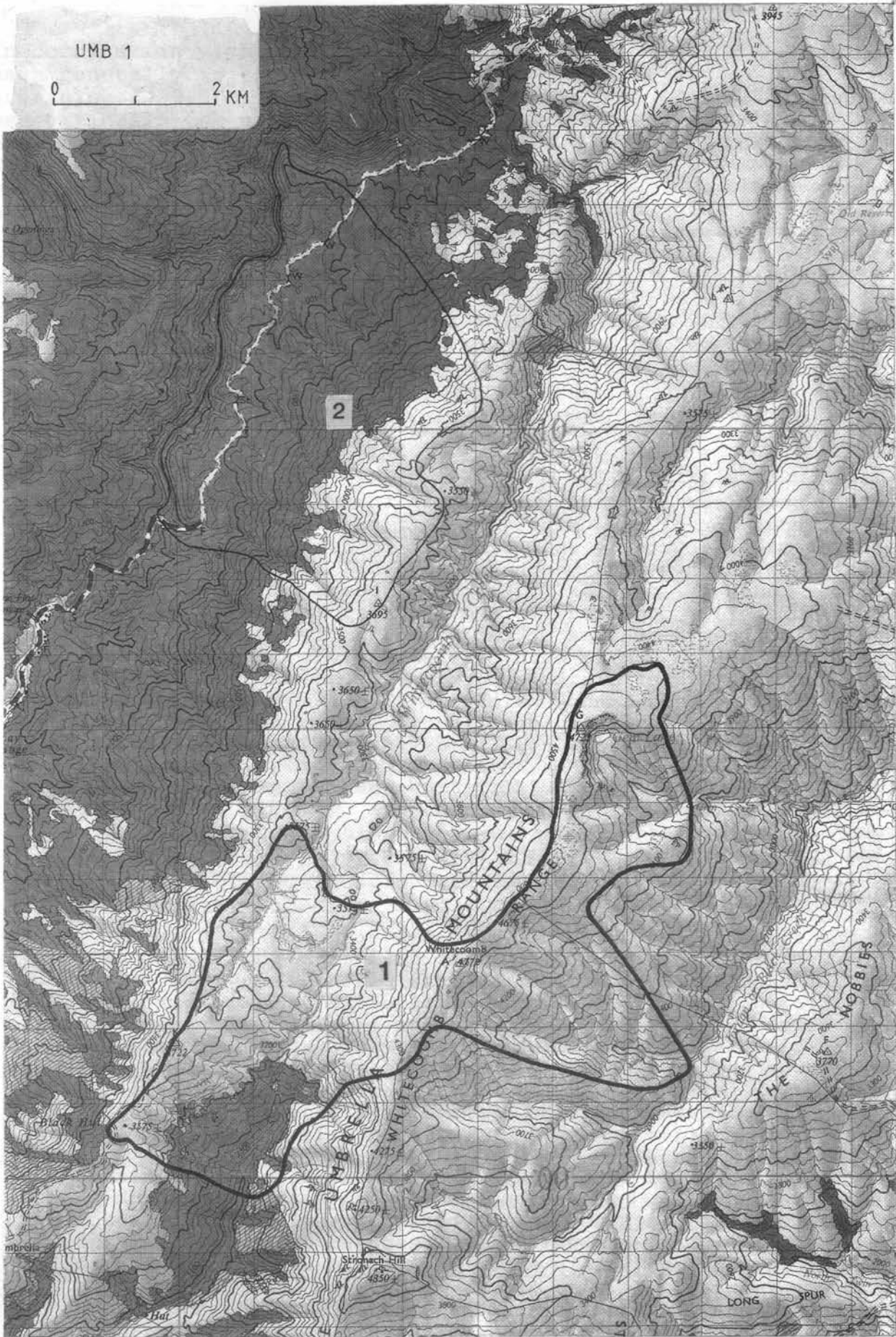
The second existing protected natural area, Timber Creek Conservation covenant, covers an area of 8.9 ha. The covenant applies only to the southern portion of an isolated beech stand in the upper reaches of Timber Creek, a tributary of the Pomahaka River. The stand is of mixed age silver beech, predominantly located on the western banks of the creek. The canopy attains some 14-15 m in height with beech regeneration being particularly vigorous in canopy gaps. The understorey tiers are fairly sparse, particularly away from creeks. Inaka (*Dracophyllum longifolium*) occupies forest margins in the heads of small gullies and in cold-air-drainage paths within the forest. The D.S.I.R. report submitted on the covenanted forest area (Lee 1982) indicated that the small size of the area negated the practicability of fencing it to exclude stock. Fencing was only deemed an option if the whole forest remnant was protected and reserve boundaries delineated by the catchment boundary. Reservation of the whole forest remnant plus an extension to include the Timber Creek headwaters is proposed here as UMB 05 (refer plot cards 034 to 044).

## 5.2. DESCRIPTIONS OF RECOMMENDED AREAS FOR PROTECTION

UMB 01

Whitecoomb-Gem Lake -  
Argyle BurnS152 937 029  
SN 5380 C/26  
SN 5693 D/1

|                                  |                                                                                                                      |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Rich beech forest                | ) on colluvial slopes                                                                                                |
| Silver beech forest              | ) on gorge channel margins                                                                                           |
| Shrub-tussockland                | on colluvial crest<br>on colluvial gully slope                                                                       |
| Modified shrub-tussockland       | on colluvial gully slope<br>(forest margins)                                                                         |
| Tussock-shrubland                | on colluvial slope (S. aspect)<br>on gully slope<br>on ridge                                                         |
| Tussockland                      | on cirque lip<br>on cirque wall<br>on ridge<br>on colluvial slope<br>on interfluvium<br>on gully slopes (N. aspects) |
| Modified-tussockland             | on cirque wall                                                                                                       |
| Grassland (modified-tussockland) | on moraine (terminal)                                                                                                |
| Shrubland                        | on rippled colluvial slopes<br>(S. aspects)                                                                          |
| Herb-tussockland                 | on colluvial slope<br>on slumped colluvial slope                                                                     |
| Tussock-herbfield                | on slumped colluvial slope<br>on ridge                                                                               |
| Grass-herbfield                  | on colluvial crest<br>on derivative slope                                                                            |
| Sedge-herbfield                  | on ridge crest                                                                                                       |
| Cushionfield                     | on raised area within flush<br>on ridge<br>on valley floor                                                           |
| Snowbank                         | in nivation hollow<br>on cirque wall                                                                                 |
| Cushion-mossfield                | on valley floor                                                                                                      |
| Lichen-shrub-cushionfield )      |                                                                                                                      |
| Shrub-cushionfield )             | on valley floor                                                                                                      |
| Moss-shrubland )                 |                                                                                                                      |
| Moss-cushionfield                | in flush (valley floor)                                                                                              |
| Sedge-mossfield                  | on creek margins in flush                                                                                            |



|                   |                            |
|-------------------|----------------------------|
| Herbfield         | Gem Lake outlet            |
| Herb-cushionfield | in flush                   |
| Shrub-sedgeland   | in flush                   |
| Shrub-mossfield   | in flush                   |
| Cushion-mossfield | on valley floor            |
| Herb-mossfield    | in flush                   |
| Rock bluffs       | on cirque wall             |
| Rock bluffs       | on ridge<br>as summit tors |

### Vegetation and flora

The beech remnant contained within the valley of the Argyle Burn includes forest communities classified into Group 3 (rich beech forest) and Group 4 (silver beech forest). The stand is dominated in parts by red beech (*Nothofagus fusca*) and in others by silver beech (*N. menziesii*): mountain beech (*N. solandri* var. *cliffortioides*) is occasional. Red beech appears to be most abundant in the mid-reaches of the stand, particularly on the western bank of the Argyle Burn, whereas silver beech dominates in the northern higher altitude portions. The red beech dominated forest has an average canopy height of 22 m with an open understorey, individual species generally contributing <1% cover. These include the small trees broadleaf (*Griselinia littoralis*), marbleleaf (*Carpodetus serratus*) and *Pseudopanax simplex*, the shrubs *Coprosma colensoi*, *C. cuneata*, *C. parviflora*, *C. pseudocuneata*, *C. rhamnoides*, the climber, bush lawyer (*Rubus cissoides*), plus the herbs *Lagenifera strangulata*, *Epilobium pedunculare*, *Nertera ciliata*, a hooked sedge *Uncinia clavata* and fern *Grammitis billardierei*. In places, the filmy fern *Hymenophyllum multifidum* assumes dominance as ground cover.

The silver beech dominated forest averages 15 to 20 m in height with a canopy cover of 50-75%. Silver beech is also a prominent understorey component together with celery pine (*Phyllocladus aspleniifolius* var. *alpinus*), snow totara (*Podocarpus nivalis*) and *Coprosma cuneata*, all of which achieve 5-25% cover in some areas. Other species include the shrubs *Coprosma ciliata*, *C. colensoi*, *C. propinqua* and *Brachyglottis buechananii*, plus the herbs *Blechnum fluviatile*, *B. minus*, *Grammitis billardierei*, *Forstera tenella* and *Luzuriaga parviflora* plus the orchids *Chiloglottis cornuta* and *Aporostylis bifolia*. Bryophyte cover generally ranges from 1 to 25%.

Sites classified into Groups 8 and 9 (mid- to high-altitude tussock grassland) are described as tussock-shrubland, shrub-tussockland and tussockland on the basis of their dominant species. The tussock-shrubland community is widespread on the margins and colluvial slopes immediately above and to the west of the Argyle Burn beech remnant. It also occurs in the Gem Lake catchment on the slopes of gullies and on southerly aspects. Dominant shrubs are mountain tauhini (*Cassinia vauvilliersii*), *Hebe* aff. *rakaiensis*

in combination with narrow-leaved snow tussock (*Chionochloa rigida*), each generally in the cover categories 5-25%, or 25-50% and averaging c. 0.8 m in height. Dominant species in the tiers 0 to 0.4 m are variously the subshrub *Brachyglottis revolutus*, the herbs and grasses browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*), *Nertera dichondrifolia* and *Ranunculus lappaceus*. Other species present but with <1% cover are turpentine scrub (*Dracophyllum uniflorum*), *Coprosma cheesemanii* and *C. ciliata*, plus the herbs *Epilobium glabellum*, *Rytidosperma nigricans*, *Schizeilema haastii* var. *cyanopetalum*, *Anemone tenuicaulis*, *Festuca multinodis* and *Celmisia semicordata* var. *aurigans*.

The shrub-tussockland community occurs in the Whitecoomb East catchment on shady aspects and on the margins of the Argyle Burn. Narrow-leaved snow tussock dominates (5 to 50%) except where the community has been substantially modified and the tussocks replaced by prickly shield fern (*Polystichum vestitum*), sweet vernal and a bidibid (*Acaena caesiiglauca*).

The prominent shrub is generally *Hebe* aff. *rakaiensis*. The average canopy height in the least modified community is 0.8 m, but is only 0.3 m where the tussock cover has been depleted. Other abundant species include the subshrubs *Brachyglottis revolutus* and snowberry (*Gaultheria depressa*) plus the herbs *Celmisia prorepens* and *C. semicordata* var. *aurigans*. Species of infrequent occurrence include the subshrub *Pimelea pseudolyallii*, and the herbs *Epilobium tasmanicum*, *Hierochloë novae-zeelandiae*, *Rytidosperma gracile*, a sedge *Carex berggrenii* and *Caltha obtusa*. Snow totara and celery pine feature on the margins of the Argyle Burn remnant beech stand.

Tussockland/modified tussockland is the most widespread community within this priority place for protection, occurring in the Gem Lake, Whitecoomb East and West catchments, as well as on White Umbrella ridge, from 900 to 1170 m. In some areas a large proportion of the tussock cover has been replaced by blue tussock (*Poa colensoi*) and/or browntop. However, floristic composition between sites of low and high degrees of modification remain substantially the same. The dominant tussock species in all cases is narrow-leaved snow tussock. Cover ranges from 5-25% in modified tussockland, to 50-75% and in certain localities 75-100% where modification appears low. In the latter cases litter cover is substantial, in places contributing 50% cover. Tussock height varies from 0.4 to 1 m, averaging c. 0.6 m overall. Species which dominate the ground tier include the subshrub snowberry and the herbs sweet vernal, browntop, catsear (*Hypochaeris radicata*), *Gunnera monoica* and *Celmisia gracilentia*. Other species include the herbs, *Raoulia subsericea*, *Erythranthera pumila*, *Epilobium chlorifolium*, *Hydrocotyle novae-zeelandiae* var. *montana*, *Helichrysum bellidioides*, *Rytidosperma nigricans*, *Oreostylidium subulatum* and the fern ally *Lycopodium fastigiatum*.

The community represented by Groups 10 and 11 is also widespread, occurring mainly in the eastern and western Whitecoomb catchments and the Gem Lake cirque. The community varies from shrubland through to herbfield when described on the basis of dominant species and occurs on a variety of aspects and topographical situations.

The shrubland and tussock-shrubland communities generally occur on southerly aspects at altitudes varying from 1150 to 1340 m. The dominant shrub species are turpentine scrub (*Dracophyllum uniflorum*) and/or *Hebe* aff. *rakaiensis*, with narrow-leaved snow tussock and

slim snow tussock (*Chionocholea macra*) subdominant. Shrub cover varies from 5-25% to 75-100%, the latter being a generally species-poor community dominated by turpentine scrub. Average height varies from 0.2 to 0.8 m. Dominant species in the ground tier include the subshrub *Brachyglottis revolutus* (mainly 1-5% cover) and the herbs *Celmisia semicordata* var. *aurigans* (5-25%) and blue tussock which may achieve 50-75% cover. Other species occurring with <1% cover include the rare and regionally endemic shrub *Hebe poppelwellii*, the subshrub snowberry and the herbs *Aciphylla hectorii*, *Anisotome brevistylis* plus sedges *Uncinia fuscovaginata*, *Carex berggrenii* and *C. wakatipu*. The adventive component is consistently low.

The shrub-tussockland community within Groups 10 and 11 is particularly widespread in the Whitecoomb East catchment but also occurs in the western catchment and within the Gem Lake catchment. The community occupies a variety of aspects and topographic situations. Dominated variously by narrow-leaved snow tussock, slim snow tussock or their hybrids, the shrubs *Hebe* aff. *rakaiensis* and turpentine scrub are the common subdominant canopy species. In places the regionally endemic and generally rare shrub *Pimelea poppelwellii* also achieves prominence. Tussock cover varies from 5-25% to 50-75% with height averaging c. 0.7 m if the 0.4-2 m tier is reached - a number of sites recorded maximum heights of <0.4 m. Dominant ground tier species included the subshrubs *Brachyglottis revolutus* and snowberry and the herbs blue tussock, *Celmisia prorepens* and *C. semicordata* var. *aurigans*. The subshrubs *Myrsine nummularia* and *Coprosma pumila*, sedge *Carpha alpina*, and comb sedge (*Oreobolus pectinatus*), together with the herbs *Caltha obtusa* and *Astelia nivicola* are locally abundant.

Other species occurring infrequently with <1% cover include the shrub *Hebe* sp. (?*subulata*), the cushion *Dracophyllum muscoides* plus the herbs *Celmisia laricifolia*, *Forstera sedifolia*, *Hierochloa recurvata* and the sedges *Carex kirkii* and *Uncinia nervosa*. Litter cover varies from 1-5% to 50-75% where bryophyte and lichen cover is generally low. Again, adventive presence is minor.

Tussockland classified into Groups 10 and 11 is more restricted than the tussock communities with a prominent shrub element. Generally on northerly aspects or dry, flat areas, altitudes occupied vary from 1070 m to 1450 m. Dominated by narrow-leaved snow tussock or slim tussock, cover ranges from 5-25% to 50-75% and averages 0.3 m to 0.8 m in height. In modified areas blue tussock often replaces the snow tussock species, in places achieving cover of 50-75%. The daisy *Celmisia semicordata* var. *aurigans* is widespread in the ground tier. Other species of more sporadic occurrence and abundance include the subshrub *Brachyglottis revolutus* and snowberry plus the herbs *Schoenus pauciflorus*, *Epilobium glabellum*, sweet vernal, *Blechnum penna-marina* and sedge *Carpha alpina*. Other species which occur infrequently at <1% cover include the herbs *Anisotome brevistylis*, *Plantago lanigera* and sedge *Carex kirkii*.

The herb-tussockland sites are generally found on colluvial slopes of varying aspects ranging in altitude from 1190 m to 1435 m. Dominated by either narrow-leaved snow tussock or slim snow tussock, the widespread subdominant is the conspicuous daisy *Celmisia semicordata* var. *aurigans* or more rarely *C. densiflora* and/or *C. lyallii*. Cover of the dominants range from 5-25% to 50-75% with height averaging 0.3 to 0.8 m. Snow tussock cover has been depleted in places and replaced by blue tussock as the dominant grass. In the ground tier

widespread species include the subshrub *Brachyglottis revoluta* and the rush *Luzula rufa*. Some of the infrequent species are the shrub *Hebe* sp. (?*subulata*), the herbs *Celmisia brevifolia*, *C. laricifolia*, *Abrotanella* aff. *inconspicua*, *Poa incrassata*, *Oreobolus impar*, *Anisotome brevistylis* and *Epilobium glabellum*.

The grass/tussock-herbfield sites are dominated in the canopy variously by the daisies *Celmisia semicordata* var. *aurigans*, *C. densiflora* or *C. prorepens* with subdominants most commonly being the subshrubs *Pernettya alpina*, *Brachyglottis revoluta* and the herbs blue tussock with *Raoulia grandiflora*, sweet vernal or *Pratia angulata* abundant in places. Infrequent species include the whipcord shrub *Hebe poppelwellii*, the subshrub edelweiss (*Leucogenes grandiceps*), the cushions *Dracophyllum muscoides* and *Raoulia hectorii*, and several herbs of special significance in the District - *Abrotanella* aff. *inconspicua*, *Gingidia barterae*, *Celmisia hectorii*, *Cotula pectinata* and *Hectorella caespitosa*. Bryophyte and lichen cover is generally <5% while rock cover averages from 1 to 5%.

A few sites in Groups 10 and 11 have *Marsippospermum gracile* as a prominent subdominant to slim snow tussock which in places is depleted and superseded by blue tussock.

The Groups also include rockfields which were recorded in both Gem Lake and Whitecoomb East cirques (altitude c. 1400 m). On these generally well-vegetated boulderfields *Celmisia hectorii* in places forms extensive sheets contributing 5-25% to 50-75% cover. *Celmisia semicordata* var. *aurigans* and the summer-green fern *Polystichum cystostegia* are present in the categories 5-25% and 1-5%, respectively. Other species, include the herbs slim snow tussock, *Colobanthus strictus*, the sedge *Carex lachenalii* and *Celmisia haastii*, plus restricted occurrences in both cirques of the rare and regionally endemic shrub *Hebe dilatata*. Rock cover is included in the cover categories 25-50% and 50-75%.

Group 12 is described as cushionfield or cushion-tussockland, the latter dominated by slim snow tussock (5-25%). This community occurs on the main ridge above Gem Lake and near to Whitecoomb summit (altitude c. 1440 m). Dominant cushion species are *Dracophyllum muscoides* and *Phyllachne colensoi* (5-25% and 25-50%); others present are *Celmisia sessiliflora* and *Raoulia hectorii*. Species present, but of <1% cover include the rare and regionally endemic shrub *Hebe poppelwellii*, the subshrubs *Celmisia brevifolia* and *Chionohebe densifolia*, plus the herbs *Celmisia laricifolia*, *Cotula goyenii*, *Schizeilema exiguum* and *Myosotis pulvinaris*.

Snowbanks feature in Group 13 and were described at six sites located in the high altitude portions of the cirques of Gem Lake and to the east of Whitecoomb summit. Early snowbanks are dominated by *Marsippospermum gracile* (50-75% cover) which decreases in cover the later the snow persists. *Celmisia haastii* is widespread and generally >5% cover. Other species include the cushions *Raoulia subulata* and *Drapetes* aff. *lyallii*, the regionally endemic subshrub *Parahebe trifida*, plus the herbs *Ranunculus pachyrrhizus*, *Epilobium tasmanicum*, *Carex pyrenaica* var. *cephalotes* and *Anisotome imbricata* var. *prostrata*.

Two sites, described by dominants as cushionfield and cushion-mossfield, are included in Group 14. *Sphagnum cristatum* is prominent at both sites which occur in the western Whitecoomb catchment very close to each other at c. 1040 m. At these species-poor sites the

dominant vascular plants are the trailing subshrub *Dracophyllum prostratum* or comb sedge (*Oreobolus pectinatus*). Other species include the cushion *Phyllachne colensoi* and the herbs *Abrotanella* aff. *inconspicua*, a sundew (*Drosera arcturi*) and *Celmisia alpina*.

Three sites were classified into Group 15 and recorded from the Whitecoomb West catchment as well as the White Umbrella ridge. These are described as shrub-cushionfield, lichen-shrub-cushionfield and moss-shrubland according to the dominant cover. The most important shrub is bog pine (*Halocarpus bidwillii*), in places achieving 75-100% cover and averaging 0.4 to 0.7 m tall. Dominant ground tier species include the cushion *Donatia novae-zelandiae*, trailing shrub *Dracophyllum prostratum* and subshrub *Myrsine nummularia*. Other distinctive species include the sedge *Oreobolus strictus* and *Gaimardia setacea*. Celery pine was recorded at one site only, on the White Umbrella ridge at c. 1090 m. Bryophytes are dominated by *Sphagnum cristatum*, total cover varying from 1-5% to 25-50%.

Group 16 (sedgeland) is represented by sites from the headwaters of Whitecoomb Creek c. 1080 m, the wetlands and flushes above Gem Lake (c. 1370 m) and also near to its outlet (c. 1300 m), plus two flushes in the Whitecoomb East catchment (c. 1300 m). The site description based on dominant species varies from moss-cushionfield to sedge-mossfield. The cushionfield sites are variously dominated by the cushion species *Donatia novae-zelandiae* and comb sedge, and the trailing subshrub *Dracophyllum prostratum*. The cushion *Phyllachne colensoi* is present but generally contributes <1% cover. Other species include the sedges *Rostkovia magellanica*, *Carex lachenalii*, *C. gaudichaudiana*, plus sundew and a rush (*Luzula leptophylla*). Slim snow tussock is present but with <1% cover.

Herbfield included in Group 16 is dominated by *Celmisia alpina*, *Euphrasia dyeri* and *Carex pyrenaica* var. *cephalotes*. Other species of note include *Aciphylla pinnatifida* and *Parahebe trifida*, both near the Gem Lake outflow. Large *Donatia novae-zelandiae* cushions with *Hebe poppelwellii* and *Hebe* sp. (?*subulata*) occur in the near vicinity.

The sedge-mossfields in Group 16 are distinguished by their 50-75% bryophyte cover, in which *Sphagnum cristatum* dominates.

*Sphagnum* also dominates (up to 75-100%) at most sites included in Group 17 and was recorded at high altitudes within the Gem Lake and Whitecoomb catchments. Dominants vary from the shrub *Hebe pauciramosa* (1-5% cover) to the rush *Schoenus pauciflorus* (in places 25-50%), comb sedge (5-25%), and *Gentiana amabilis* (max. 25-50%). Other species include *Aciphylla pinnatifida* (Whitecoomb East and Gem Lake catchments).

Rock bluffs are more extensive in the Gem Lake cirque than in the cirques east of Whitecoomb summit. Consequently, the number of species recorded are greater in the former, c. 40 on the southern bluffs and c. 38 on the northern bluffs compared to c. 18 on the cirque bluffs of Whitecoomb East.

Species of restricted distribution within the District that were recorded here include *Chionohebe thomsonii*, *C. densifolia*, and *Cotula goyenii*. Also present were the shrub *Coprosma serrulata*, the subshrub edelweiss and the herbs *Celmisia laricifolia*, *Hectorella caespitosa* and *Pachycladon novae-zelandiae*.

Species richness of the Whitecoomb summit tors and those bluffs to the west of the main ridge (c. 35) is greater than on bluffs within the cirque and includes the shrubs *Coprosma serrulata* and *Hebe buechananii*.

Rock bluffs at c. 1100 m in both the Gem Lake and Whitecoomb East catchments are refuges for snow totara. Rock bluffs at this altitude in the Whitecoomb East catchment also support edelweiss while most of the other species present are generally widespread in the mid- to high-altitude plant communities.

Lichens recorded from the Gem Lake/Whitecoomb summit areas by Mr P. and Mrs M. Child in March 1986 are presented in Appendix V .

### Landform

Landforms within this recommended area for protection are varied and are reflected in the many different habitats already described.

The Whitecoomb Range forms one of two major fault blocks present within the Umbrella Ecological District (see Chapter 2). The range has undergone uplift possibly combined with some warping and tilting. The altitude attained was great enough to allow minor glaciation in pre-glacial gully heads of which the Gem Lake cirque presents the best example on the range and within the District. A small terminal moraine blocks Gem Lake (see cover ) at c.1300 m while lateral moraines descend eastwards towards Jordan Creek down to c. 1220 m. The cirque's southern spur comprises a colluvial crest while the northern spur is a lateral moraine. Within the cirque itself the initially scoured bedrock has been covered by solifluction debris with deposition of fine material within flushes. Rock bluffs forming the cirque headwall provide examples of ice-worn mammilated buttresses.

Seasonal nivation is still in progress with snow persisting in the most sheltered areas until mid to late December. Boulderfields are common on slopes below the rock bluffs.

Below the terminal moraine bordering Gem Lake slumping and earth flow still occur.

Further south, to the east of Whitecoomb summit, there appear to have been three ice origins with the two northernmost cirques apparently glaciated the most. Rock buttresses are present but are not as extensive as those in the Gem Lake cirque. The northernmost Whitecoomb cirque shows evidence of a major slump at its head. Substantial cracks and depressions imply rotation and subsidence of material. Similar features have been observed on the Garvie Mountains and on the Old Man Range at the head of Gorge Creek (Mr M.W. Stirling, pers. comm.).

The Whitecoomb cirques are generally broad with lateral moraines less well-defined than those near Gem Lake. A bedrock bench bounds the southern side of the northernmost cirque whereas on the northern side lateral moraines have been deposited, probably where the ice was deeper. A small but regular feature at c. 1220 m in the northern portions of the cirque is most likely to be a lateral moraine rather than either a gravity slump or fault scarp (Mr M.W. Stirling, pers. comm.).

Slumping and earth flow processes appear to be active in all the Whitecoomb cirques. The creek flowing from the relatively ill-defined southern cirque has become in places deeply incised resulting in steep rock bluffs. The largely planar or ripply colluvial slopes are interspersed by some large areas of slumping. To the west of the main Whitecoomb Range the slopes are mainly colluvial, both ripply and planar types being present. Reverse scarplets are present but uncommon. The White Umbrella ridge consists of a plateau surface which has faulted off the main Umbrella Range. Whitecoomb Creek follows a major fault line. The Argyle Burn also exploits a fault, at its head forming a deeply incised gorge. However, the Burn does not appear to be incising a fault line to the south of the gorge.

Soils are predominantly upland yellow-brown earths of the Carrick, Carrick hill and Dunstan steep land series. Parent material is schist solifluction detritus, schist and slope deposits and some loess from schist. Texture varies from silt loams to stony loams. Organic soils, derived from sedge and rush vegetation, and texturally consisting of peats and peaty loams (Kaherekoau soils), occur in the headwaters of Whitecoomb Creek.

#### Fauna

The fauna associated with this recommended area for protection were the most intensively studied within the District. Detailed reports relating to aquatic fauna, Lepidoptera, Coleoptera and avifauna are contained in Chapter 4 (Sect. 4.3), but the faunal values are summarised here.

Birds recorded were kea, South Island pied oystercatcher, paradise shelduck, southern black-backed gull, skylark, New Zealand pipit, New Zealand falcon and Australasian harrier. Paradise shelduck and southern black-backed gulls were most commonly associated with Gem Lake while South Island pied oystercatchers were common particularly on wetlands. Kea were noted on two occasions. One was heard calling at c. 1200 m below Gem Lake and a pair was observed on the main Gem Lake ridge at c. 1300 m.

Birds associated with the beech remnant were bellbird, chaffinch, blackbird, yellow-breasted tit, yellow-crowned parakeet, rifleman, grey warbler, New Zealand robin and fantail. Sightings and general bird observations made from the Pomahaka Valley to the Gem Lake area by Mr P. and Mrs M. Child in March 1986 are included in Appendix IV.

Shells of the endemic land snail *Powelliphanta spedenii* subsp. *spedenii* were found on the flush areas formed at the outlet of Gem Lake and within the Argyle Burn beech remnant. In the former location it is possible that the shells could have been transported by southern black-backed gulls as some were severely damaged. The shells found in the beech forest were found at altitudes varying from 780 m to 960 m. Several shell specimens were found, two almost intact with little damage evident.

The Whitecoomb Range wetland habitats are relatively undisturbed and unmodified examples of subalpine southern South Island freshwater faunal associations. No snails or ostracods were recorded from Gem Lake and surrounding ponds. Crustacea collected included *Daphnia carinata* King (only in Gem Lake), the endemic species *Echinisca schauinslandi* (Sars) (only on the White Umbrella ridge: S152 894 008), *Microcyclops monacanthus* (Kiefer) and *Boeckella dilatata*

Sars. The *B. dilatata* populations are apparently unique, displaying unusual features of giantism, large clutch size, resting eggs and red pigmentation.

The beetle fauna of the Whitecoomb Range is very diverse and many species were found to be extremely abundant. Eighty-three species of Coleoptera were recorded from the Whitecoomb Range with the majority (73) being recorded in the Gem Lake cirque. Affinities are shared with the beetle fauna of the Old Man Range, the Garvie Mountains and the Blue Mountains.

The Lepidopteran fauna of the Umbrella Mountains shares many affinities with that of the Garvie Mountains and the Lammermoor Range. Many species recorded are not found in Central Otago. The Umbrella Mountains moth fauna is both richer and different from that of the Old Man Range to the north. Ninety-two alpine species were recorded from the Umbrella Mountains, 49 of which were present within the Gem Lake area. Species recorded include those reaching their easternmost limits, westernmost limits and those found from eastern Otago across northern Southland to western alpine areas where they are more common.

### Discussion

This recommended area for protection is outstanding within the District in terms of vegetation, flora, fauna and landform. The diversity of each is unmatched elsewhere in the District and in general, vegetation modification is low. Below 1200 m adventive species become more abundant but in only small isolated areas do they achieve dominance. Both floral and faunal elements reach their eastern or western limits on the Umbrella Mountains and several species are of very limited distribution. Gem Lake is one of only a very small number of New Zealand lakes known to be in an unmodified state. It is imperative that exotic fish are not introduced as its values as a scientific baseline are extremely high (see Sect. 4.3). Tussockland communities are vigorous within the area identified, in places reaching the highest cover and height recorded anywhere in the District.

Problems are associated with abuse of wetland bogs by vehicles, particularly on the main Whitecoomb ridge and to a lesser extent on the White Umbrella ridge. Extensive cattle pocking was observed in bogs between the ridge above Gem Lake and Whitecoomb summit. Some active erosion is present on the northerly facing slopes to the west of Jordan Creek as a legacy of past management practices. However, erosion on the banks of creeks in the same catchment is likely to be natural rather than management induced.

The recommended area for protection does not include the majority of the western slopes of the Umbrella Mountains above the Argyle Burn beech remnant and to the south of Whitecoomb summit. Vegetation modification of these slopes is high, and erosion is active. The proposal presented here includes the Gem Lake cirque and the catchment down to c. 1100 m, below which vegetation modification and the proportion of adventives increase markedly. In contrast, the Whitecoomb East catchment is included to Jordan Creek at c. 850 m. High natural values are maintained to this altitude within this eastern catchment.

Some of the slopes of the western Whitecoomb catchment have been recently burnt. However, the recovery potential is high with a low representation of adventive species. The latter become more abundant in and around the Argyle Burn but their extent is generally limited.

The area identified includes the wetlands to the north of Gem Lake and follows the 1370 m (4500 ft) contour to include the distinctive North West Bog Ponds (see Sect. 4.3). Wetlands and a buffer zone are included between Gem Lake and Whitecoomb summit.

The northern portion of the Argyle beech remnant is included, particularly for its abundance of celery pine and snow totara, the colonies of *Powelliphanta spedenii* subsp. *spedenii*, and for the stands of red beech. Bog pine and *Donatia novae-zelandiae* cushions are included on the White Umbrella Ridge. The headwaters of the Whitecoomb Creek are distinctive for their extensive *Sphagnum* moss-fields and the large old specimens of *Donatia* on peaty soils.

|                |                                                                    |                  |
|----------------|--------------------------------------------------------------------|------------------|
| Area           | c. 1800 ha                                                         |                  |
| Altitude range | c. 600-1453 m                                                      |                  |
| Aspect         | A great range with catchments trending east, west north and south. |                  |
| Plot cards     | 081 to 086 m                                                       | Groups 3 and 4   |
|                | 087 to 105                                                         | Groups 8 and 9   |
|                | 106 to 138                                                         | Groups 10 and 11 |
|                | 139, 140                                                           | Group 12         |
|                | 141 to 147                                                         | Group 13         |
|                | 148, 149                                                           | Group 14         |
|                | 150 to 152                                                         | Group 15         |
|                | 153 to 162                                                         | Group 16         |
|                | 163 to 166                                                         | Group 17         |
|                | 167 to 171                                                         | Rock bluffs      |
| Tenure         | Pastoral lease                                                     |                  |

|                              |                                                                                        |                                              |
|------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------|
| UMB 02                       | Waikaia Bush                                                                           | S152 918 105<br>SN 5380 B/26<br>SN 5380 C/26 |
| Open red-silver beech forest | on colluvial crest (interfluve)<br>on gully slope                                      |                                              |
| Mixed beech forest           | on gully slope<br>on colluvial crest (interfluve)                                      |                                              |
| Rich beech forest            | on gully slope<br>on derivative slopes below<br>rock bluffs<br>on ridge top<br>in seep |                                              |
| Shrubland                    | on colluvial slope                                                                     |                                              |
| Modified tussockland         | on colluvial slope<br>on slumped colluvial slope                                       |                                              |
| Modified tussock-shrubland   | on colluvial crest                                                                     |                                              |

#### Vegetation and flora

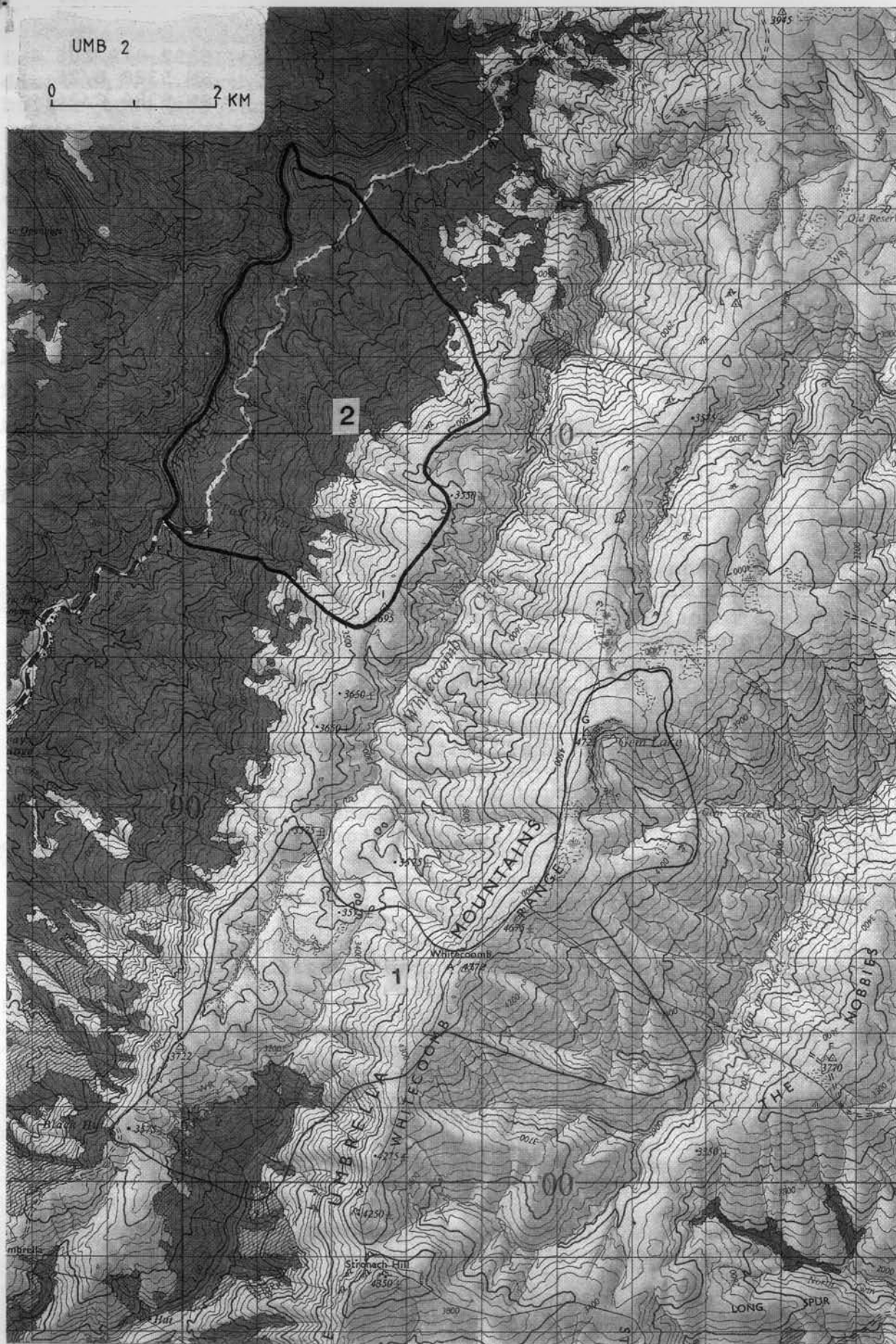
The beech forest contained within Waikaia Bush is classified into three groups (see Chapter 4): Open red-silver beech forest; mixed beech forest; and rich beech forest. The latter two groups also feature within the Leithen Bush Scenic Reserve.

Open red-silver beech forest was sampled at six sites within the recommended area for protection at altitudes of 350 to 465 m. This forest community is characterised by an open understorey and usually occurs on well-drained sites on ridges or on gully slopes. At most sites red beech (*Nothofagus fusca*) and silver beech (*N. menziesii*) codominate with red beech tending to greater overall canopy cover (up to 50-75%). Mountain beech (*N. solandri* var. *cliffortioides*) reaches the canopy at one site only, contributing little to overall cover. At two sites red beech is the canopy dominant with a cover of 75-100%. Height ranges from 20 to 28 m with a mean of c. 25 m. Red and silver beech are the only species occurring in the height tiers 2-5 m and 5-12 m with combined cover generally of 5-25%, rarely 25-50%. In the 0.3 m to 2 m tier the shrub species *Coprosma colensoi*, *C. parviflora*, *C. propinqua* and *C. rhamnoides* are widespread but contribute little to overall cover. Pepper tree (*Pseudowintera colorata*), weeping mapou (*Myrsine divaricata*) and lancewood (*Pseudopanax crassifolius*) feature intermittently. Below 0.3 m plant cover is low, generally including the herbs *Grammitis billardiarei*, a filmy fern (*Hymenophyllum multifidum*), *Nertera dichondrifolia* and the hooked sedges *Uncinia angustifolia* and *U. filiformis*. Litter cover is generally high, while bryophyte cover is variable, ranging from 1-5% to 75-100%.

Group 2 (mixed beech forest) was documented at seven sites of differing slope (the steepest being above the Waikaia River), aspect (100° M to 291° M) and altitude (300 m to 600 m). In many respects the sites are located in forest similar to the open beech forest of Group 1. Red and silver beech codominate with an average

UMB 2

0 2 KM



canopy height of c. 23 m in well-drained positions such as on spurs (interfluvies) between gullies and on gully slopes. Combined beech canopy cover is generally in the category 50-75%, at one site mountain beech contributes 25-50% cover to the canopy.

Hall's totara (*Podocarpus hallii*) was not recorded in the northernmost portions of Waikaia State Forest but appeared frequently in the vicinity of Post Office Creek, in places contributing 5-25% cover. The two main beech species codominated in all tiers above 0.3 m. Other species occurring within these tiers rarely exceeded 2 m in height. The widespread understorey shrub and herb species are the same as for Group 1, in addition to broadleaf (*Griselinia littoralis*) which is present from 5-12 m and below 0.3 m but was not recorded in the intervening height tiers. Marbleleaf (*Carpodetus serratus*) features intermittently at heights of <0.3 m. Additional species include the shrub *Coprosma pseudocuneata*, the fern *Blechnum fluviatile*, climber *Clematis paniculata* and a hooked sedge *Uncinia rupestris*.

Group 3, rich beech forest, was described at eight sites over a wide altitudinal range (270 to 825 m). Sites are often on very steep slopes, in many instances bounded by rock bluffs, or are in seepage areas or gullies. Red and silver beech codominate to c. 750 m, above which silver beech becomes the sole dominant and average height decreases from c. 22 m to c. 16 m. Mountain beech attains canopy codominance only in certain limited areas. Hall's totara features as a canopy species (5-25% cover) on the very steep slopes (c. 41°) immediately above the Waikaia River (c. 270 m). Hall's totara, marbleleaf, broadleaf and lancewood occur as small trees (height 5-12 m) below 750 m altitude with bush lawyer (*Rubus cissoides*) as a climber.

The number of species occurring in the height stratum of 2-5 m increases with decreasing altitude, with this tier being poorly represented above 750 m. At low altitudes (c. 240-350 m) species present at 2-5 m include all the small tree species previously mentioned (except broadleaf) plus weeping mapou and pepper tree. *Coprosma linariifolia* was recorded only once. Species 0.3-2 m in height, additional to those above 2 m, include pokaka (*Elaeocarpus hookerianus*), *Fuchsia excorticata*, *Coprosma pseudocuneata*, *C. rhamnoides* and fool's beech (*Gaultheria antipoda*). A species-rich representative gully site at 800 m supports mountain ribbonwood (*Hoheria glabrata*) plus the shrubs *Coprosma cuneata*, *C. pseudocuneata*, *Olearia arborescens* and the herbs prickly shield fern (*Polystichum vestitum*) and mountain flax (*Phormium cookianum*). In the herb layer (0 to 0.3 m) additional species include a filmy fern (*Hymenophyllum multifidum*), spleenworts (*Asplenium flaccidum* - also epiphytic - and *A. richardii*) and hooked sedges *Uncinia clavata* and *U. filiformis*. At all sites bryophyte cover is <25%, litter and log cover is generally high.

Rock bluffs, especially in the Waikaia River gorge, support several species in greater abundance than can be found in the surrounding forest. Species recorded include the small trees, broadleaf and marbleleaf plus the spleenworts *Asplenium bulbiferum*,

*A. flaccidum* and *A. richardii*, *Blechnum chambersii*, filmy fern *Hymenophyllum multifidum*, *Urtica incisa* and *Schizeilema trifoliolatum*.

Forest margin vegetation (Group 5), as documented at two sites above the bush-line at c. 860 m and c. 890 m, is shrubland and modified tussockland respectively based on the dominant species but the two sites are similar floristically. The lower site includes silver and red beech in the ground tier (<0.3 m). Dominant shrubs are *Coprosma parviflora*, *C. propinqua* with a combined cover of 50-75% at the shrubland site but <1% in the tussockland community where narrow-leaved snow tussock dominates (50-75%). In the ground tier, prominent species are variously blue tussock (*Poa colensoi*), browntop (*Agrostis capillaris*), catsear (*Hypochaeris radicata*) and sweet vernal (*Anthoxanthum odoratum*). Hall's totara covers <1% in the ground tier of the *Coprosma* dominated shrubland. Other plants present include widespread tussockland species such as *Blechnum penna-marina*, *Gunnera monoica*, *Geum leiospermum* and the fern ally *Lycopodium fastigiatum*.

The vegetation on the slopes above the forest margin (to 1070 m) was described at four sites which are all included in Groups 8 and 9 (mid- to high-altitude tussock grassland). On the basis of dominants the vegetation is modified-tussockland or modified tussock-shrubland. Narrow-leaved snow tussock is the canopy dominant or codominant in all instances, varying from 1-5% to 25-50% cover. Height averages 0.5 m with cover greatest on south facing slopes. Tussock bases show evidence of recent burning over much of the catchment. *Hebe* aff. *rakaiensis* codominates at one site while blue tussock, browntop, sweet vernal and the subshrub snowberry (*Gaultheria depressa*) are prominent in the ground tier. The small grass *Erythranthera pumila* is locally abundant, reaching 50-75% in one close-cropped sward. The majority of other ground tier species recorded are widespread though the sedge *Oreobolus impar* was only locally common.

Rock bluffs within the catchment above the bush margins near Post Office Creek are c. 30 m at their highest point and support c. 68 species. The shrubs inaka (*Dracophyllum longifolium*), turpentine scrub, celery pine (*Phyllocladus aspleniifolius* var. *alpinus*), *Brachyglottis buechananii*, *Olearia arborescens* and *O. nummularifolia* were recorded on the bluffs overlooking Post Office Creek (at c. 1050 m) but not in the surrounding tussockland. Other species such as the subshrub *Brachyglottis revoluta* were abundant on and in gullies between the bluffs.

Rock bluffs on the main White Umbrella ridge support c. 52 species. Uncommon species recorded here were the shrub snow totara (*Podocarpus nivalis*) and the fern *Hypolepis ambigua*.

### Landform

The White Umbrella ridge is the result of faulting from the main Whitecoomb Range, the SW-NE fault line being currently occupied by the Whitecoomb Creek before it swings through 90° to follow a SE-NW fault line to the Waikaia River.

The Waikaia River in places has cut a deeply incised gorge flanked by schist bluffs. Colluvial slopes between the gorge and the White Umbrella ridge are moderately incised with many narrow steep-sided gullies. Above the present bush-line rock bluffs outcrop both on spurs and on the main ridge. A large area of slumping is present in the area of the Post Office Creek headwaters.

Soils are predominantly high country yellow-brown earths derived from greywacke and semi-schist. They consist of stony loams and silt loams (Waikaia steepland soils).

### Fauna

Birds observed were yellowhead, New Zealand robin, fantail, rifleman, yellow-crowned parakeet, chaffinch, bellbird, New Zealand pigeon, morepork, blackbird, yellow-breasted tit, grey warbler, silvereye, New Zealand falcon and New Zealand pipit.

Mr P. Child in May 1975 recorded the following bird species and numbers in the vicinity of Piano Flat in forested and farmland habitats. Those numbering between 1 and 10 were: skylark, song thrush, hedgesparrow, housesparrow, starling, chaffinch, black shag, white-faced heron, paradise shelduck, Australasian harrier, yellow-crowned parakeet, rifleman, yellowhead, New Zealand pipit, and New Zealand kingfisher; and between 11 and 100 were blackbird, goldfinch, redpoll, yellowhammer, spur-winged plover, fantail, yellow-breasted tit, New Zealand robin, silvereye, grey warbler and bellbird. In 1979 the same observer recorded from the upper reaches of the Waikaia River above Piano Flat in both forest and non-forest habitats, the additional species greenfinch, South Island pied oystercatcher, southern black-backed gull, long-tailed cuckoo and brown creeper, each numbering between 1 and 10.

Wildlife Service in February 1980 also possibly recorded a single red-crowned parakeet, a once widespread species now rare in the South Island (Falla *et al.* 1978).

The endemic land snail *Powelliphanta spedenii* subsp. *spedenii* was recorded on the rock bluffs at c. 1050 m at the headwaters of Post Office Creek above the bushline. Two live specimens were found, one in the base of a narrow-leaved snow tussock, the other under a bush of turpentine scrub. Three shells were found, in varying states of disrepair.

Long-tailed bats have been reported in the Waikaia Bush area.

Lepidoptera recorded were many and varied, numbering some 69 species in the forest areas and five on the White Umbrella ridge (see Sect. 4.3.3). Intensive light-trapping would be needed to reveal the presence of many species. However, even on the basis of those recorded, the forest is listed as a key invertebrate site (Sect. 4.3.3).

Two species of Carabidae were recorded at 970 m in Waikaia Bush, *Oregus aereus* White and *Mecodema sculpturatum* (G.P.) Blanch, and one of Chrysomelidae, *Adoxia* sp. 3 also at 970 m (see Sect. 4.3.5).

## Discussion

The forest included in the recommended area identified, encompasses a range of species-poor to species-rich sites and represents almost the full range of forest communities differentiated within the District (i.e. Groups 1 to 3).

Ross (1979) described seven beech associations within Waikaia State Forest. Of these, those including mountain beech as a canopy dominant on a small number of sites or codominant with red or silver beech were the least represented in the present survey. Red and silver beech associations however were well represented. Red beech prefers dry, fertile habitats whereas mountain beech generally occupies droughted, shallow soils often on steep sites.

Species richness and abundance increases markedly in gullies and also along the Waikaia River gorge. In the latter, rock bluffs support species considered highly palatable to deer, for example broadleaf and the spleenwort, *Asplenium bulbiferum*. Elsewhere, broadleaf is rarely found above 0.3 m in height or below 5 m.

Deer and possum sign is widespread throughout the forest area, decreasing only on very steep and otherwise inaccessible areas. Ross (1979) concluded that the deer population of the Waikaia State Forest was compatible with forest health. (However, further deer management was recommended by Wildlife Service personnel during a survey contributing to the National Habitat Register in 1980.) Beech regeneration appeared to be largely ignored in preference to small-leaved *Coprosma* spp. as the main source of browse. The possum population is apparently moderate and nowhere appears to be damaging the subcanopy to a significant degree. Both recreational deer and possum shooting are permitted within the State Forest which is managed as an open indigenous forest under an amendment to the Forest Act 1949.

The road which traverses the forest stand harbours a large number of adventive species, many of which do not extend further than c. 5 m from the roadside.

Whilst this recommended area for protection encompasses beech forest representative of northerly and westerly, and therefore drier, aspects the more moist situations experienced to the west of the Waikaia River are not so far represented in a recommended area for protection. It is anticipated that any survey of the Nokomai Ecological District which includes the western portions of the Waikaia Forest, will consider representation of the communities west of the Waikaia River. The case for a continuation of the area identified in this report can then be assessed.

The margins to the Waikaia State Forest are largely artificial, having been modified by a history of burning (Ross 1979). The natural bushline, estimated at c. 1100m, exists in only a few sheltered situations. Within the reserve proposal the upper forest margin is irregular with some narrow fingers of beech forest extending well above the current dominant altitudinal limit of the forest. On the slopes above the forest, tussock cover is variable, reaching a maximum on southerly slopes. Adventive species such as browntop are scattered throughout, being concentrated in flush areas and on north-facing slopes directly above the forest

margins. The majority of the slopes appear to have been burnt in the recent past (c. five years). However, there seems to be potential for high tussock cover on a large proportion of the upper slopes. Active erosion is present on both north and south facing gully slopes. Sheep and cattle sign is widespread on the non-forest slopes and cattle sign is evident, particularly on the forest margins. By contrast, tussock communities on the main White Umbrella ridge appear little modified with adventive presence low.

With regard to fauna the forested areas harbour a full range of forest-associated bird species, in an abundance not recorded in the numerous small remnants existing elsewhere in the District (Wildlife Service National Habitat Register). Yellow-crowned parakeets are particularly numerous while confirmation of a yellowhead population has been recently made by Foord (1985) and also during the course of the present survey (See Sect. 4.3.1).

The finding of *Powelliphanta spedenii* subsp. *spedenii*, a protected species, both as shells and live specimens, is significant. Little is known of this species' distribution, it having been previously recorded from the Mataura Range in Southland (Powell 1979). Meads *et al.* (1984) declared that too little information was available on the species and that a survey of status was required. They also listed habitat modification as being one of the greatest threats to survival of *Powelliphanta* species.

Bats have also been recorded within the forest (Mr G. Loh, pers. comm.). Combined with the rich invertebrate fauna associated with the forest areas, the area identified here is of very high faunal value and is considered, along with the existing Leithen Bush Scenic Reserve, to be a key site. The recommended area for protection is therefore ranked as Priority 1 on both fauna and flora as well as on landform grounds.

|                |                                                                                    |                                 |
|----------------|------------------------------------------------------------------------------------|---------------------------------|
| Area           | 1350 ha                                                                            |                                 |
| Altitude range | 230 to 1127 m                                                                      |                                 |
| Aspect         | Predominantly westerly but with steep southerly and northerly facing gully slopes. |                                 |
| Plot cards     | 244 to 249                                                                         | Group 1                         |
|                | 250 to 256                                                                         | Group 2                         |
|                | 257 to 264                                                                         | Group 3                         |
|                | Refer also 267                                                                     |                                 |
|                | 265 to 266                                                                         | Group 5                         |
|                | 268                                                                                | Gorge                           |
|                | 269 to 272                                                                         | Groups 8 and 9                  |
|                | 273 to 276                                                                         | Rock bluffs above forest margin |
|                | Refer also 277 to 283                                                              |                                 |
|                | 284 to 287                                                                         | (West of Waikaia River)         |
| References:    | Powell (1979)                                                                      | Ross (1979) Foord (1985)        |
|                | Meads <i>et al.</i> (1984).                                                        |                                 |
| Tenure         | State Forest and pastoral lease.                                                   |                                 |

UMB 03 Pomahaka River and Boulder  
Creek Headwaters

S143 015 028  
SN 8215 B/1

|                      |                                                                                       |
|----------------------|---------------------------------------------------------------------------------------|
| Tussock-shrubland    | on colluvial slope                                                                    |
| Shrubland            | on colluvial slope                                                                    |
| Modified tussockland | on plateau                                                                            |
| Tussockland          | on valley slope<br>on colluvial slope<br>on plateau<br>on colluvial crest<br>on ridge |
| Herb-tussockland     | on valley slope<br>on gully slope                                                     |
| Snowbank             | in nivation hollow                                                                    |
| Cushionfield         | on plateau<br>in flush                                                                |
| Sedge-cushionfield   | on valley floor<br>on plateau                                                         |
| Moss-cushionfield    | on valley floor<br>on plateau                                                         |
| Herb-sedgeland       | on plateau                                                                            |
| Sedgeland            | on plateau                                                                            |
| Moss-sedgeland       | in flush<br>on plateau                                                                |
| Sedge-mossfield      | in flush<br>on valley floor                                                           |

#### Vegetation and flora

The broad plateau area from which the Pomahaka River and Boulder Creek have their sources is distinguished by extensive wetlands. Also distinctive are the snowbank communities and a deeply incised gorge on the Pomahaka. The lowland to mid-altitude tussockland and bog pine communities found in other portions of the District are largely absent.

Only one site (c. 1170 m) was included in Group 9 of the classification produced by cluster analysis. A species-rich (c. 33) site, the vegetation is described as tussock-shrubland according to dominant species. *Hebe* aff. *rakaiensis* is the dominant shrub with a cover of 50-75% and averaging 1 m in height. Narrow-leaved snow tussock (*Chionocholea rigida*) is subdominant with a cover rating of 5-25%. The most prominent understorey species include the subshrub *Brachyglottis revoluta* (1-5%) and the herbs *Helichrysum bellidioides* (1-5%), *Oreomyrrhis ramosa* (5-25%) and *Rumex acetosella* (1-5%). Other understorey species include the shrub *Coprosma ciliata*, and several herbs; the annual gentian *Gentiana grisebachii*, *Celmisia* aff. *graminifolia*, *C. semicordata* var. *aurigans* and *Hydrocotyle heteromeria*. Total plant cover is from 75-100%, with <1% litter and dead plant cover. Bryophytes and lichen are largely absent. The community occurs on protected easterly facing slopes within the Pomahaka River gorge and is bounded to the west by prominent rock bluffs.

UMB 3



Groups 10 and 11 are documented by eight sites described variously as shrubland, tussockland and herb-tussockland on the basis of dominants. The community occurs at altitudes varying from 1200 m to 1380 m and on a variety of slopes and aspects.

The shrubland community is dominated by turpentine scrub (*Dracophyllum uniflorum*) (75-100%) with a 1-5% cover of narrow-leaved snow tussock. Average canopy height is 0.8 m. A relatively species-poor community, ground tier species (<1%) include the herbs blue tussock (*Poa colensoi*), *Hierochloë equisetata*, slim snow tussock (*Chionochloa macra*) and *Forstera sedifolia*. Litter cover is in the category 5-25% while lichen cover (1-5%) is dominated by *Hypogymnia lugubris* and *Usnea contexta* which are particularly well developed on the shrubs. Cover of *Celmisia semicordata* var. *aurigans* increases substantially where cover of turpentine scrub decreases.

Tussockland (or modified tussockland) is represented by seven sites, only one of which is in the headwaters of Boulder Creek. The community is widespread in the Pomahaka headwaters where it occupies a variety of slopes and aspects. Dominated variously by narrow-leaved snow tussock and slim snow tussock or their hybrids, cover varies from 25-50% to 50-75%, with average height ranging from 0.4 to 0.8 m. Blue tussock is prominent in the ground tier particular in modified tussockland. Widespread but infrequent species include the herbs *Celmisia lyallii*, *C. semicordata* var. *aurigans*, *Luzula rufa*, *Gnaphalium mackayii* and a speargrass (*Aciphylla scott-thomsonii*). Uncommon species include the cushions *Celmisia sessiliflora* and *Dracophyllum muscoides*, plus the herbs *Uncinia drucei* and *Festuca multinodis*.

A herb-tussockland community occurs on the steep westerly facing slopes of the deeply incised upper reaches of the Pomahaka River. Dominated by slim snow tussock (5-25%), the opposite easterly facing slopes support narrow-leaved snow tussock. The slim snow tussocks average 0.6 m in height, with *Celmisia semicordata* var. *aurigans* prominent in the ground tier. Other species include blue tussock (1-5%), *Hierochloë equisetata*, the summer-green fern *Polystichum cystostegia* and the sedge *Carex kirkii*, the latter three species all occurring with <1% cover.

Seven sites are included in Group 12. These are mainly described as slim snow tussockland based on the dominant species. The community is widespread on the ridge and plateau areas and on some shady aspects at high altitude (1250-1400 m). The tussockland forms a mosaic with the plateau's extensive wetland communities. Slim snow tussock cover generally is included in the categories 25-50% but some areas of dense cover (75-100%) were recorded on the plateau above the source of Boulder Creek. Blue tussock and snowberry (*Gaultheria depressa*) are the most widespread and abundant ground tier species. Other common species, but generally contributing <1% cover, include *Geum leiospermum*, *Luzula rufa*, *Celmisia prorepens*, *Astelia nivicola* and *Gnaphalium mackayii*. *Marsippospermum gracile* and *Celmisia haastii*, generally associated with snowbank communities, feature in some plots but with <5% cover.

Five sites were classified as snowbank communities (Group 13), four of which were located in the basin of the headwaters of Boulder Creek. Snowbanks are restricted in the headwaters of the Pomahaka River. All occur at altitudes of c. 1340 to 1365 m. Species occurring at most sites include the regionally endemic subshrub *Parahebe trifida*

and *Pernettya alpina*, plus the herbs *Celmisia haastii*, *Luzula pumila*, *Drapetes* aff. *lyallii*, *Epilobium tasmanicum*, *Raoulia grandiflora*, *R. subulata* and *Plantago lanigera*. Abundance varies, however, in relation to length of snow lie with *Pernettya alpina* and *Celmisia haastii* having the greatest cover in early snowbank sites. Uncommon species of note include the cushion species *Phyllachne rubra* as well as the more widespread *P. colensoi*, the herbs *Abrotanella inconspicua*, *Montia australasica*, *Schizilema exiguum* and *Uncinia drucei*. Bare ground generally is included in the cover category 5-25%, while rock cover varies from low (<1%) to very high (75-100%) values.

Group 14 is documented by one site at 1340 m, sampled as a small but distinctive part of the larger plateau wetland system. It is dominated by comb sedge (*Oreobolus pectinatus*) (50-75%) with bryophyte cover contributing 5-25% cover. Other species include the sedge *Carex gaudichaudiana* (1-5%), trailing shrub *Dracophyllum prostratum* (1-5%), and herbs *Epilobium komarovianum*, *Abrotanella caespitosa*, a gentian *Gentiana amabilis* and *Rostkovia magellanica*.

Group 16 is represented by 12 sites located in the headwaters of both Boulder Creek and the Pomahaka River. Altitudes vary from 1220 to 1400 m, with most sites occurring within the plateau wetland system. The vegetation is described variously as cushionfield, moss-cushionfield through to moss-sedgeland and sedge-mossfield on the basis of dominants. The cushionfield sites are dominated by comb sedge with cover varying from 25-50% to 75-100%. Bryophyte cover ranges from 1-5% to 25-50%. Widespread vascular plants include the sedges *Rostkovia magellanica* (1-5% to 25-50%), *Carex gaudichaudiana* (1-5% to 5-25%) plus the herb *Celmisia alpina* (<1% to 5-25%). Species which are locally of >1% cover include the subshrub *Coprosma pumila* (1-5%) and the herbs *Euphrasia dyeri* (1-5%), *Caltha obtusa* (1-5%), a sedge *Carpha alpina* (1-5%), a rush *Luzula leptophylla* (1-5%) and *Abrotanella caespitosa* (1-5%). Species of <1% cover include the herbs *Anisotome imbricata* var. *prostrata*, the sedge *Carex lachenalii*, the small grass *Erythranthera australis*, *Montia fontana*, sundew (*Drosera arcturi*) and rush *Juncus antarcticus*.

The sedgeland sites all have abundant bryophyte cover (5-25% to 75-100%). *Sphagnum cristatum* is prominent, while dominant cyperaceous species are *Carex lachenalii* (in places 5-25%), *C. gaudichaudiana* (in places 25-50%), *C. pyrenaica* var. *cephalotes* (up to 25-50%), *Isolepis aucklandica* (to 5-25%), *C. echinata* (1-5%), *Carpha alpina* (1-5%) and *Rostkovia magellanica* (to 5-25%).

Species locally exceeding 1% include the cushion species, comb sedge, the herbs *Celmisia alpina* (1-5%), *Epilobium komarovianum*, *Abrotanella caespitosa*, *Anisotome imbricata* var. *prostrata*, *Euphrasia dyeri* and *Drapetes* 'bog'. Species contributing <1% but of note include bladderwort (*Utricularia monanthos*) and *Gaimardia setacea*.

On wetland portions slightly raised above the rest, slim snow tussock, blue tussock, the cushion *Phyllachne colensoi* and the trailing shrub *Dracophyllum prostratum* exceed 1% cover.

Extensive rock bluffs are found at c. 1200 m on easterly facing aspects within the Pomahaka River headwaters (S161 GR: 002 202 and 006 204). The eastern bluffs, although generally of smaller stature than those in the west, are more species-rich at c. 70 species compared to c. 55. Species on the eastern bluffs not recorded in the west include the shrubs *Hymenanthera alpina* and *Olearia*

*nummularifolia*, the subshrubs *Celmisia brevifolia* *Brachyglottis revolutus*, the herbs *Geum uniflorum*, the undescribed variety of *Anisotome haastii*, *Epilobium chlorifolium*, *E. pernitens*, *E. pubens*, *Trisetum antarcticum*, *Astelia nivicola*, *Gingidia barterae* and *Aciphylla pinnatifida*. Only one species, the herb *Raoulia hookeri*, was recorded on the western bluffs only. Species recorded on both include the herbs *Cystopteris tasmanica*, *Celmisia laricifolia*, *Pachycladon novae-zelandiae*, *Koeleria novae-zelandiae* and *Marsippospermum gracile*.

On rock faces in the gorge of the main Pomahaka channel the shrub *Hebe rakaiensis*, the herbs *Raoulia tenuicaulis* and a filmy fern *Hymenophyllum peltatum* were also recorded.

### Landform

The Old Man Range reaches its southern limit in the headwaters of the Pomahaka River. Here an extensive broad plateau descends southwards into the Pomahaka River channel which, in places, is deeply incised. The gorge feature may be the result of incision along a fault. Below the gorge the river channel is bounded by steep colluvial valley slopes.

Nivation hollows are common in the headwaters of Boulder Creek which has moderately incised the eastern scarp face descending from the broad upland plateaux to the Clutha Valley.

High country yellow-brown earths derived from schist solifluction detritus and some loess (Carrick hill and Carrick soils) with stony loam and silt loam textures cover the area.

### Fauna

Birds recorded were redpoll, southern black-backed gull, South Island pied oystercatcher.

Mr P. Child in November 1973 recorded skylark, New Zealand pipit, Australasian harrier, and South Island pied oystercatcher at the southern end of the Old Man Range. These species numbered less than ten. Southern black-backed gulls were observed in numbers of 20+.

The moth fauna has much in common with the northern parts of the Old Man Range but is different enough to be considered separately. In addition, six species were found only on the southern end of the Old Man Range and nowhere else in the Umbrella District.

Lepidoptera species recorded were *Aoraia* sp. aff. *senex* (Hudson), *Gymnobathra* sp., *Gelophaula* sp., *Orocrambus flexuosellus* (Doubleday), *O. scoparioides* (Philpott), *Orocrambus* sp., *Tawhitia glaucophanes*, *Eudonia psammitis* (Meyrick), *E. submarginalis* (Walker), *Scoparia autochroa* (Meyrick), *Scoparia nomeutis* (Meyrick), *Scoparia* sp. aff. *panopla* (Meyrick), *Scoparia* sp. aff. *claranota* (Howes), *Dasyuris anceps* (Butler), *Notoreas isomoera* (Prout), *N. ortholeuca* (Hudson), *Asaphodes clarata* (Walker), *A. dionysias* (Meyrick), *Asaphodes* sp., *A. sericodes* (Meyrick), '*Notoreas*' *insignis* (Butler) '*N.*' *orphnaea* (Meyrick), '*N.*' *brephosata* (Walker), '*N.*' *zopyra* (Meyrick), *Agrotis ipsilon aneituma* (Walker), *Persectania aversa* (Walker) and *Aletia longstaffi* (Howes) (see Sect. 4.3)

### Discussion

The plateau area which forms the headwaters of Boulder Creek

and the Pomahaka includes extensive mosaics of wetland and slim snow tussockland. The abundance of adventive species is generally low on the plateau areas although some wetland, bogs and snowbanks show cattle pocking or use as sheep resting sites. Cattle faeces are present throughout the recommended area for protection but are of low density. Sheep and hare faeces are frequent but only locally abundant.

The Waikaia Bush 'road' follows the ridge line and also coincides with the boundary between the Old Man and Umbrella Districts (also the Central Otago and Waikaia regions). The wetland and tussockland communities are traversed by this 'road' and as a result are divided between the two Districts. It is stressed here that the wetland systems should not be separated for reserve propositions simply because of the District boundary position. Protection of the area identified here should be considered in conjunction with those made for the Old Man District (Brumley *et al.* 1986).

The snowbanks located in the headwaters of Boulder Creek are both extensive and diverse. Degree of modification is substantially less than in those found in the headwaters of the Little Pomahaka (see UMB15). Consequently, the upper reaches of the Boulder Creek catchment are included with the Pomahaka River, as first priority for reservation in the present proposal. Tussockland at lower altitudes within the Boulder Creek catchment is modified and presently dominated by blue tussock. Thus, the current reserve proposal is limited to the headwaters only.

The gorge through which the Pomahaka River flows supports a particularly diverse and abundant flora compared to areas in the immediate vicinity. The rock bluffs are the best representation of this landform in the northern part of the District. At altitudes below the rock bluffs the abundance of adventives and evidence of stock impact increases markedly. As a result, the boundary of the proposed reserve does not extend southwards to the junction of the Pomahaka and Little Pomahaka Rivers.

The Lepidopteran fauna appears diverse and shares some affinities with the main Old Man Range. The broad flat wetlands are considered to be key sites (see Sect. 4.3.3).

With vehicular access made relatively easy by the Waikaia Bush 'road' the plateau's wetland systems are particularly vulnerable to abuse. Trail bike tracks through the bogs are conspicuous and in places abundant. The situation is particularly serious in the flush areas below the snowbanks in the Boulder Creek catchment.

Goldmining was active within the area last century, particularly at nearby Potter's Gully, southern Old Man District. Water races are present within the recommended area for protection extending for much of the length of the Pomahaka Valley to the sluices at the Pomahaka/Little Pomahaka confluence (see Chapter 2).

|                |                                                                                                                                                                  |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Area           | 880 ha                                                                                                                                                           |
| Altitude range | 1060-1440 m                                                                                                                                                      |
| Aspect         | Boulder Creek flows northwards with generally northerly aspects. The Pomahaka River flows westwards and then southwards with valley slopes of differing aspects. |

|            |            |                  |
|------------|------------|------------------|
| Plot cards | 172        | Group 9          |
|            | 173 to 180 | Groups 10 and 11 |
|            | 181 to 187 | Group 12         |
|            | 188 to 192 | Group 13         |
|            | 193        | Group 14         |
|            | 194 to 205 | Group 16         |
|            | 206        | Rock bluffs      |

References      Brumley *et al.* (1986).

Tenure          Pastoral lease

UMB 04 Leithen Burn Headwaters

S161 892 870  
SN 5693 D/4

|                       |                                             |
|-----------------------|---------------------------------------------|
| Rock bluff vegetation | on ridge                                    |
| Herb-tussockland      | on colluvial slopes                         |
| Modified tussockland  | ( on colluvial slopes<br>( on creek margins |
| Tussockland           | ( on colluvial slopes<br>( on ridge         |
| Cushion-tussockland   | on ridge                                    |

### Vegetation and flora

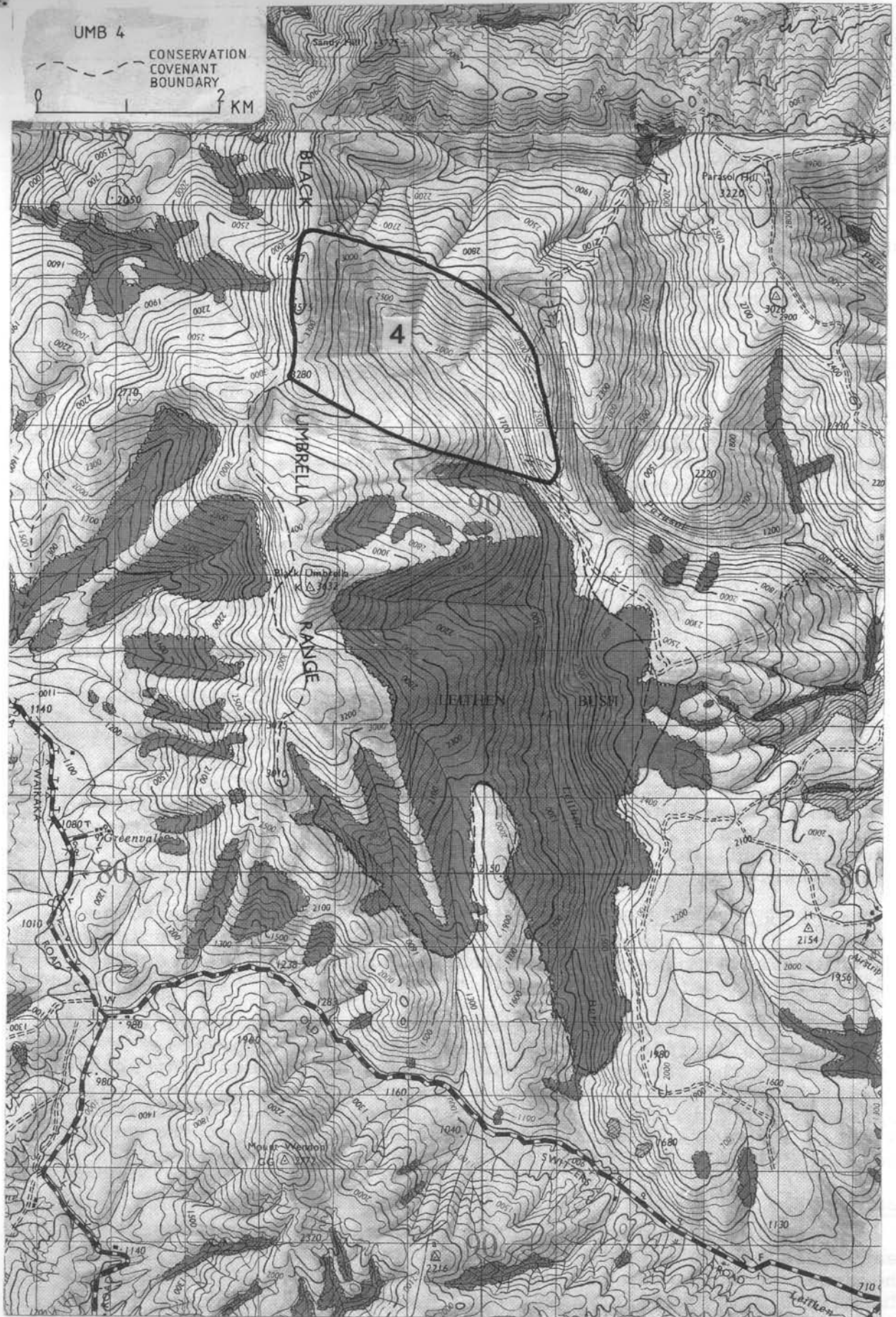
The majority of the area described here as the Leithen Burn Headwaters, and currently outside of the Leithen Bush Scenic Reserve, falls within the Group 9 community (mid- to high-altitude tussock grassland) differentiated using cluster analysis. Altitude covered ranges from c. 500 m to 1060 m and extends over a variety of slopes and aspects. Described variously under the Atkinson system as tussockland, herb-tussockland and modified tussockland, the community is dominated by narrow-leaved snow tussock (*Chionochloa rigida*) with varying amounts of the adventive species browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*), and catsear (*Hypochaeris radicata*) in the ground tier. In places browntop forms dense swards particularly on the margins of Leithen Burn and in small depressions, especially on the lower valley slopes. Cover of the herb *Celmisia semicordata* var. *aurigans* and subshrub snowberry (*Gaultheria depressa*) are generally high throughout with local abundance of *Celmisia densiflora* and the subshrub *Brachyglottis revoluta*. Creek margins particularly in the southern sections of the area identified also support limited shrub communities containing such species as inaka (*Dracophyllum longifolium*), mountain tauhini (*Cassinia vauvilliersii*), mountain ribbonwood (*Hoheria glabrata*), manuka (*Leptospermum scoparium*), turpentine scrub (*Dracophyllum uniflorum*), *Hebe* aff. *rakaiensis* and *H. rakaiensis*.

Rock outcrops (c. 880 m) for the most part support species also occurring in the surrounding tussockland. Exceptions include the shrub *Helichrysum selago*, subshrub *Parahebe lyallii*, herbs *Aciphylla lecomtei*, *Gingidia montana* plus the rush *Luzula banksiana*.

The cushion-tussockland community falls within Group 10 of the cluster classification and is represented by one site. Dominated in the canopy by narrow-leaved snow tussock (*Chionochloa rigida*), and by comb sedge (*Oreobolus pectinatus*) and the herb *Coprosma pumila* in the ground tier, the community is of limited extent. It covers several small areas on the ridge at the valley head (c. 1010 m).

### Landform

A deeply incised valley in semi-schist which contains the headwaters of the Leithen Burn. Steep colluvial slopes rise from the creek to both east and west. The valley head rises steeply to the main Black Umbrella Range which forms a narrow but prominent ridge. A few rock bluffs outcrop, mainly on the leading ridge which forms the eastern catchment boundary.



High-country yellow-brown earths with related steepland soils (Waikaia/Leithen) plus high-country podzolised yellow-brown earths and podzols (Maungatua) occur within the area. Textures vary from silt loams and stony silt loams to peaty loams being derived from greywacke, schist, semi-schist and/or schist loess.

### Fauna

Birds recorded were redpoll, New Zealand pipit, silvereye, bellbird and yellow-crowned parakeet, the last three species being recorded on the northern margins of Leithen Bush.

Invertebrates recorded from the Black Umbrella Range and from Parasol Hill  $\approx$  3 km to the east but at a similar altitude were: *Heterocrossa cryodana* (Meyrick), *Capua semiferana* (Walker), *Gelophaula* sp., *Lycaena salustius* (Fabricius), *Stenoptilia orites* (Meyrick), *Orocrambus aethonellus* (Meyrick), *Eudonia chalara* (Meyrick), *E. feredayi* (Knaggs), *E. sabulosella* (Walker), *Chloroclystis nereis* (Meyrick), *Dasyuris transaureus* (Howes), *Notoreas paradelpha* (Meyrick) and '*Notoreas*' *orphnaea* (Meyrick) (see Sect. 4.3).

Details of the adjacent scenic reserve are contained in Lands and Survey Department (1983a) and have been summarised in the present report (Sect. 4.3 and 5.1).

### Discussion

This area of the Leithen Burn headwaters is the only portion of the upper catchment remaining outside the Leithen Bush Scenic Reserve. At present the Leithen Bush Scenic Reserve includes mixed beech forest, shrubland, tussockland and rock bluff communities. The shrub *Helichrysum selago* was recorded in the proposed extension but not within the existing reserve. The herb *Aciphylla lecomtei* plus edelweiss (*Leucogenes grandiceps*) are particularly abundant on the westerly facing rock bluffs near to the Black Umbrella summit. In places these bluffs approach 20 m in height and are both typical and representative of the ridge top landform of the southern Umbrella Mountains.

The recommended area for protection described here includes tussockland communities representative of those occurring in the mid-altitude areas of the Umbrella District. Cover of narrow-leaved snow tussock (*Chionochoila rigida*) varies from <10% to c. 50%. Adventive grasses are particularly widespread and abundant. However, this situation is typical of tussockland communities at these altitudes (c. 500 m to 1000 m) within the District. Moreover, the tussockland falls within the most species-rich group differentiated by cluster analysis from data obtained within the District.

Assignment of Priority 1 status to this area emphasizes its significance as a possible extension of the scenic reserve which would enhance its viability and integrity. Protection of the entire upper reaches of the Leithen Burn would give an extremely valuable representation of the range of vegetation, flora, fauna and landform of the semi-schist country which comprises a large proportion of the southern sections of the Umbrella District. In view of the broader representation than simply forest now within the reserve, a change of name to "Leithen Burn Scenic Reserve" might be considered.

|                |                                                                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Area           | c. 700 ha                                                                                                                                                          |
| Altitude range | 500-1090 m                                                                                                                                                         |
| Aspect         | Valley head faces south but extensive slopes face in both easterly and westerly directions                                                                         |
| Plot cards     | 020, 022 to 025, 027 Group 9<br>021 Rock bluffs<br>026 Group 10<br>Refer also 017 to 019, 288 to 308<br>(Leithen Bush Scenic Reserve)<br>028 to 033 (Parasol Hill) |
| Tenure         | Pastoral lease                                                                                                                                                     |

UMB 05

Timber Creek Headwaters

S152 084 025  
SN 8215 D/3

|                      |                            |
|----------------------|----------------------------|
| Rock bluffs          | on ridge and valley slopes |
| Silver beech forest  | on creek margins           |
| Moss-cushionfield    | on plateau margins         |
| Cushion-mossfield    | on plateau                 |
|                      | ( on colluvial slopes      |
| Modified tussockland | ( on plateau               |
|                      | ( on ridge                 |
| Tussockland          | on ridge                   |
| Tussock-shrubland    | on colluvial slopes        |

### Vegetation and flora

The forest consists of one c. 20 ha stand (altitude c. 700 to 800 m) dominated by silver beech (*Nothofagus menziesii*) with >75% cover in the tallest stratum (>12 m) and an average height of c. 18 m. The stand falls within Group 4 (silver beech forest) of the cluster analysis classification. Regeneration of silver beech is abundant in the tiers recorded between two and 12 m with cover in the category 5-25%. However, regeneration in the lowest tiers from 0-2 m appears less abundant. Of the understorey species, prickly shield fern (*Polystichum vestitum*) dominates the stratum from 0.4-2 m whereas a hooked sedge *Uncinia clavata* dominates the ground tier. Fifty-one species were recorded in the northern bush portions compared to 55 known from the southernmost sections which are protected under a Reserves Act Conservation Covenant (see Sect. 5.1 : Lee 1982). The beech forest appears generally uniform throughout, with a litter cover of 1-5%.

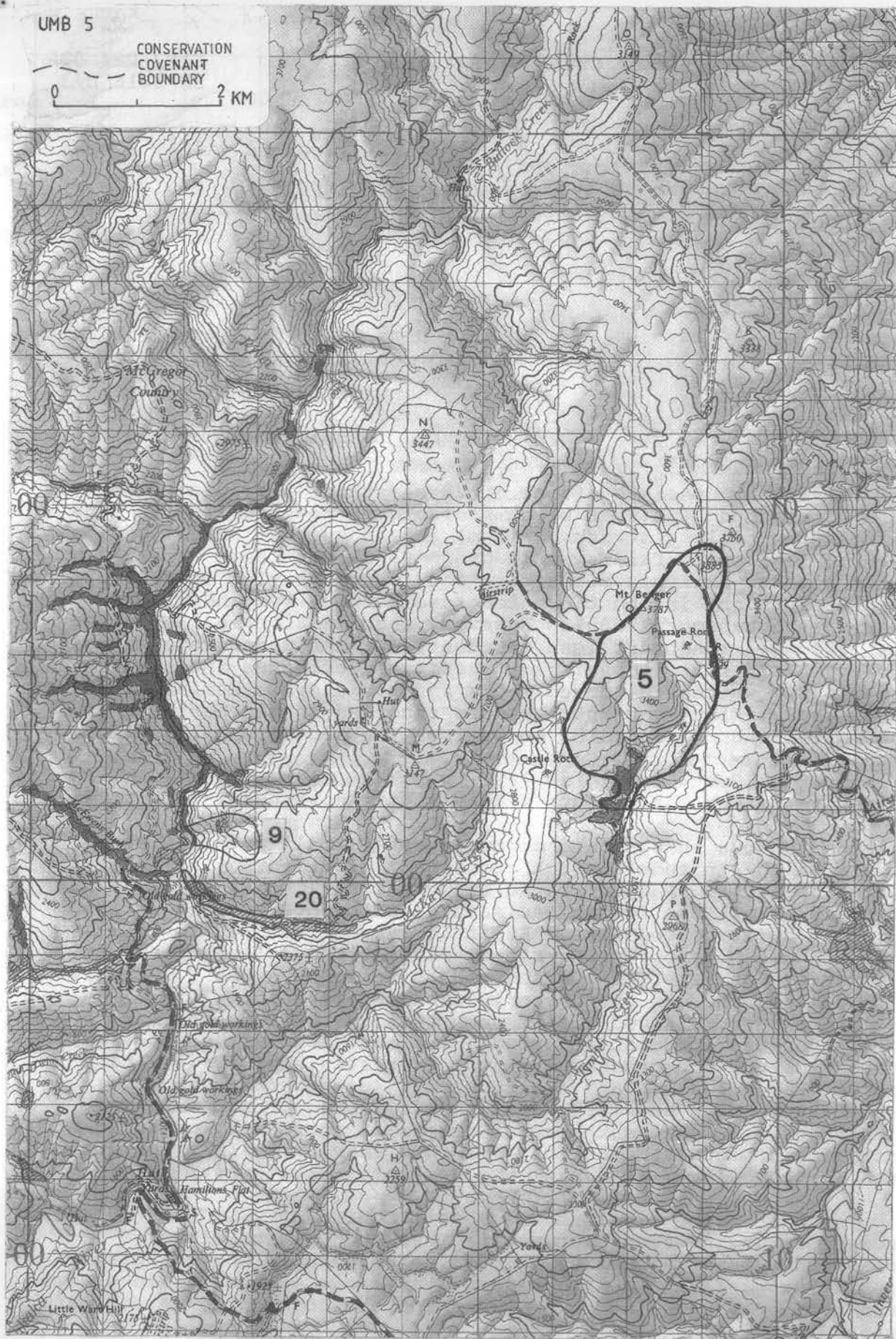
The various tussockland communities all fall within Group 8 (mid- to high-altitude tussock grassland) as differentiated by cluster analysis. Narrow-leaved snow tussock (*Chionocholea rigida*) dominates at all the five sites sampled with cover mainly in the 5-25% and 25-50% categories. Altitude ranges from 970 to 1155 m with the community occupying ridge, plateau and colluvial slopes on a variety of aspects. On the ridges tussock height is generally 0.4 m or less whereas on southerly aspects its height can reach 1 m. Some narrow-leaved X slim snow tussock (*Chionocholea rigida* X *macra*) hybrids were also recorded. The most abundant ground layer species include the grasses browntop (*Agrostis capillaris*), blue tussock (*Poa colensoi*) and sweet vernal (*Anthoxanthum odoratum*) plus the subshrubs snowberry (*Gaultheria depressa*) and *Pernettya macrostigma*. In places, the shrub component increases, predominantly consisting of mountain tauhina (*Cassinia vauvilliersii*), turpentine scrub (*Dracophyllum uniflorum*) and *Hebe* aff. *rakaiensis*.

There are some localised flushes occupied by swards of adventive species of varying abundance notably browntop, white clover (*Trifolium repens*), foxglove (*Digitalis purpurea*), scotch thistle (*Cirsium vulgare*) and woollymullein (*Verbascum thapsus*). In places *Carex coriacea*, *Schoenus pauciflorus* and the moss *Sphagnum cristatum* dominate.

UMB 5

CONSERVATION  
COVENANT  
BOUNDARY

0 2 KM



The moss-cushionfield community documented at one site (c. 1125 m) falls within Group 16 of the cluster analysis. It occurs on the plateau margins and is dominated by comb sedge (*Oreobolus pectinatus*) and bryophytes, each having cover in the 25-50% category. Bryophytes consist predominantly of *Sphagnum cristatum* and *Polytrichum juniperinum*. Species of 1-5% cover include the cushions *Phyllachne colensoi* and *Drapetes 'bog'*, plus the sedge *Rostkovia magellanica*. The sedge, *Carex lachenallii* was also recorded within the plot.

The cushion-mossfield community, also documented by one sample, was included in Group 10 of the cluster analysis. This community forms a mosaic with tussockland vegetation on the plateau at the head of the catchment (c. 1155 m). Bryophyte cover is in the 25-50% category and is dominated by *Racomitrium lanuginosum*. The cushion species *Dracophyllum muscoides* achieved 5-25% cover, whilst narrow-leaved snow tussock is of minor importance with 1-5% cover. Other species include the subshrub *Cyathodes pumila*, the cushions *Phyllachne colensoi* and *Celmisia sessiliflora*, the herbs *Gentiana bellidioides*, and *Euphrasia zelandica* plus the cushion rush *Luzula pumila*. Lichens are present with a cover of 1-5%.

The rock bluffs are relatively species-rich (c. 70 species). Notable records include the rare *Aciphylla ?inermis*, and the hooked sedge *Uncinia purpurata* (see Sect. 4.1). Other species noted include the shrubs *Olearia lineata* and *O. arborescens*, the subshrub *Myrsine nummularia* and the herbs *Asplenium richardii*, *Grammitis poeppigiana*, *Celmisia semicordata* var. *aurigans* and *Astelia nervosa*. Rock bluffs in the western portion of the catchment are species-poor compared with those to the east of Timber Creek.

### Landform

Timber Creek has its source on the southern slopes of Mt Benger. The plateau landscape of the block-faulted erosion surface which typifies the Mt Benger area grades southwards into the rolling foothill country typical of much of the southern portions of the Umbrella District. Timber Creek has carved a deeply incised valley, now flanked mostly by stable slopes. Rocks outcrop on ridges as well as on valley slopes, which in places are steep.

Lowland yellow-brown earths with related steepland soils (Tuapeka) are associated with the margins of Timber Creek. The majority of the reserve proposal is covered by high-country yellow-brown earths of the Teviot group, which vary texturally from silt loams to stony loams and are derived mainly from schist with a thin cover of schist loess in places.

### Fauna

Possum faeces were noted within the beech remnant. Birds recorded were grey warbler, yellow-breasted tit and rifleman all within the beech forest. Mr P. Child in October 1974 recorded blackbird, goldfinch, chaffinch, redpoll, yellowhammer, fantail, yellow-breasted tit, grey warbler and bellbird from the Mt Benger area. Habitats covered were beech forest, scrub, tussockland and stream.

A rich Lepidoptera fauna was associated with the Timber Creek and Mt Benger areas. Several species were not recorded elsewhere in the District (see Sect. 4.3). Those recorded were *Stigmella* sp. 2, *Stigmella* sp. 3, *Aoraia* sp. 1, *Aoraia* sp. aff. *senex* (Hudson), *Reductoderces* sp., *Elachista thallophora* (Meyrick), *Heterocrossa cryodana* (Meyrick), *Circia barbata* (Philpott), *Tingena lassa* (Philpott), '*Eurythecta*' *phaeoxylla* (Meyrick), *Harmologa petrias* (Meyrick), *H. sanguinea* (Philpott), *Pyrgotis consentiens* (Philpott), *Eudonia legnota* (Meyrick), *E. paltomacha* (Meyrick), *E. sabulosella* (Walker), *E. xysmatias* (Meyrick), *Scoparia* sp., *Chloroclystis nereis* (Meyrick), *Epyaxa rosearia* (Doubleday), *Helastia corcularia* (Guenee), *Helastia* sp., *Notoreas paradelpa* (Meyrick), *N. perornata* (Walker), *Asaphodes abrogata* (Walker), '*Notoreas*' *brephosata* (Walker), *Dichromodes gypsotis* (Meyrick), and *Homohadena fortis* (Butler) (see Sect. 4.3).

### Discussion

The Timber Creek bush remnant constitutes one of the most easterly remaining stands of beech forest within the District. The presence of forest dimples and Hall's totara logs in its vicinity imply that beech forest was once more widespread and that the current absence of podocarp species in the area was not always the case (see Sect. 4.1).

The tussockland community which covers the majority of the recommended reserve varies in its degree of modification. The abundance of adventive species appears to increase as altitude decreases and with localised increases in ground moisture and around rocks. Grazing intensity appears to be moderate with occasional old cattle pats and a low to moderate density of sheep pellets. Hare pellets are widespread but generally of low density.

The tussockland community in Timber Creek catchment shares many features with the reserve proposed for Leithen Burn Headwaters (UMB 04) and the non-forest areas presently within the scenic reserve. With regard to most aspects of its vegetation and landform this (PNA 04) reserve recommendation might be considered as of Priority 2 status to supplement the existing Leithen Bush Scenic Reserve and the proposed extension (UMB 04). However, the area contains a particularly rich Lepidoptera fauna. Five alpine moths were found on Mt Benger alone within the District. Moreover, the record for *Scoparia* sp. was the first for the species, having subsequently been collected only from the Lammermoor Range and Mt Teviot (Mr B.H. Patrick, pers. comm.) (see Sect. 4.3). These facts, combined with the occurrence of the most easterly remnant of beech forest, justify Priority 1 status for this area.

The boundary of the area identified includes the highest point, Mt Benger (1183 m). A vehicle access track currently more or less coincides with the northern and eastern limits of the catchment, but excludes Mt Benger itself. The western boundary of this recommended area for protection generally follows the catchment limits until the degree of modification of the vegetation becomes unacceptably high and widespread. At this point the boundary descends along a spur to include the beech remnant.

Area                    c. 355 ha

Altitude range 730-1183 m

Aspect                Of southerly orientation but extensive slopes face  
                         in easterly and westerly directions. The plateau  
                         area around Mt Bengier is generally flat to gently  
                         south-facing.

Plot cards            036                    Rock bluffs  
                         037                    Group 4  
                         040 to 044            Group 8  
                         038                    Group 10  
                         039                    Group 16

                         Refer also 034 , 035    (Timber Creek Conservation  
                                                                         covenant)

References            Lee (1982)

Tenure                Pastoral lease and freehold

UMB 06

Awatere: Charlie's Hill  
South/Tussock BlockS161 811 796  
SN 5693 C/5

|                            |                                                     |
|----------------------------|-----------------------------------------------------|
| Tussockland                | ( on valley floor<br>( on ridge                     |
| Modified tussockland       | on colluvial slopes                                 |
| Shrub-tussockland          | ( on ridge<br>( on colluvial slopes                 |
| Modified shrub-tussockland | ( on colluvial slopes<br>( in gullies<br>( on ridge |
| Shrubland                  | ( in gullies<br>( on colluvial slopes               |
| Modified shrubland         | on colluvial slopes                                 |
| Rich beech forest          | on creek margins and gully<br>slopes                |

#### Vegetation and flora

With the exception of one tussockland community which falls into Group 6 of the classification, and the beech forest community (Group 3), all communities recorded in this recommended area for protection classified into Group 7.

The Group 6 tussockland community is dominated by red tussock (*Chionochloa rubra*) (5-25% cover), *Carex coriacea* (5-25%), browntop (*Agrostis capillaris*) (5-25%) cover and *Sphagnum cristatum* (also 5-25% cover). The adventive grass, yorkshire fog (*Holcus lanatus*) and rush *Juncus effusus* are present with a cover of 1-5%. Other species include the herbs *Eleocharis acuta*, *Hydrocotyle novae-zeelandiae* and *Ranunculus glabrifolius* Hook.

This community occurs at c. 670 m in a gently sloping area formed at the base of a shallowly incised valley.

Those communities which were classified into Group 7 on the basis of floristics are described variously as tussockland, modified tussockland, shrub-tussockland, modified shrub-tussockland, shrubland and modified shrubland on the basis of the dominant species. The communities range in altitude from 560 to 700 m and cover a range of slopes, aspects and landform. The tussockland community is documented by two sites at c. 620 m and occurs on ridge and upper colluvial slopes. The community is dominated by narrow-leaved snow tussock (*Chionochloa rigida*) having some features of red tussock (cover 5-25%). Tussock height ranges from 0.4 to 1 m, averaging 0.6 m. The ground tiers (0-0.3 m) are dominated variously by the adventive, browntop (5-25%), the shrub *Coprosma cheesemani* (5-25%), the subshrub *Pernettya macrostigma* (5-25%) and the herbs *Celmisia densiflora* (5-25%) and very locally *C. prorepens* (5-25%). Species having 1-5% cover include the shrub mountain tauhini (*Cassinia vauvilliersii*) and the herbs *Herpolirion novae-zeelandiae* and sweet vernal (*Anthoxanthum odoratum*).



The shrub-tussockland community is dominated by hybrid narrow-leaved X red tussock and/or narrow-leaved snow tussock with cover ranging from 1-5% to 25-50%. The community occurs at altitudes from c. 620 to 700 m in a variety of sites ranging from ridges to gullies. Tussock cover is supplemented by varying proportions of the shrubs mountain tauhini, *Coprosma cheesemanii*, *Hebe propinqua* and inaka (*Dracophyllum longifolium*) in the 0.4-2 m tier. Height of the dominant species varies from 0.4 to 1.5 m and averages c. 0.7 m. Species dominating the ground tier (0-0.4 m) are the shrubs *Gaultheria crassa* and *Hebe* aff. *rakaiensis*, the subshrubs *Pernettya macrostigma* and the herbs browntop, sweet vernal, white clover (*Trifolium repens*), *Celmisia densiflora*, a hooked sedge *Uncinia aucklandica* and fescue tussock (*Festuca novae-zelandiae*). Other species include the shrubs turpentine scrub (*Dracophyllum uniflorum*), *Coprosma parviflora*, and the herbs *Ophioglossum coriaceum*, *Acaena profundeincisa* plus the hooked sedges *Uncinia affinis* and *U. ?purpurata*. Lichen and bryophyte cover is generally from 1-5%.

The shrubland communities are a seemingly even-aged stand at c. 560 m on the beech forest margins consisting of a 50 m wide strip of inaka with 50-75% cover. Shrub height ranges from 0.8 to 1.8 m with an average of 1.2 m. The shrub *Hebe propinqua* is abundant on the fringes of the inaka community. Other species with >1% cover are narrow-leaved snow tussock, mountain flax (*Phormium cookianum*), a fern *Blechnum minus*, the fern ally *Lycopodium scariosum* and *Brachyglottis southlandicus* var. *albidulus*. Other shrubland sites are dominated by mountain tauhini, with subdominants of *Coprosma cheesemanii* and narrow-leaved snow tussock. These shrublands occur at c. 620 m and occupy colluvial slopes.

The modified shrubland is dominated by *Coprosma* cf. *parviflora* but with a prominent element of bracken fern (*Pteridium esculentum*). Occurring at c. 640 m the shrubland occupies northerly facing colluvial slopes. Species present with >1% cover include the subshrub *Pernettya macrostigma*, the shrub *Coprosma cheesemanii* and the herbs browntop, catsear (*Hypochaeris radicata*), *Blechnum penna-marina* and *Rytidosperma gracile*. The shrubs manuka (*Leptospermum scoparium*) and *Hebe propinqua* are abundant in the vicinity, ranging from 1 to 1.5 m in height.

The beech forest remnant is dominated by silver beech (*Nothofagus menziesii*) with a high shrub cover and is classified as Group 3 forest. Canopy cover is in the category 50-70% and tree height averages c. 22 m. Regenerating silver beech is dominant in all height categories below 12 m, being particularly abundant in canopy gaps. Cover from 0 to 2 m is 25-50% and 1-5% from 2 m to 12 m. Other species contributing to understorey cover are the shrubs *Coprosma rhamnoides*, *C. colensoi* and the fern *Blechnum minus* (all 1-5%). Other species present but with <1% cover include the small trees lancewood (*Pseudopanax crassifolius*), *P. simplex*, marbleleaf (*Carpodetus serratus*), broadleaf (*Griselinia littoralis*), the shrubs *Coprosma cuneata*, *C. parviflora*, *C. pseudocuneata* plus the herbs crape fern (*Leptopteris superba*), *Blechnum fluviatile* and *Astelia nervosa*. Additional species noted include the stemless tree fern *Cyathea colensoi*, the shrubs *Olearia arborescens*, pepper tree (*Pseudowintera colorata*), weeping mapou (*Myrsine divaricata*), *Coprosma ciliata* and *C. rugosa*, together with the herbs *Luzuriaga parviflora* and *Rumohra adiantiformis*.

### Landform

Largely a rounded hill of semi-schist with drainage channels lightly to moderately incising colluvial slopes. The reserve recommendation covers channels draining eastwards. Beech forest remnants occupy the mid reaches of the larger and more deeply incised gullies.

Lowland yellow-brown earths with related steepland soils (Tuapeka soils) plus some elements of upland yellow-brown earths (Pukekoma hill soils) occur within the proposal.

Textures include silt loams to stony loams (Tuapeka) plus silt loams and shallow silt loams (Pukekoma) and are derived from schist and schist loess over greywacke, with loess shallow on steeper faces.

### Fauna

Birds recorded were bellbird, fantail, yellow-breasted tit, grey warbler and New Zealand falcon.

The moth fauna within this reserve proposal is both rich and diverse and several were recorded only here within the District (see Sect. 4.3). Lepidoptera recorded from Awatere were *Aoraiia* sp., *Asterivora* sp., *Protosynaema steropucha* (Meyrick), *Sagephora phortegella* (Meyrick), *Capua semifera* (Walker), *Gelophaula* sp., *Antiscopa elaphra* (Meyrick), *Eudonia arena* (Meyrick), *E. deltophora* (Meyrick), *E. feredayi* (Knaggs), *Chloroclystis filata* (Guenée), *Epicyme rubropunctaria* (Doubleday), *Austrocidaria cedrinodes* (Meyrick), *Epyaxa rosearia* (Doubleday), *Helastia* sp. aff. *cymoseuta* (Meyrick), *Asaphodes abrogata* (Walker), *Pseudocoremia productata* (Walker), *Xyridaema veronicae* (Prout) and *Graphania homoscia* (Meyrick).

### Discussion

The upland areas comprising Charlie's Hill and the so-called 'Tussock Block' on Awatere Station are the largest and best examples of mid-altitude tussock/shrubland combinations that remain in the Umbrella Ecological District. Despite the fact that adventives such as browntop, sweet vernal, white clover and catsear, in addition to bracken fern are widespread and in places abundant, and that *Chionochloa* tussocks have in places been replaced by fescue tussock, this area recommended for protection is outstanding.

The largest areas of *Hebe propinqua* shrubland recorded in the District occur here. The southernmost beech stand is species-rich with little evidence of heavy grazing. The shrubland margins of the beech remnants, while dominated by inaka, have young silver beech present, implying that the community may be transitional to forest.

The tussock communities contain both narrow-leaved snow tussock and red tussock, together with their hybrids. The shrub component increases in abundance in gullies and on shady aspects. The 'Tussock Block' (referring to the southwestern section of the area identified here) has patchy tussock cover varying from <10% to >70%. The so-called 'Tussock Block' is currently fenced with the south-eastern flanks abutting ploughed land and extensively modified tussockland. Evidence of recent grazing within the block is scant.

Some isolated silver beech trees and small beech stands persist in gullies. Logs of Hall's totara (*Podocarpus hallii*), some c. 0.4 m diameter, were noted in several places in gullies and on ridges in the block. Moreover, old fences which still stand have been erected using totara for posts.

The boundary of this recommended area for protection denotes where the degree of modification of the indigenous vegetation is considered to be unacceptably high. The northern boundary is somewhat impeded by the large airstrip which covers much of the summit of Charlie's Hill. The above features, combined with the distinctive and diverse, invertebrate fauna (see Sect. 4.3), justify this area being assigned Priority 1 status. Priority 2 status is assigned to Awatere: Charlie's Hill North (UMB 16).

|                |                                                                                                    |         |
|----------------|----------------------------------------------------------------------------------------------------|---------|
| Area           | c. 290 ha                                                                                          |         |
| Altitude range | 510-730 m                                                                                          |         |
| Aspect         | Generally southeasterly but with southwesterly and northeasterly facing valley slopes both common. |         |
| Plot cards     | 050 , 051                                                                                          | Group 3 |
|                | 069                                                                                                | Group 6 |
|                | 052 to 068                                                                                         | Group 7 |
| Tenure         | Freehold                                                                                           |         |

UMB 07 Crown Rock/Stronach Hill

S152 900 957  
SN 5380 D/26

|                       |                                                      |
|-----------------------|------------------------------------------------------|
| Rock bluff vegetation | on ridge                                             |
| Rockfield vegetation  | on derivative slopes below or<br>between rock bluffs |
| Cushionfield          | on ridge                                             |
| Herbfield             | on ridge                                             |
| Grassland             | on ridge                                             |
| Tussockland           | on colluvial slopes                                  |

### Vegetation and flora

Stronach Hill appears to be the southern limit for the rare and regionally endemic shrub *Hebe poppelwellii* and for the subshrub *Celmisia walkeri* as well as providing the only District record for *Cotula pectinata* var. *villosa*. The summit of Stronach Hill is covered by cushionfield dominated by *Phyllachne colensoi*. In places, blue tussock (*Poa colensoi*) forms extensive mats. While the rock bluffs on the main ridge vary in their species composition and abundance, they harbour species of restricted distribution within the District such as the shrubs *Coprosma serrulata* and *Helichrysum selago* plus the herbs *Aciphylla lecomtei* and *Schizeilema haastii*. *Helichrysum selago* was particularly abundant on the rock bluffs to the north of Crown Rock.

### Landform

Prominent rock bluffs on the main crest of the Black Umbrella Range. These, predominantly facing westwards in the southern sections, occur on the ridge top around Crown Rock and face eastwards in the northern sections of the area identified here.

High-country yellow-brown earths with related steepland soils (Waikaia) plus some podzolised yellow-brown earths (Maungatua soils) occur within the area. The former are derived from greywacke and semi-schist with textures of stony loam and silt loam, the latter have parent material of schist and some schist loess and vary texturally from peaty loams to sandy loams.

### Fauna

New Zealand falcons were observed along the main ridge on several occasions. Lepidoptera recorded near Crown Rock were *Dasyuris leucobathra* (Meyrick) and *Notoreas perornata* (Walker). *Gelophaula* sp., *Lycaena salustrius* (Fabricius), *Stenoptilia orites* (Meyrick), *Eudonia chalara* (Meyrick) and '*Notoreas*' *orphnaea* (Meyrick) were recorded from the Black Umbrella Range (see Sect. 4.3.3.).

### Discussion

The southern limit for certain plant species and the prominent ridge top landform would normally merit Priority 1 status. However, the plant species, communities and landform are all well-represented in existing or in other recommended areas for protection in the District. *Helichrysum selago* was not recorded in the Leithen Bush Scenic Reserve but is abundant on the Archies Spur rock bluffs (UMB 19). Nevertheless on the basis of invertebrate records, which although limited by the time available were outstanding (Mr B.H. Patrick, pers. comm.: see Sect. 4.3.3) this area is assigned Priority 1 status. The larger

UMB 7



size of the area here described, and the more diverse plant communities surrounding the prominent rock bluffs outweigh the natural values contained within the Archies Spur area (UMB 19).

Western extension is limited by a rapid transition into highly modified tussockland. Some rock bluffs are separated by scree slopes which in certain places are actively eroding. The situation becomes more acute to the south of Crown Rock. A bulldozed track follows the ridge top fence line.

|                |                                                                     |
|----------------|---------------------------------------------------------------------|
| Area           | c. 150 ha                                                           |
| Altitude range | 1150-1325 m                                                         |
| Aspect         | Ridge top with bluffs facing both easterly and westerly directions. |
| Plot cards     | 016 refer also 012 to 015, 019 (Black Umbrella Range)               |
| Tenure         | Pastoral lease                                                      |

Rock tor vegetation

on ridge

Vegetation and flora

A relatively species-rich community (c. 56) made distinctive by the abundance of the highly palatable and generally rare *Gingidia enysii* var. *peninsulare* which apparently is confined to this group of tors within the District (see Sect. 4.1). Also present, and of restricted distribution are the regionally endemic shrub *Pimelea poppelwellii* and the small grass *Poa maniototo*, the latter constituting the only District record. Other species recorded but of wider distribution, include the shrubs turpentine scrub *Dracophyllum uniflorum*, *Hebe* aff. *rakaiensis* and *Hymenanthera alpina*, the subshrubs snowberry (*Gaultheria depressa*), *Myrsine nummularia* and *Pentachondra pumila*, the climber *Muehlenbeckia complexa*, the ferns *Asplenium richardii*, *Blechnum penna-marina*, *Grammitis poeppigiana*, *Hypolepis millefolium*, *Polystichum cystostegia* and *P. vestitum*, and other herbs such as an undescribed variety of *Anisotome haastii* (see Sect. 4.1.), *Cotula pectinata*, *Epilobium pedunculare* and *Pachycladon novae-zelandiae*.

The lichens *Neuropogon ciliata* and *Umbilicaria cylindrica* are abundant.

Landform

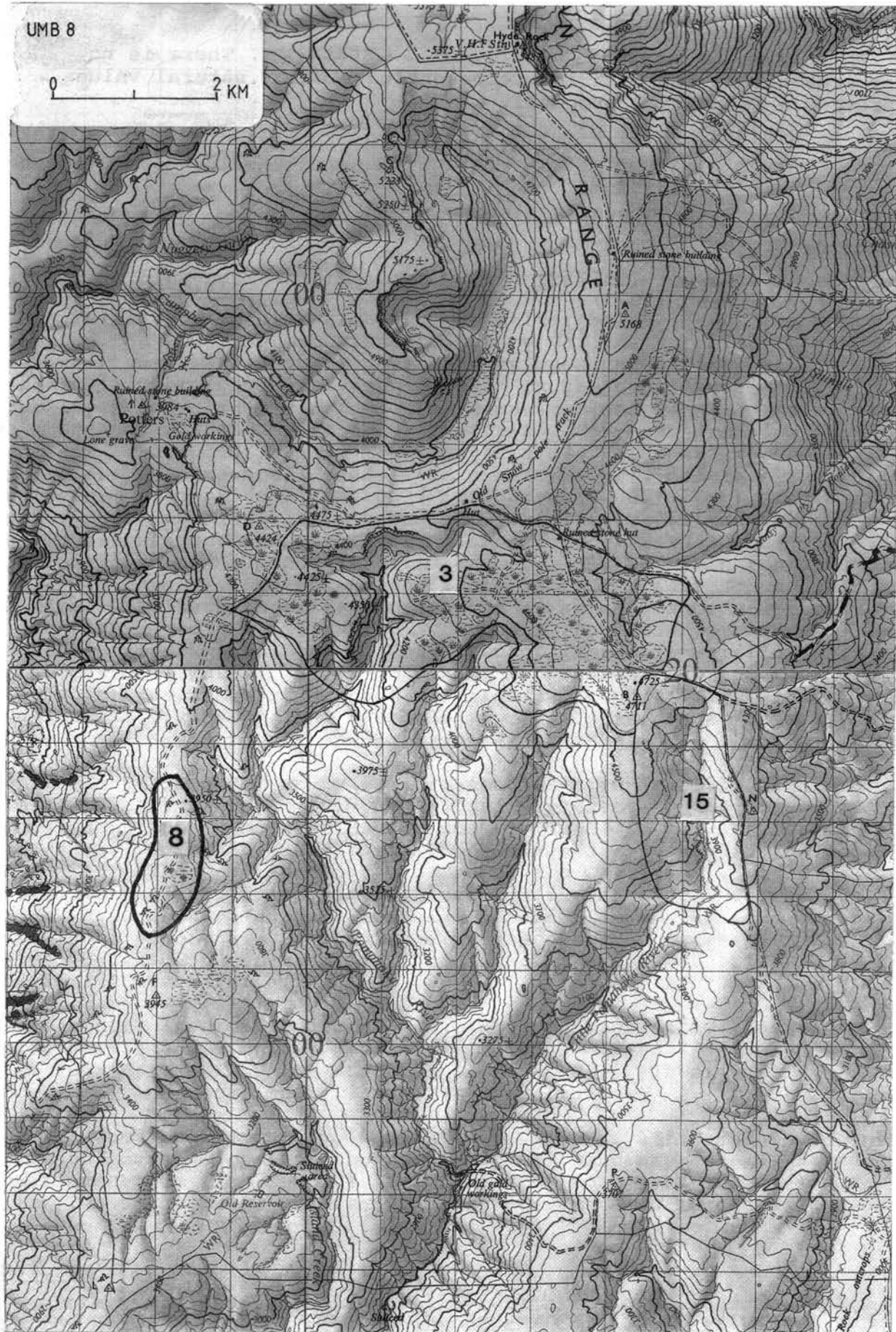
Prominent tors (c. 15 m tall) on the broad ridge-top plateau which separates the catchments of the Waikaia (East Branch) and Pomahaka Rivers.

Soils are derived from schist, have a sandy texture and are classified as high-country yellow-brown earths (Carrick hill soils).

Discussion

These tors are the largest and most prominent of their type within the District and thereby provide the best examples of the ridge top/tor landform. The tors also have a distinctive flora (see above). Although no invertebrates were collected from the tors, rock sites present within the District are often associated with a distinctive fauna (see Sect. 4.3).

A buffer zone is allocated surrounding the tors which consists mainly of tussockland/shrub-tussockland communities dominated by narrow-leaved snow tussock (*Chionochloa rigida*), and also sedgeland. Modification of indigenous vegetation increases dramatically with decreasing altitude, particularly to the west. The Waikaia Bush 'road' currently passes through the centre of the recommended area for protection. The 'road' is not considered to be an appropriate eastern boundary as it passes close to the tors, and a western extension is impractical due to the rapid gradation into highly modified country. Particular problems are associated with the use and abuse of the Waikaia Bush 'road' which in places is routed through wetland associations containing deep peat. The situation regarding vehicle disturbance is particularly acute within, and near, the area identified but is having no apparent effect on its main feature.



112.

This area is assigned Priority 1 status. There is no other area within the District representing similar natural values to provide a Priority 2 proposal.

|                |                              |
|----------------|------------------------------|
| Area           | 110 ha                       |
| Altitude range | 1170-1200 m                  |
| Aspect         | Flat to gently sloping       |
| Plot cards     | 001                          |
| References     | Dawson (1967)<br>Webb (1977) |
| Tenure         | Pastoral lease               |

UMB 09

Pomahaka Tributary

S152 025 007

SN 5380 D/27

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| Silver beech forest                            | in deeply incised valley             |
| <i>Coprosma/Dracophyllum/Corokia</i> shrubland | on rock bluffs and derivative slopes |
| <i>Olearia</i> aff. <i>odorata</i> woodland    | on colluvial slopes                  |

### Vegetation and flora

A relatively species-rich (c. 56) silver beech forest remnant occupying the lower sections and tributary margins bordering the Pomahaka River. The community has a very open understorey with generally low bryophyte and fern cover. In the small tree and shrub layer *Coprosma parviflora*, *C. rhamnoides* and *Corokia cotoneaster* are abundant, whereas *Aristotelia fruticosa*, *Coprosma crassifolia*, koromiko (*Hebe salicifolia*), *Hymenanthera alpina*, inaka (*Dracophyllum longifolium*), lancewood (*Pseudopanax crassifolius*), manuka (*Leptospermum scoparium*), matipo (*Pittosporum tenuifolium*), fool's beech (*Gaultheria antipoda*), broadleaf (*Griselinia littoralis*), *Olearia arborescens* and marbleleaf (*Carpodetus serratus*) are occasional. Weeping mapou (*Myrsine divaricata*), mountain ribbonwood (*Hoheria glabrata*), *Olearia hectorii* and broom (*Cytisus scoparius*) are rare. The herb layer is represented by an abundance of prickly shield fern (*Polystichum vestitum*), catsear (*Hypochaeris radicata*), bracken (*Pteridium esculentum*) and browntop (*Agrostis capillaris*), with occasional ferns: *Blechnum minus*, *B. penna-marina* and the spleenwort *Asplenium richardii*. *Lagenifera pinnatifida*, *Asplenium flaccidum*, *A. terrestre* and *Blechnum fluviatile* are rare, as are the climbers *Clematis marata* and *Fuchsia perscandens*.

The shrubland community is more species-rich (c. 120) than the forest. Silver beech is only occasionally present in the shrub layer. Abundant shrub species include *Carmichaelia virgata*, *Corokia cotoneaster*, *Coprosma parviflora*, *C. propinqua*, *Aristotelia fruticosa* and inaka. Those of sporadic occurrence are *Cassinia fulvida*, manuka, marbleleaf, *Brachyglottis buechananii*, lancewood, *Coprosma rigida*, *Hymenanthera alpina*, kowhai (*Sophora microphylla*) and broadleaf. *Hebe rakaiensis*, three finger (*Pseudopanax colensoi*), *Olearia lineata*, *O. virgata*, *Melicope simplex* and sweet brier (*Rosa rubiginosa*) are rare.

The herb layer includes *Blechnum capense* agg., the spleenworts *Asplenium flaccidum* and *A. richardii*, *Astelia nervosa*, *Uncinia rubra*, *Carex ?virgata* and toe toe (*Cortaderia richardii*) all of rare occurrence, and occasional *Dichelachne crinita*.

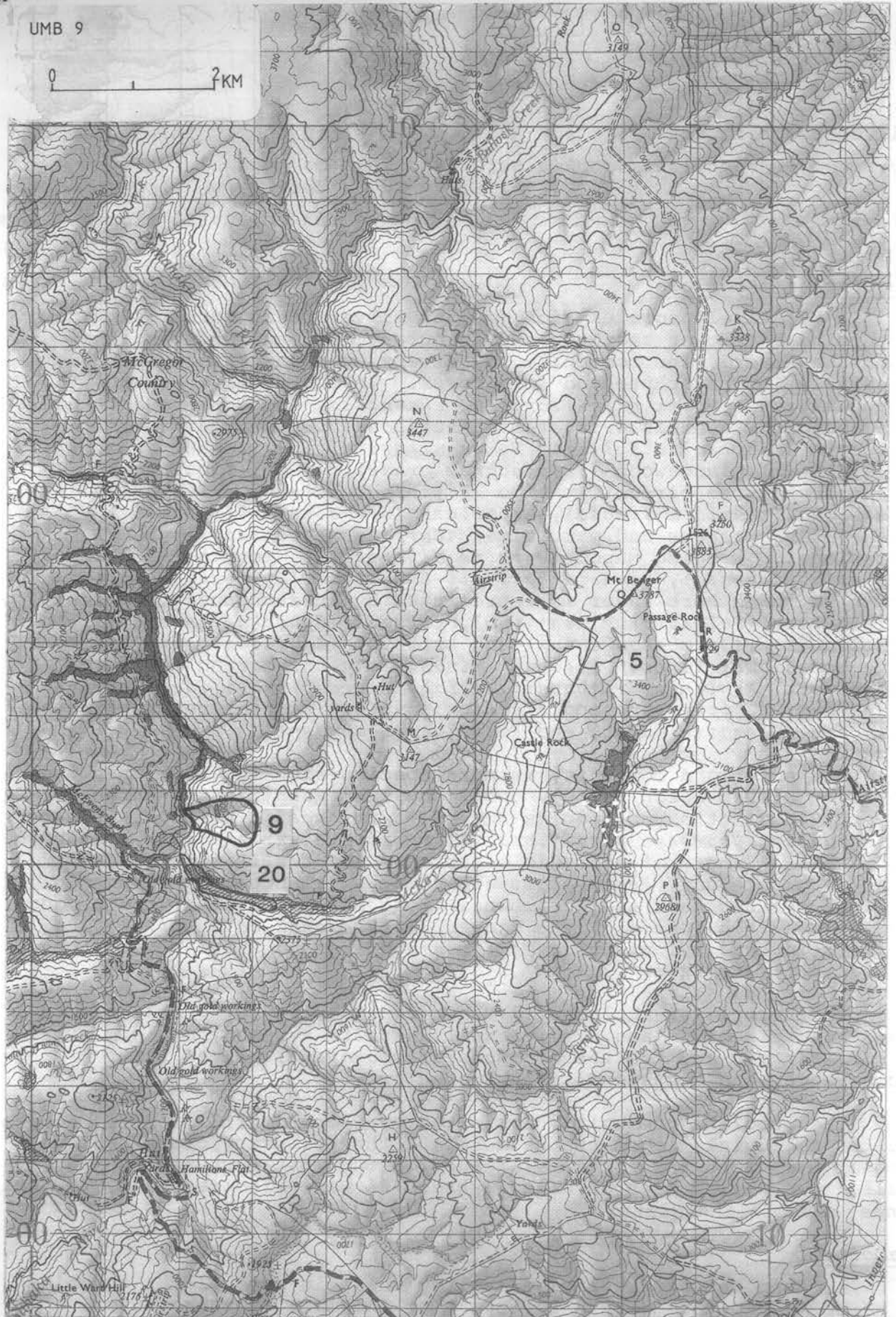
The woodland community, dominated by *Olearia* aff. *odorata*, occurs on the colluvial slopes to the north of the tributary creek. Stands appear even-aged (see Sect. 4.1) and for the most part are c. 4-5 m tall. Two small trees of *Olearia hectorii* were also recorded, the only ones seen in the District.

### Landform

A steep and deeply incised valley which in some places occupies a narrow gorge formed by a tributary of the main Pomahaka River. Two creeks join to form the main tributary alongside which is the beech forest. A rocky backwall separates the two creeks and shrubland occupies the derivative slope developed at its base.

UMB 9

0 1 2 KM



Lowland yellow-brown earths of silt loam and stony loam texture (Tuapeka steep-land soils) derived from schist and schist loess occur within the reserve proposal.

### Fauna

Bird species recorded were blackbird, fantail, yellowhammer, bellbird, yellow-breasted tit and rifleman. Wildlife Service personnel in 1982 recorded blackbird, chaffinch, greenfinch, redpoll, grey warbler, silvereye, rifleman and bellbird in the nearby forest remnant of McEwens Bush as part of the New Zealand Wildlife Service National Habitat Register.

Lepidoptera species recorded from McKay Creek immediately to the south were *Deana hybreasalis* (Walker), *Eudonia psammitis* (Meyrick), *E. sabulosella* (Walker). An undescribed species of *Stigmella* collected from the Pomahaka River is known to have larvae which mine leaves of *Olearia hectorii* and *O. virgata* var. *rugosa*. Several other species were recorded from the general area of the Pomahaka River valley (see Sect. 4.3).

### Discussion

This small catchment contains the least modified remaining shrubland community of the mix *Coprosma/Dracophyllum/Corokia* within the mid-reaches of the Pomahaka catchment. It also includes *Olearia odorata* woodland which appears to be widespread in the mid-altitude, central portions of the District, particularly in the Pomahaka valley. The proposed reserve is surrounded by pasture. Several adventive species occur throughout the beech forest and extend into the margins of the shrubland community. The latter appears to have been largely excluded from stock influence due to difficulties of access. To incorporate the *Olearia odorata* woodland into the area identified it is impossible not to include a large area of low grade poor quality pasture dominated by browntop (*Agrostis capillaris*) and fescue tussock (*Festuca novae-zelandiae*). Above the main stand of silver beech forest isolated beech survivors occur, implying that the forest was once more extensive. Some shrubland vegetation survives on the upper creek margins but is of limited extent. The headwaters of the tributary contains highly modified tussock grassland with a large adventive component and thus do not warrant formal protection.

The Pomahaka Tributary has many species in common with McKay Creek to the south (UMB 20). However, the latter being long and sinuous is of less compact shape and moreover has a higher degree of grazing pressure evident throughout. McKay Creek was therefore considered inferior to the Pomahaka Tributary and has been assigned Priority 2 status.

|                |                                                                 |
|----------------|-----------------------------------------------------------------|
| Area           | 50 ha                                                           |
| Altitude range | 420-700 m                                                       |
| Aspect         | Predominantly westerly with some northerly and southerly faces. |
| Plot cards     | 002<br>003                                                      |
| Tenure         | Pastoral lease                                                  |

UMB 10 Lake Roxburgh Shrubland

S143 140 213  
SN 8215 B/4Kanuka shrubland )  
Kowhai shrubland )on and between rockbluffs and  
along creek marginsVegetation and flora

A kanuka (*Kunzea (Leptospermum) ericoides*) dominated shrubland 3-4 m tall, of patchy density with kowhai (*Sophora microphylla*) c. 4-5 m tall locally dominant. A relatively species-rich (c. 107) mosaic with a number of species occurring here which were not recorded elsewhere in the District, for example the ferns, *Cheilanthes sieberi* (occasional) and *Pellaea rotundifolia* (occasional), the shrub *Hebe pimeleoides* var. *rupestris* (occasional), the herbs *Raoulia australis*, *Chenopodium allanii* (rare), *Calystegia tuguriorum* (occasional), and the grass *Rytidosperma racemosa* (occasional). Species recorded elsewhere in the District but of limited distribution were the shrubs *Carmichaelia compacta* (rare: see Sect. 4.1), *Melicope simplex* (rare), and the climber *Scandia geniculata* (occasional).

Abundant species were the shrubs matagouri (*Discaria toumatou*), sweet brier (*Rosa rubiginosa*), *Coprosma propinqua*, *Helichrysum aggregatum* and wild thyme (*Thymus vulgaris*), the climbers *Rubus schmidelioides* and *Muehlenbeckia complexa*, plus bracken fern (*Pteridium esculentum*). Occasional species included cabbage tree (*Cordyline australis*), the shrubs *Hymenanthera alpina*, koromiko (*Hebe salicifolia*), *Carmichaelia virgata*, *Coprosma parviflora* and *Olearia avicenniifolia*, the climber *Clematis marata*, and the herbs toetoe (*Cortaderia richardii*), fescue tussock (*Festuca novae-zelandiae*), *Dichelachne crinita*, *Polystichum richardii*, a spleenwort (*Asplenium richardii*), blue tussock (*Poa colensoi*) and *Oreomyrrhis ramosa*. Species which occurred only rarely included the shrub *Olearia lineata* and the herbs *Asplenium bulbiferum*, *A. terrestre*, *A. richardii*, *Blechnum chambersii* and *Epilobium pubens*.

Lichens are particularly abundant and diverse on these rock bluffs.

Landform

The most extensive rock bluffs occupy the upper valley slopes above the Clutha River, now dammed to form the hydro-electric impoundment, Lake Roxburgh. Elbow Creek enters Lake Roxburgh from a deeply incised, gorge-like valley flanked by rock bluffs. Differential weathering of the schistose rock has, in places, formed caves above where Elbow Creek flows into Lake Roxburgh. The creek flows over a flat area of deposited alluvial material prior to entering the lake.

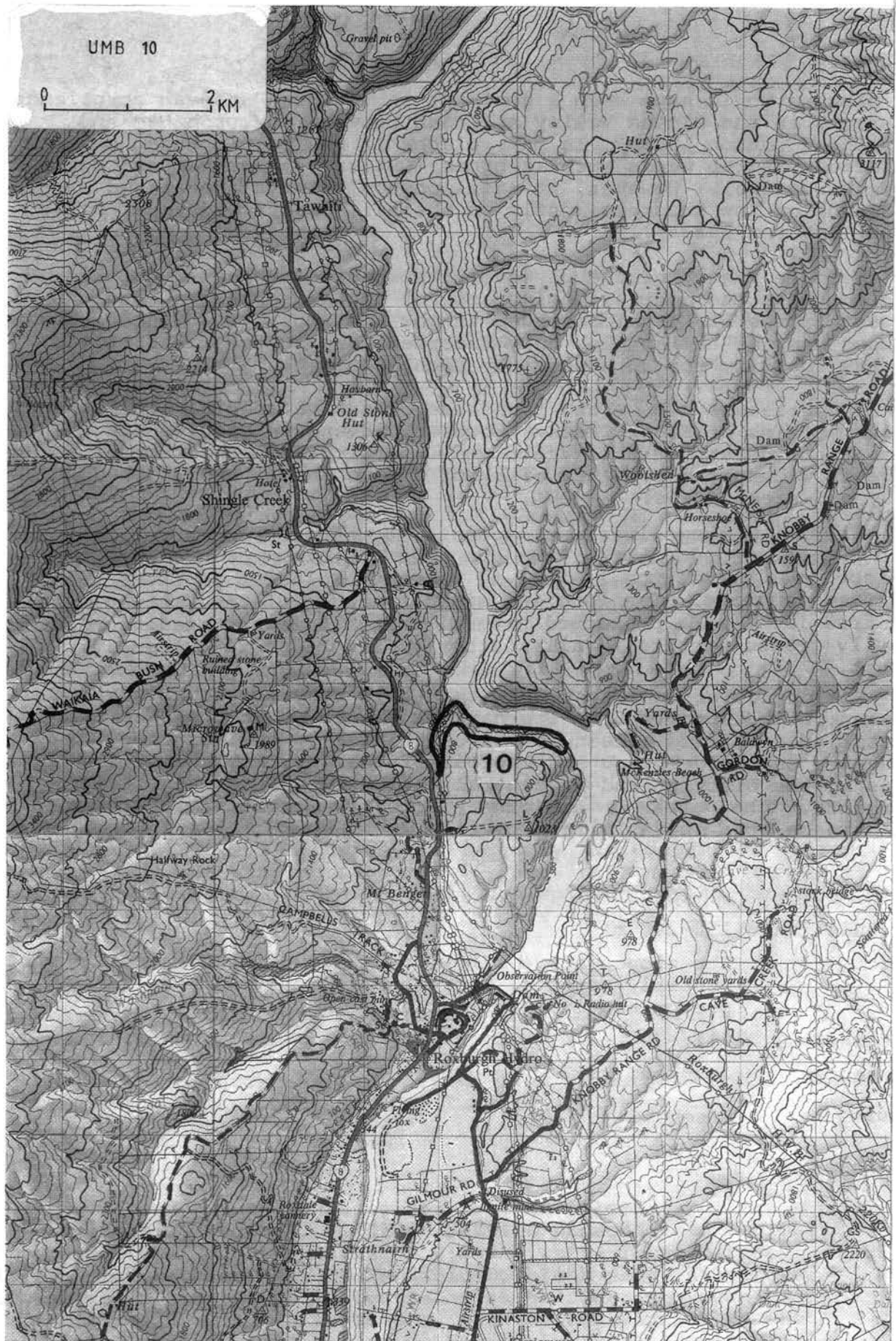
Soils are predominantly derived from schist and loess and form an intergrade between brown-grey and yellow-grey earths (Roxburgh steep-land soils).

Fauna

Birds observed were fantail, grey warbler, black shag, rock pigeon, spur-winged plover and southern black-backed gull. The caves showed some evidence of use as nesting and perching sites.

UMB 10

0 2 KM



### Discussion

Kanuka would have been a dominant in the pre-European scrublands occurring in the Clutha Valley at least between Roxburgh Dam and Beaumont (Johnson 1983a). In many places it has been invaded or replaced by scrub weeds such as broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*). However, it still commonly forms localised woodlands or low thickets mostly on the hill crests and upper hill faces (Johnson 1983a).

Despite the abundance of adventive species, the area identified here contains the most extensive area of kanuka shrubland, and the largest groves of kowhai recorded in the District. The rock bluffs harbour many of the species only recorded here in the District and are the locality for an apparently rich lichen flora.

The greatest number and abundance of native species are present on the margins of Elbow Creek. However, adventive species are common throughout the identified area, particularly sweet brier. There is widespread evidence of stock damage in all except the rocky and steep areas.

The bluffs themselves are separated by pasture, or shrubland with a pasture understorey, but the area of this recommended area for protection (RAP) is too limited to warrant exclusion of these highly modified portions. The long and sinuous nature of the RAP would be far from ideal as a protected natural area. However, gradation into heavily grazed pasture in all southerly directions is extremely abrupt.

The degree of modification within this reserve recommendation substantially detracts from its natural values. Nonetheless, the vegetation contained herein is representative of an indigenous ecosystem once widespread and typical of the dry, lowland valley areas in the District and in central and eastern Otago generally. Therefore, the area is assigned Priority 1 status; there is no adequate area suitable for Priority 2 assignment.

|                |                                                                                                                                      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Area           | c. 40 ha                                                                                                                             |
| Altitude range | 150-240 m                                                                                                                            |
| Aspect         | The slopes above Elbow Creek are of both easterly and westerly aspects, whereas Lake Roxburgh bluffs are predominantly north-facing. |
| Plot cards     | 011                                                                                                                                  |
| References     | Johnson (1983a)                                                                                                                      |
| Tenure         | Freehold                                                                                                                             |

UMB 11

Devil's Gorge

S161 976 872  
SN 5693 E/18

Silver beech forest       )  
Mixed broadleaf forest    )  
Rock bluff vegetation     )                      in deeply incised gorge

### Vegetation and flora

Silver beech (*Nothofagus menziesii*) dominates in patches. Red beech (*N. fusca*) and a red-mountain beech (*N. fusca* X *solandri*) hybrid were recorded but only rarely. The tallest beech specimens (c. 15-20 m) occur on small terraces adjacent to the Pomahaka River. The beech forest grades into forest dominated by broadleaf (*Griselinia littoralis*) and marbleleaf (*Carpodetus serratus*), with a canopy height of c. 5-10 m. *Corokia cotoneaster*, *Coprosma crassifolia*, *C. parviflora*, *C. propinqua*, *Hebe rakaiensis*, *Helichrysum aggregatum*, *matagouri* (*Discaria toumatou*) and manuka (*Leptospermum scoparium*) are abundant in the shrub layer whereas inaka (*Dracophyllum longifolium*) is only locally abundant. *Carmichaelia virgata*, lancewood (*Pseudopanax crassifolius*), fool's beech (*Gaultheria antipoda*), *Olearia aviceniifolia*, *O. odorata*, *O. arborescens* and mountain ribbonwood (*Hoheria glabrata*) are occasional. Rare tree and shrub species include *Teucrium parvifolium* (see Sect. 4.1), kowhai (*Sophora microphylla*), sweet brier (*Rosa rubiginosa*), elderberry (*Sambucus nigra*) and mountain tauhini (*Cassinia vauvilliersii*).

In the herb layer bracken fern (*Pteridium esculentum*), catsear (*Hypochaeris radicata*), *Hypolepis millefolium* and prickly shield fern (*Polystichum vestitum*) are abundant. Those species of sporadic occurrence include several adventives, for example sweet vernal (*Anthoxanthum odoratum*), browntop (*Agrostis capillaris*), white clover (*Trifolium repens*) and sheep's sorrel (*Rumex acetosella*) plus the native species *Phymatosorus diversifolius*, the spleenworts *Asplenium bulbiferum* and *A. flaccidum*, plus *Blechnum minus* and *Uncinia clavata*. Herbs occurring only rarely include *Urtica incisa*, the speargrass *Aciphylla scott-thomsonii*, *Raoulia tenuicaulis*, *Blechnum vulcanicum*, *Carex breviculmis*, the spleenworts *Asplenium flabellifolium* and *A. richardii* plus *Pyrrosia serpens*.

### Landform

A deeply incised section through schist, cut by the Pomahaka River, the area consists of rock bluffs and steep debris slopes on both eastern and western banks.

Lowland yellow-brown earths derived from schist and schist loess of silt loam and stony loam texture (Tuapeka soils) cover the reserve proposal.

### Fauna

Birds recorded were fantail, New Zealand falcon, southern black-backed gull, redpoll. Wildlife Service personnel in February 1980 recorded grey duck, paradise shelduck, white-faced heron, bellbird, grey warbler, New Zealand pipit, black shag, silvereye, yellow-breasted tit, fantail, Australasian harrier, southern black-backed gull, goldfinch, yellowhammer, mallard and skylark in the Devil's Gorge area (Wildlife Service National Habitat Register).

No invertebrates were collected here.



### Discussion

The steepest sections and rock bluffs are generally inaccessible to stock. On the western banks the herb layer is generally sparse and the surface often very friable with unconsolidated rocks and soil. The litter layer, where undisturbed, is c. 5 cm in depth. In places, where the canopy opens adventive species are locally abundant. They are also common on the banks of the Pomahaka River where sheep tracks are evident. Of the *Chionochloa* species only *C. conspicua* is represented, and this but rarely. The area identified has some patches of forest dominated by broadleaf which are separated from the main shrubland and forest area by low-grade pasture. These stands have evidence of stock throughout, with an open understorey and an abundance of adventives.

Despite the high modification to the vegetation in places, the distinctive landform, combined with the plant associations of beech forest and broadleaf forest plus the occurrence of the generally rare shrub *Teucrium parviflorum* merit identification as Priority 1 status. The area should be fenced to exclude stock. Dusky Hill (UMB 18) is an analogous area assigned Priority 2 status.

|                |                                                                                                          |
|----------------|----------------------------------------------------------------------------------------------------------|
| Area           | c. 35 ha                                                                                                 |
| Altitude range | 270-460 m                                                                                                |
| Aspect         | Both easterly and westerly flanks of the Pomahaka River with also northerly and southerly facing slopes. |
| Plot cards     | 007 to 009                                                                                               |
| Tenure         | Freehold and pastoral lease                                                                              |

UMB 12

Awatere: Waikaka Stream  
HeadwatersS161 840 812  
SN 5693 C/5

Tussockland

on valley floor

Mixed beech forest

on gully margins and colluvial  
slopesVegetation and flora

Generally similar to UMB 13. A restricted area of red tussock (*Chionochloa rubra*) community, included in Group 6 of the cluster analysis, occupies the valley floor. Tussock cover is high being in the 75-100% category in the tallest tier present (0.4 to 2 m). Average tussock height is c. 1.4 m with a range of 0.4 to 1.8 m. Other abundant species include the adventives lotus (*L. pedunculatus*) (5-25%) and sweet vernal (*Anthoxanthum odoratum*) (1-5%), plus the native shrub *Coprosma* aff. *intertexta* (1-5%). Species recorded at <1% cover include the shrub mountain tauhini (*Cassinia vauvilliersii*), the subshrub *Pernettya macrostigma*, the herbs *Celmisia* ?*graminifolia* *C. gracilentia*, *Schizeilema cockaynei*, *Gonocarpus aggregatus* and toetoe (*Cortaderia richardii*).

The beech remnant is dominated by silver beech (*Nothofagus menziesii*) for the most part but red beech (*N. fusca*) and mountain beech (*N. solandri* var. *cliffortioides*) are scattered through the lower portions of the stand. The canopy cover is 50-75% with tree height averaging c. 20 m (range of 18 to 22 m). Regeneration of silver beech is patchy and concentrated mainly in the 1 to 2 m height range. The understorey is generally sparse with the shrub *Coprosma rhamnoides* the most abundant species at 1-5% cover. Shrubs having <1% cover are fool's beech (*Gaultheria antipoda*), three-finger (*Pseudopanax colensoi*), lancewood (*P. crassifolius*) and marbleleaf (*Carpodetus serratus*). The ground tier is dominated by the fern *Blechnum minus* (5-25%) with *Nertera dichondrifolia* featuring with 1-5% cover. Other herbs are the spleenworts *Asplenium bulbiferum*, *A. flaccidum*, together with *Blechnum discolor*, *B. vulcanicum*, *Astelia fragrans* and a hooked sedge *Uncinia clavata*. Litter cover is in the 50-75% cover category. The stemless tree fern *Cyathea colensoi* is relatively common in the immediate creek environs.

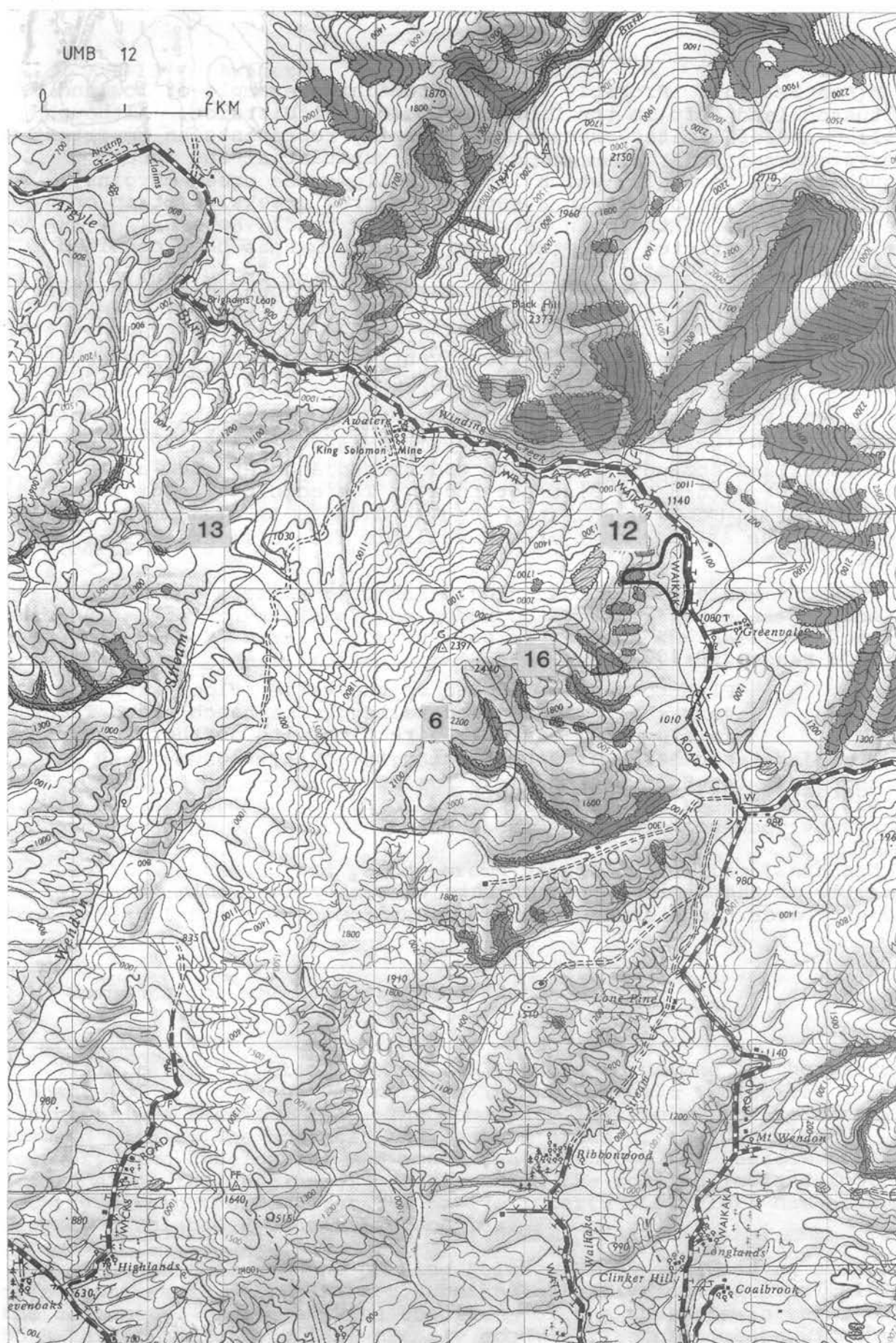
Landform

A broad, flat to gently sloping, shallowly incised valley from which the Waikaka Stream has its source. The beech forest is now restricted to gully margins, the latter having moderately incised the colluvial slopes.

As for UMB 13, upland yellow-brown earths of rolling lands and hills (Pukekoma soils) occur within the area identified. The texture is silt loam, with the soils mainly derived from schist loess over greywacke and semi-schist.

Fauna

Of particular note: two fernbirds were observed within the red tussock community on one occasion (November 1985). It is thought that individual fernbirds may use such tussock communities at several different locations (Mr G. Loh, pers. comm.).



### Discussion

(See UMB 13). Probably the best remaining example of lowland red tussockland left in the Umbrella Ecological District. Although modified and of limited extent the community represents an important reserve recommendation. Evidence of cattle is substantial and occurs throughout the community which largely follows the creek margins. The community also occurs in a separate narrow creekside strip on the eastern side of the main Waikaia-Waikaka road\*. However, despite its restricted size the area identified has been confined to the western side of the road with an extension to include the small stand of mixed beech forest. Pasture or ploughed land borders on all sides with a farm track and electric fence traversing the foot of the slope below the beech stand. The proportion of red tussock decreases, and that of the adventive rush *Juncus effusus* increases as the beech margin is approached.

Nonetheless, this small area within the headwaters of the Waikaka Stream is an important natural area given that the red tussockland community was once widespread and very few areas remain extant within the District today. The combination of this recommendation and UMB 13 as Priority 1 for reservation is far from ideal. However, these are the best areas available from a severely limited choice.

|                |                                                                                                                                                                                                       |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Area           | c. 30 ha                                                                                                                                                                                              |
| Altitude range | 330-400 m                                                                                                                                                                                             |
| Aspect         | Flat to gently sloping on the valley floor with a very shallowly incised valley. The beech stand faces in a general easterly direction with northerly and southerly aspects forming the gully slopes. |
| Plot cards     | 047 to 049 Group 6                                                                                                                                                                                    |
| Tenure         | Freehold                                                                                                                                                                                              |

\* In view of the limited area of this community available an extension over the highway might be considered.

UMB13      Awatere : King Solomon Flats

S161 785 815  
SN 5693 C/5

Tussockland

in shallowly incised valley with a  
broad, almost flat floorVegetation and flora

A restricted red tussock (*Chionochloa rubra*) dominated community falling within Group 6 of the cluster analysis. Red tussock cover generally is in the 25-50% and 50-75% categories. The greatest cover is associated with creek margins. The tussock height ranges from 0.4 to 1.6 m with a mean of c. 1.1 m. The intertussock flora is represented by an abundance of the adventive species lotus (*L. pedunculatus*), browntop (*Agrostis capillaris*) and catsear (*Hypochaeris radicata*) with white clover (*Trifolium repens*) and yorkshire fog (*Holcus lanatus*) also present. Other adventives recorded in the vicinity, but not actually in the plots are gorse (*Ulex europaeus*), broom (*Cytisus scoparius*) and corsican pine (*Pinus nigra*), as well as a range of indigenous species including the shrub *Olearia lineata* plus the herbs *Eleocharis acuta* and *Nertera setulosa*.

Indigenous species recorded within the plots include the shrub *Coprosma parviflora*, the subshrub *Pernettya macrostigma* and the sedge *Carex coriacea*. Other species include the herbs *Anisotome aromatica* var. *flabellifolia*, *Gentiana grisebachii* and *Mentha cunninghamii*.

Landform

A very gently sloping surface forming the base of a shallow valley incised by a source tributary of the Argyle Burn. The area occurs slightly to the north of the divide between the Wendon Stream and Argyle Burn, which drain to the south and north respectively.

Soils are the upland yellow-brown earths of rolling lands and hills (Pukekoma soils). Texturally silt loams, the soils are derived from schist loess over greywacke and semi-schist.

Fauna

Comments for UMB12 apply here also.

Discussion

This rather limited area of red tussock forms one of the largest remnants of the community remaining in the Umbrella Ecological District (see also UMB12). The community is likely to have once covered much of the southern and eastern areas of the District. However, land development has meant that although red tussock still occurs along the margins of creeks and on the rolling lowland foothill country within the District the native intertussock flora has been largely displaced by adventive species.

Although this remnant on King Solomon Flats includes an abundance of adventives it does retain a substantial native component within the community. Moreover, the condition of the tussocks in terms of both height and vigour is extremely good, a rare phenomenon within the District. The remnant is associated with southerly aspects and flats bordering the creek which itself flows northwards to join the Argyle Burn. Cattle impact is pronounced in places.



The area identified is small only because the community is so restricted. As a result, top priority for protection is recommended for all of the red tussock community remaining on King Solomon Flats. The red tussockland is representative of a formerly extensive community, now so endangered within the Umbrella District that, despite the fact that this recommendation plus UMB 12 are substantially the same, both remnants are given Priority 1 ranking.

|            |                                                                                                          |
|------------|----------------------------------------------------------------------------------------------------------|
| Area       | c. 25 ha.                                                                                                |
| Altitude   | 300 m                                                                                                    |
| Aspect     | For the most part flat, or very gently sloping northwards, with some gentle southwesterly facing slopes. |
| Plot cards | 045, 046    Group 6<br>refer also UMB 12.                                                                |
| Tenure     | Freehold                                                                                                 |

UMB 14

Coal Creek Bluffs  
(Rocky Point)S152 096 163  
SN 8215 B/3*Coprosma/Discaria/Olearia* shrublandon rock bluffs and  
derivative slopesVegetation and flora

A dense mixed shrubland (c. 82 species) codominated by *Olearia avicenniifolia*, *matagouri* (*Discaria toumatou*), *Coprosma crassifolia*, *C. propinqua*, *Corokia cotoneaster*, *Carmichaelia virgata* and *kowhai* (*Sophora microphylla*). Other species which are abundant include the shrubs *Helichrysum aggregatum* and *Hymenanthera alpina*, the climbers *Muehlenbeckia australis* and *Fuchsia perscandens* plus the herbs *Phymatosorus diversifolius* and sweet vernal grass (*Anthoxanthum odoratum*). Crack willow (*Salix fragilis*) is locally abundant on the creek margins. Species occurring sporadically include the shrubs gooseberry (*Ribes uva-crispa*), *Cassinia ?fulvida* and *Coprosma rigida*, the climbers *Muehlenbeckia complexa*, *Scandia geniculata* and *Rubus schmidelioides*, and the herbs mountain flax (*Phormium cookianum*), golden spaniard (*Aciphylla aurea*), a spleenwort (*Asplenium hookerianum*), *Blechnum chambersii* and *B. vulcanicum*.

The shrubs *Carmichaelia ?compacta*, *Coprosma rugosa*, *Olearia lineata* and *Aristotelia fruticosa*, the climber *Parsonsia* sp. and herbs *Asplenium terrestre*, *Brachyglottis ?haastii*, narrow-leaved snow tussock (*Chionochloa rigida*), *Libertia ixioides* and *Gingidia montana* occur only rarely.

Landform

Rock bluffs occurring on the south-easterly aspect of a spur formed by the confluence of two deeply incised streams which together form Coal Creek. Incision of the main stream has exploited a fault line so that its erosional effect has been enhanced. The subsidiary creek is thus perched and oversteepened above its confluence with the main stream.

Soils are derived from schist, colluvium and loess and fall within the yellow-grey earths group (Arrow steepland soils). Texture varies from loam to sandy loam, mostly stony.

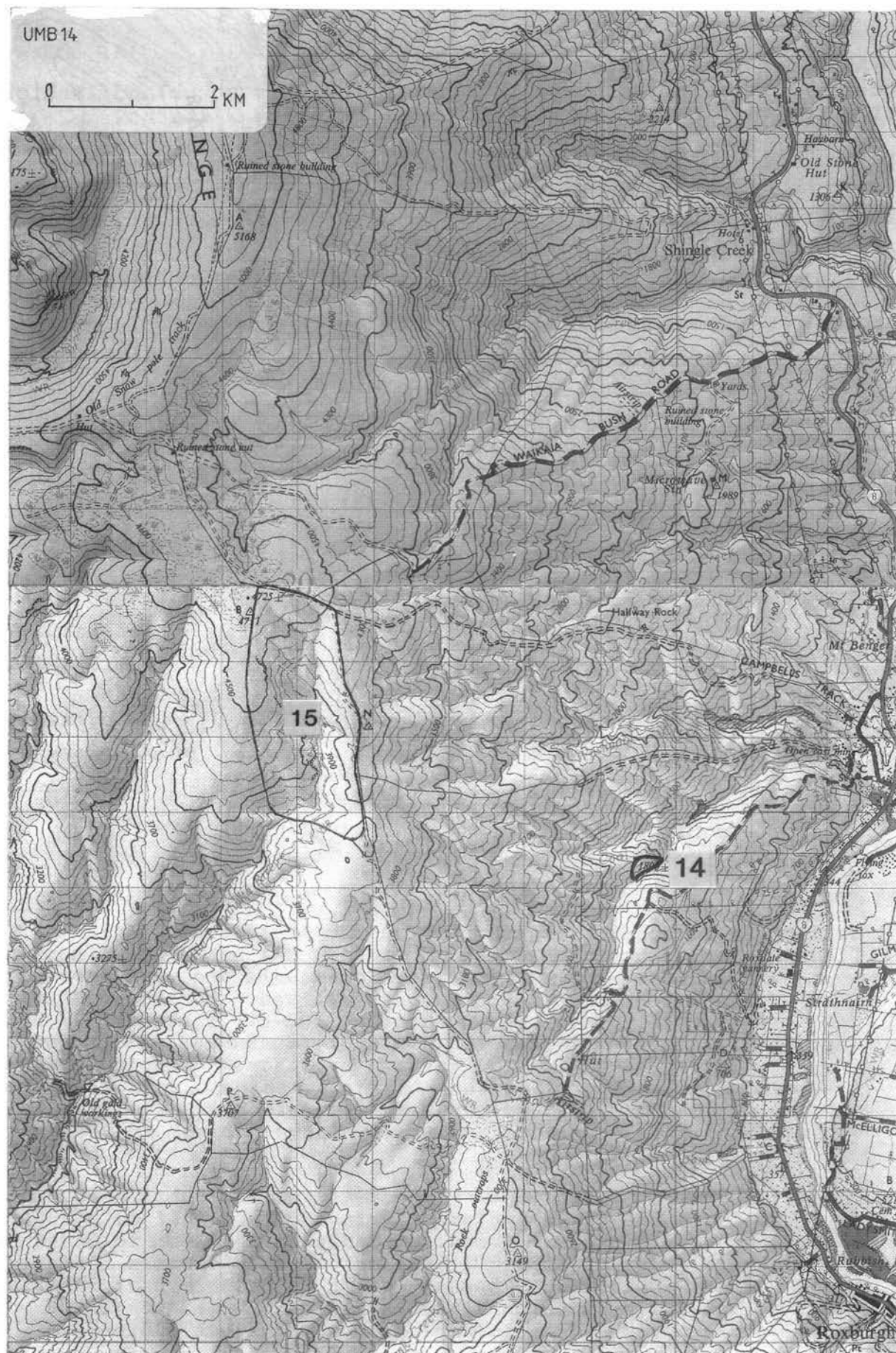
Fauna

Mr P. Child, in October 1979, recorded birds in the scrub and second growth, developed farmland, undeveloped tussockland and stream habitats to the west of Coal Creek. Species noted were hedgesparrow, blackbird, starling, Australasian harrier, South Island pied oystercatcher, spur-winged plover, southern black-backed gull, silvereye, grey warbler, New Zealand pipit, skylark, chaffinch, redpoll and yellowhammer. With the exception of the last four, each species numbered between one and ten. Skylark numbers were estimated as 100+, while the remaining three species were estimated to number between 11 and 100.

Discussion

Inaccessible for the most part to stock the shrubland includes the greatest abundance of *Fuchsia perscandens* recorded in the District. The shrubland also represents the best example of mixed *Coprosma/matagouri/Olearia* shrubland remaining in the District. Some adventive species are locally abundant but overall the exotic component is minor. The shrubland boundary is well defined with a rapid transition to pasture.

UMB 14



Although small, this area is assigned Priority 1 status. There is no adequate substitute for this shrubland/landform combination within the District to merit Priority 2 status.

|                |                 |
|----------------|-----------------|
| Area           | c. 20 ha        |
| Altitude range | 460-530 m       |
| Aspect         | Southeasterly   |
| Plot cards     | 010             |
| Reference      | Johnson (1983a) |
| Tenure         | Freehold        |

UMB 15

Little Pomahaka Headwaters

S152 052 182

SN 8215 B/2

|                                  |                                                              |
|----------------------------------|--------------------------------------------------------------|
| Modified tussockland             | on colluvial slopes<br>on colluvial crest<br>on valley floor |
| Tussockland                      | on colluvial slope<br>on plateau                             |
| Grassland (modified tussockland) | on ridge<br>on colluvial slope<br>on colluvial crest         |
| Tussock-shrubland                | on colluvial slope                                           |
| Shrubland                        | on colluvial slope                                           |
| Herbfield                        | on hummockfield (plateau)<br>on ridge crest                  |
| Grass-sedgeland                  | in nivation hollow                                           |
| Snowbank                         | in nivation hollow                                           |
| Cushionfield                     | on ridge<br>on plateau                                       |
| Sedgeland                        | on terraced wetland                                          |
| Sedge-mossfield                  | on valley floor                                              |
| Sedge-mossfield                  | on colluvial slope<br>on plateau                             |
| Herb-mossfield                   | on plateau                                                   |
| Tussock-sedgeland                | in flush                                                     |
| Herb-sedgeland                   | on plateau<br>in flush<br>on colluvial slope                 |

### Vegetation and flora

The Little Pomahaka catchment encompasses a range of vegetation types from tussockland and wetland to snowbank communities. Group 7 is represented by one site sampled at c. 850 m and described as modified tussockland. Dominated by narrow-leaved snow tussock (*Chionochloa rigida*) (25-50%), cover of the adventive species sweet vernal (*Anthoxanthum odoratum*), catsear (*Hypochaeris radicata*) and white clover (*Trifolium repens*) plus blue tussock (*Poa colensoi*) is high. Golden spaniard (*Aciphylla aurea*) is a canopy subdominant but only achieves 1-5% cover overall. Canopy height averages 0.6 m. Golden spaniard becomes more abundant on northerly aspects and on ridges.

Groups 8 and 9 are represented by 13 sites at altitudes ranging from 1000 m to 1290 m. Communities are generally described as tussockland or modified tussockland, the latter in places modified to grassland status. Some sites have a prominent shrub element. Tussockland is dominated by narrow-leaved snow tussock or slim snow tussock (*Chionochloa macra*) with cover ranging from categories 25-50% to 75-100% and an average height of c. 0.7 m for narrow-leaved



snow tussock and c. 0.5 m for slim snow tussock. Modified sites have a high representation of the adventives sweet vernal, catsear and browntop (*Agrostis capillaris*), plus blue tussock. The latter species dominates in places with cover of 50-75%. In general, frequency and abundance of adventive species increases with decreasing altitude; they are also particularly abundant around the base of rocks and in local flushes. Blue tussock dominates on much of the westerly facing slopes in the headwaters of the catchment. Widespread ground tier species of >1% cover include the subshrubs *Leucopogon fraseri* and snowberry (*Gaultheria depressa*), plus the herbs *Helichrysum bellidioides* and *Geum leiospermum*. The sedge *Carex kirkii* is locally abundant. Species recorded infrequently within the District and contributing <1% cover include the herbs *Schizeilema haastii* var. *cyanopetalum*, *Cotula perpusila* and a hooked sedge *Uncinia sinclairii*. However, the majority of species recorded are widespread and common in the District.

Two sites have prominent shrub cover (50-75%) consisting of turpentine scrub (*Dracophyllum uniflorum*). Narrow-leaved snow tussock is subdominant but varies from 1-5% to 25-50% cover. Blue tussock dominates the ground tier. Infrequent species include the cushions comb sedge (*Oreobolus pectinatus*) and *Dracophyllum muscoides*, plus the shrub *Hebe propinqua*. Bare ground and rock cover in places reaches 5-25%.

Groups 10 and 11 are represented by two sites described as tussockland at c. 1200 m elevation. Narrow-leaved snow tussock or slim snow tussock dominate with cover of 50-75% and average height 0.8 m and 0.5 m, respectively. Slim snow tussock dominates on steep southerly facing slopes with *Brachyglottis revolutus* abundant (5-25%) as a subdominant. Other species include blue tussock (5-25% cover) plus the herbs *Epilobium chlorifolium*, *Celmisia haastii*, *C. laricifolia* and *Astelia nivicola* present at <1% cover. Narrow-leaved snow tussock dominates on northerly facing colluvial slopes with the subshrubs snowberry and *Pimelea oreophila* the most abundant ground tier species (1-5%). Bryophyte and lichen cover is low at both sites.

Group 12 encompasses tussockland to cushionfield communities, which occur at altitudes c. 1160 m to 1340 m. The tussockland sites are generally dominated by slim snow tussock with cover up to 50-75% and average height of 0.5 m. In places, tussock cover is depleted and blue tussock increases in abundance. Locally abundant ground tier species include the cushion *Celmisia sessiliflora* plus the herbs *Geum leiospermum*, *Celmisia prorepens*, *C. haastii* and hooked sedge *Uncinia caespitosa*. Infrequent species include the cushion *Phyllachne colensoi* plus the herb *Montia australasica* and sedges *Carex berggrenii* and *C. hectorii*. Bryophyte and lichen cover is generally <5% while litter cover increases to 5-25% where tussock cover is greatest (50-75%).

Cushionfield sites are dominated by the cushion species *Dracophyllum muscoides* and *Celmisia sessiliflora* with blue tussock subdominant. One site has a cover of 5-25% of sheep sorrel (*Rumex acetosella*). Infrequent species include the cushion species *Phyllachne rubra*, *Raoulia hectorii* and *Hectorella caespitosa* plus the herb *Myosotis pygmaea*, hooked sedge *Uncinia elegans* and *Chionohebe densifolia*. Rock cover varies to a maximum of 5-25%.

One site within Group 12 is codominated by the sedge *Marsippospermum gracile*, a species usually indicative of early snowbanks. The site has been susceptible to particularly heavy grazing. Species of >1% cover are *Poa incrassata* (5-25%), *Epilobium tasmanicum* (1-5%), *Geum leiospermum* (1-5%) and slim snow tussock (1-5%). The cushions *Phyllachne rubra* plus the herbs *Abrotanella inconspicua* and *Montia australasica* were recorded at <1%.

The snowbank communities (Group 13) were documented at two sites (1225 m and 1330 m). Both are classed as early snowbanks although the dominants vary from *Marsippospermum gracile* (5-25%), *Celmisia haastii* (25-50%) and *Luzula pumila* (5-25%) in one to *Drapetes* aff. *lyallii* (25-50%) and *Pernettya alpina* (5-25%) in the other. *Parahebe trifida* is locally dominant. Infrequent species contributing <1% cover include the herbs *Ranunculus enysii*, *R. pachyrrhizus*, *Uncinia drucei*, *Raoulia subulata* and *Luzula leptophylla*.

Group 14 is represented by one species-poor plateau site at 1230 m where a ridge merges into a wetland mosaic. Comb sedge (*Oreobolus pectinatus*) dominates in certain areas, forming a mosaic with the trailing shrub *Dracophyllum prostratum* and the moss *Sphagnum cristatum*. Additional species include the cushion *Phyllachne colensoi* plus the sedges *Carpha alpina* and *Rostkovia magellanica*. Slim snow tussock dominates on the wetland margins.

The sedgeland group (16) was documented at six sites (1130-1340 m) mainly on the plateau areas of the Little Pomahaka headwaters but also on the crest of the western ridge bounding the catchment. This community is widespread in the headwaters of the catchment and is described variously as sedgeland through to herb-mossfield on the basis of dominants which include the sedges *Carex pyrenaica* var. *cephalotes*, *C. gaudichaudiana*, *C. lachenalii*, *Schoenus pauciflorus*, comb sedge and a gentian (*Gentiana amabilis*). All sites have an abundant bryophyte cover of 50-75% to 75-100%. Locally abundant species include the trailing subshrub *Dracophyllum prostratum* plus the herbs *Coprosma pumila*, *Abrotanella caespitosa*, *Celmisia alpina*, blue tussock and *Drapetes* 'bog'. Species of restricted distribution within the District, occurring infrequently, include the herbs *Colobanthus affinis* and *Anisotome imbricata* var. *prostrata*.

The wetland group (17) was documented at three sites with elevations of c. 1080 m to 1190 m on varying aspects. Located in flushes, the community is variously dominated or codominated by *Carpha alpina*, *Celmisia glandulosa*, *C. gracilentia*, *Viola cunninghamii*, *Carex gaudichaudiana*, *C. echinata* and *Schoenus pauciflorus*. Bryophyte cover is included in the categories 25-50% and 75-100%. Infrequent species include the herbs *Cotula squalida*, *Epilobium pernitens*, a rush *Juncus antarcticus* and a grass *Festuca rubra*. Narrow-leaved snow tussock is scattered and of only low overall cover.

Rock bluffs at c. 1360 m on the western slopes at the head of the Little Pomahaka face in easterly and southerly directions. The latter support species such as the subshrub *Brachyglottis revolutus*, the herbs slim snow tussock, *Marsippospermum gracile*, the summer-green fern *Polystichum cystostegia*, *Grammitis poeppigiana* and hooked sedge *Uncinia drucei*. In contrast, the drier easterly aspect supports the shrub *Myrsine nummularia* and herbs narrow-leaved snow tussock, a speargrass (*Aciphylla scott-thomsonii*), *Raoulia grandiflora* and *Epilobium pernitens*.

### Landform

The Little Pomahaka catchment is characterised by extensive plateau areas of deep peat at its head which merge with the plateau of the Pomahaka River headwaters and form the southern extent of the block-faulted erosion surface of the Old Man Range. Nivation hollows occur at the river head which lead into flush and seepage areas. The valley slopes are colluvial showing local areas of slumping. Tussockland communities dominate the colluvial slopes. Rock tors occur on ridge crests and rock bluffs outcrop on both eastern and western slopes (see also UMB 03).

High country yellow-brown earths (Carrick and Carrick hill soils) derived from schist solifluction detritus and some loess cover the area. Texturally, soils are stony loams and silt loams.

### Fauna

Information recorded for UMB 03 is also applicable here.

Bird species recorded were New Zealand falcon, southern black-backed gull, paradise shelduck, skylark, South Island pied oyster-catcher, black shag, New Zealand pipit, banded dotterel and kea. The last was recorded as a single individual on the eastern flanks of the Little Pomahaka (c. 1325 m). The banded dotterel, also recorded on only one occasion, had one chick and was recorded in the area on the east boundary ridge dominated by blue tussock.

### Discussion

The catchment of the Little Pomahaka contains no vegetation or flora which were not recorded elsewhere in the District. The catchment appears to have been subjected to a higher degree of grazing by both sheep and cattle than the area described as UMB 03 (Pomahaka Headwaters). Sheep and cattle faeces, pocking of bogs, grazed vegetation and tracks are widespread. Nevertheless, the catchment has substantial natural values, and is representative of the landforms typical of the northern part of the Umbrella District.

In comparison with the natural values contained within the combined Pomahaka and Boulder Creek recommended area for protection the Little Pomahaka has undergone greater modification. As a result, the proposal is put forward as Priority 2, comprising a substitute for UMB 03 in terms of vegetation.

Faunal values would appear similar to UMB 03 although the only record for banded dotterel in the District was made here, and kea were not recorded in the area identified in the Pomahaka Headwaters.

|                |                                                                      |                    |
|----------------|----------------------------------------------------------------------|--------------------|
| Area           | c. 370 ha                                                            |                    |
| Altitude range | c. 1065-1440 m                                                       |                    |
| Aspect         | Generally southerly with easterly and westerly facing valley slopes. |                    |
| Plot cards     | 208                                                                  | Group 7            |
|                | 209 - 221                                                            | Group 8            |
|                | 222 - 223                                                            | Group 10           |
|                | 224 - 230                                                            | Group 12           |
|                | 231 - 232                                                            | Group 13           |
|                | 233                                                                  | Group 14           |
|                | 234 - 239                                                            | Group 16           |
|                | 240 - 242                                                            | Group 17           |
|                | 243                                                                  | Rock bluffs        |
|                |                                                                      | Refer also UMB 03. |
| Tenure         | Pastoral lease                                                       |                    |

UMB 16      Awatere: Charlie's Hill North

SL61 825 805  
SN 5693 C/5

|                            |                                                        |
|----------------------------|--------------------------------------------------------|
| Modified shrub-tussockland | ( on colluvial slope<br>( on ridge<br>( on gully slope |
| Shrub-tussockland          | on ridge crest                                         |
| Modified shrubland         | on gully slope                                         |
| Shrubland                  | on gully slope<br>on ridge crest                       |
| Rich beech forest          | on gully slope                                         |

Vegetation and flora

Similar to UMB 06. With the exception of the beech stand which is included in Group 3 all the communities described by dominants are classified into Group 7.

The shrub-tussockland community is dominated by narrow-leaved snow tussock (*Chionochloa rigida*), narrow-leaved X red tussock (*C. rubra*) hybrids or fescue tussock (*Festuca novae-zelandiae*). Height in the tallest tier ranges from 0.4 to 0.9 m, averaging 0.6 m. In places, however, canopy height does not exceed 0.4 m. Species of cover 1-5% in the 0.1-0.4 m height category are the shrubs *Coprosma cheesemanii* and *Hebe* aff. *rakaiensis*, plus the subshrub *Pernettya macrostigma*. Abundant species in the ground tier (0-0.1m) are also *P. macrostigma* (25-50%) and the herbs *Celmisia densiflora*, *Rytidosperma gracile* and sweet vernal (*Anthoxanthum odoratum*). Species present with <1% cover include the herbs *Pimelea oreophila*, *Lachnagrostis lyallii*, annual eyebright (*Euphrasia zelandica*), *Ophioglossum coriaceum* and *Herpolirion novae-zelandiae*.

The shrubland community is variously dominated by mountain tauhini (*Cassinia vauvilliersii*), manuka (*Leptospermum scoparium*), *Coprosma parviflora*, inaka (*Dracophyllum longifolium*) and *Hebe propinqua*. Cover of the dominants is included in the categories 5-25% and 25-50%. They are generally contained within the height tier 0.4-2 m, with a mean of c. 1 m. Sites located on beech margins feature <1% cover of pepper tree (*Pseudowintera colorata*), silver beech (*Nothofagus menziesii*), lancewood (*Pseudopanax crassifolius*) and marbleleaf (*Carpodetus serratus*). The ground tier is dominated by the shrub *Coprosma cheesemanii*, the subshrub *Pernettya macrostigma* and the fern *Blechnum minus*. Species having 1-5% cover include sweet vernal, browntop (*Agrostis capillaris*), fescue tussock, blue tussock (*Poa colensoi*), and catsear (*Hypochaeris radicata*). Species having <1% cover include three hooked sedges (*Uncinia affinis*, *U. purpurata* and *U. rubra*) plus *Brachyglottis southlandica* and *Gunnera monoica*.

The forest remnant is dominated by silver beech in all height tiers, with canopy height averaging 23 m and cover 50-75%. Beech regeneration is dense, particularly where the canopy opens and on the stand margins where dense pole regrowth of silver beech is present.



Understorey density is generally patchy with the thickest vegetation occurring alongside the creek in a c. 20 m strip. In general, shrub species are mostly of low cover representation with *Coprosma colensoi* and *C. rhamnoides* the most abundant, at 1-5%. Other small trees and shrubs present are broadleaf (*Griselinia littoralis*), marbleleaf, lancewood, *Coprosma parviflora* and pepper tree as well as the stemless tree fern *Cyathea colensoi*. Species occurring (<1% cover) in the ground tier include the herbs *Luzuriaga parviflora*, crepe fern (*Leptopteris superba*), *Grammitis billardieri*, *Epilobium pedunculare* plus orchids *Gastrodia cunninghamii* and *Adenochilus gracilis*. Bryophyte cover is generally low (<5%).

#### Landform (see UMB 06)

A moderately incised valley bounded by stable valley slopes. The channel drains eastwards.

Soils are the same as for PNA 06, that is lowland yellow-brown earths (Tuapeka soils) plus some elements of upland yellow-brown earths (Pukekoma hill soils).

#### Fauna (see UMB 06)

Additional bird species recorded were Australasian harrier, redpoll, skylark and New Zealand pipit.

#### Discussion

This recommended area for protection encompasses plant associations very similar to those present within UMB 06. Shrubland with *Hebe propinqua* as a prominent component is widespread with all sites sampled having high species richness. However, in comparison with UMB 06 grazing impact by both sheep and cattle is considerably higher in this identified area. In many places tussock cover is severely depleted with sheep tracks abundant. Shrub cover increases on shady aspects and also on the beech forest margins. Stock impact appears moderate to high within the stand itself.

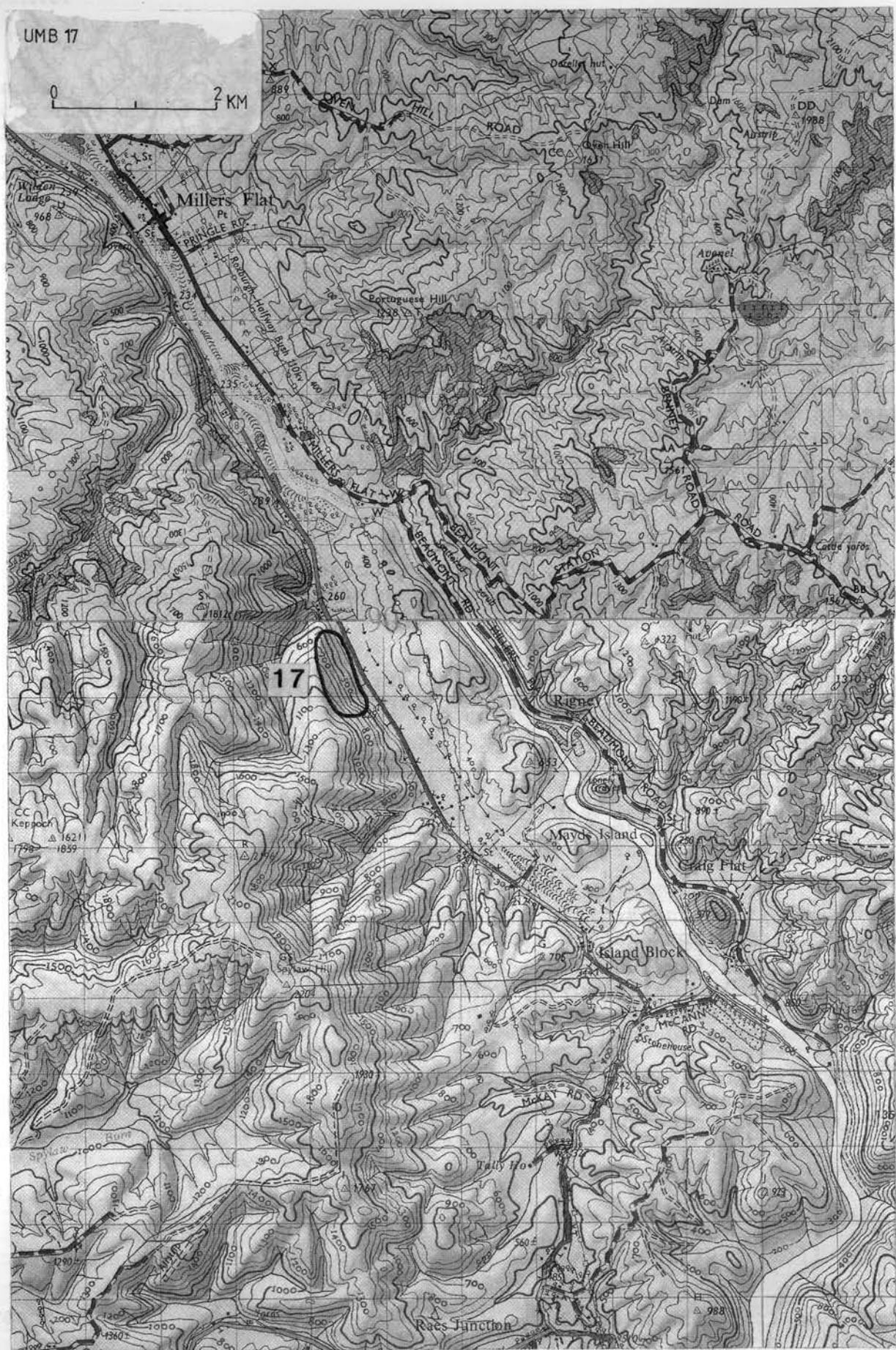
The factors relating to vegetation modification, grazing impact and general vegetation depletion detract somewhat from the outstanding nature of the plant communities distinctive to the Charlie's Hill area. In comparison to UMB 06 this recommended area for protection assumes second priority.

|                |                                                                                                                                       |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Area           | c. 70 ha                                                                                                                              |
| Altitude range | 365-730 m                                                                                                                             |
| Aspect         | Generally easterly with northerly and southerly facing valley slopes.                                                                 |
| Plot cards     | 078, 079      Group 3<br>070 to 077 Group 7<br>Refer also 050 to 069 (Awatere: Charlie's Hill South)<br>and 080 (Awatere: Black Hill) |
| Tenure         | Freehold                                                                                                                              |



UMB 17

0 2 KM



UMB 18

Dusky Hill Slopes

S161 995 745

SN 8215 G/2

Mixed broadleaf forest

on rock bluff margins and derivative  
slopes

Rock bluff vegetation

Vegetation and flora

Species number c. 72 with broadleaf (*Griselinia littoralis*) and marbleleaf (*Carpodetus serratus*) codominant and a canopy height of 3 to 6 m. Abundant shrub species include *Coprosma ciliata*, *C. propinqua*, matipo (*Pittosporum tenuifolium*), *Hymenanthera alpina*, *Corokia cotoneaster*, matagouri (*Discaria toumatou*) and inaka (*Dracophyllum longifolium*). Those species occurring sporadically were *Olearia arborescens*, broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), mountain tauhini (*Cassinia vauvilliersii*), koromiko (*Hebe salicifolia*), *Coprosma crassifolia*, *Carmichaelia virgata* and *Hebe rakaiensis*. The small trees, kowhai (*Sophora microphylla*) and cabbage tree (*Cordyline australis*) also occur occasionally. Three-finger (*Pseudopanax colensoi*), *Coprosma rugosa*, pepper tree (*Pseudowintera colorata*), and wineberry (*Aristotelia serrata*) occur only rarely.

In the herb layer *Phymatosorus diversifolius*, *Phormium ?tenax*, *Blechnum capense* agg., *Blechnum minus* and *Astelia nervosa* are abundant. Yorkshire fog (*Holcus lanatus*), sweet vernal (*Anthoxanthum odoratum*), *Brachyglottis southlandica*, a hooked sedge *Uncinia clavata*, bracken fern (*Pteridium esculentum*) and the fern ally *Lycopodium varium* are occasional. Rare species include douglas fir (*Pseudotsuga menziesii*), a speargrass (*Aciphylla glaucescens*), a mountain daisy (*Celmisia semicordata* var. *aurigans*), narrow-leaved snow tussock (*Chionochloa rigida*), and the primitive fern ally *Tmesipteris tannensis* (see Sect. 4.1).

Landform

Rock bluffs and associated derivative slopes on the eastern flanks of the Pomahaka River which occupies a deeply incised valley leading into Dusky Gorge, and separates Leithen Hill and Dusky Hill.

Lowland yellow-brown earths with related hill and steep land soils (Tuapeka) occur within the identified area. Texture varies from silt loam to stony loam and soils are derived from schist with patches of schist loess.

Fauna

Birds recorded were silvereye, bellbird, yellow-breasted tit, fantail, grey warbler, blackbird and Australasian harrier. Wildlife Service personnel in February 1980 identified New Zealand pigeon, bellbird, fantail, grey warbler, yellow-breasted tit, yellow-crowned parakeet, brown creeper, silvereye, black shag, white-faced heron, grey duck, redpoll, greenfinch, chaffinch, goldfinch, blackbird, song thrush, hedgesparrow and mallard in Dusky Gorge on the Pomahaka River just to the south-west of this priority natural area.

Invertebrates were not collected from this recommended area for protection.



### Discussion

The steep rock bluffs which encircle the head of this small area of broadleaf forest have restricted stock access. The northeastern limits of the identified area are fenced.

The forest is distinguished by abundant fern cover throughout which contrasts greatly with unfenced/accessible broadleaf forest patches in the vicinity. Adventives dominate the herb layer only in the upper forest margins at the base of the rock bluffs. However, there is a rapid transition to heavily grazed pasture above the bluffs with only a few scattered narrow-leaved snow tussocks. Adventive infestation in the main area of forest appears limited. A small stand of beech forest occurs on the western banks of the Pomahaka River below Leithen Hill but is not included in the proposed reserve as heavily grazed pasture surrounds it.

The forest is bounded by a margin of thick *Coprosma*, matagouri and *Corokia* shrubland which has a herb layer dominated by adventives.

On the basis of landform and the presence of mixed broadleaf forest this area is assigned Priority 2 status, being viewed as a complementary area to Devil's Gorge (UMB 11).

|                |                         |
|----------------|-------------------------|
| Area           | c. 30 ha                |
| Altitude range | 330-490 m               |
| Aspect         | Predominantly westerly  |
| Plot cards     | 005<br>and refer to 006 |
| Tenure         | Freehold                |

UMB 19

Archies Spur

S152 915 947

SN 5380 D/26

Rock bluff vegetation

on ridge

Vegetation and flora

Three prominent rock bluffs with a particularly rich flora (c. 96 species), some species of which are restricted in distribution and here achieve their greatest abundance within the District. For example the shrub *Helichrysum selago* (see Sect. 4.1) and the herb *Schizaeilema haastii*. Edelweiss (*Leucogenes grandiceps*) is abundant. Other species of note are the shrubs mountain ribbonwood (*Hoheria glabrata*), *Olearia nummularifolia*, inaka (*Dracophyllum longifolium*) and koromiko (*Hebe salicifolia*). Herbs include the filmy ferns *Hymenophyllum sanguinolentum* and *H. multifidum*, *Aciphylla lecomtei*, plus an undescribed variety of *Anisotome haastii* (see Sect. 4.1).

Landform

High (c. 30 m) rock bluffs of schist which outcrop on the south side of a north-west/south-east trending spur leading south-eastwards from the main Black Umbrella Range. The spur forms the catchment boundary between the deeply incised valleys occupied by Archies Creek and Gorge Creek.

High country yellow-brown earths with related steepland soils (Waikaia) occur within the area. Texturally, stony loams and silt loams, these soils are derived from greywacke and semi-schist.

Fauna

Whilst no vertebrates or invertebrates were actually recorded from these bluffs comments relating to the Black Umbrella Range apply (refer to Sect. 4.3 and UMB 04).

Discussion

These prominent rock bluffs are surrounded by depleted tussock-land which has been recently burnt and contains a large proportion of adventive species. Cattle, hare and possum faeces were evident.

A small recommended area for protection though of significance for the abundance of vegetation representative of prominent high altitude rock outcrops on the Umbrella Mountains. The small area, and the fact that the vegetation and flora is represented either in the existing Leithen Bush Scenic Reserve, or in other areas identified in this report (UMB 04) results in the Archies Spur area being given Priority 2 status. Priority 1 status for this vegetation/landform type is given to Crown Rock/Stronach Hill (UMB 07).

Area c. 25 ha

Altitude range 945-1080 m

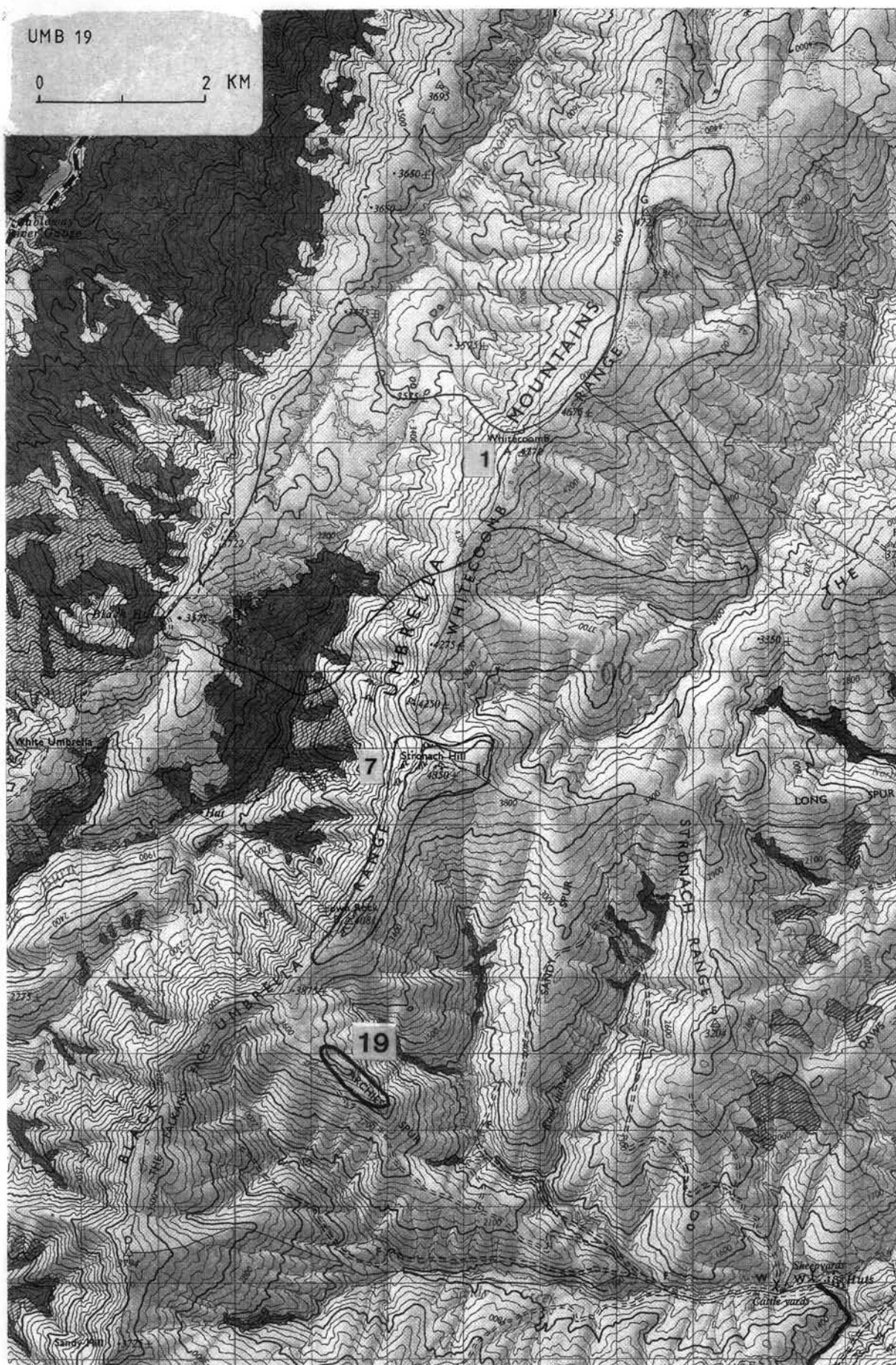
Aspect Rock bluffs face south-westerly

Plot cards 012

Tenure Pastoral lease

UMB 19

0 2 KM



Silver beech forest )  
*Olearia*, aff. *odorata* woodland )  
*Coprosma/Corokia* shrubland )

in deeply incised valley  
 in narrow gorge

### Vegetation and flora

The three communities present within McKay Creek cover small areas and merge with one another. In total, species present number c. 103 with silver beech (*Nothofagus menziesii*) codominant with *Olearia odorata* in the lower sections nearest to the Pomahaka River. Elsewhere, kowhai (*Sophora microphylla*) is locally dominant as trees (c. 5 m tall) in the mid-sections on northerly aspects with abundant small trees and shrubs of matipo (*Pittosporum tenuifolium*), broadleaf (*Griselinia littoralis*), *Coprosma parviflora*, *Corokia cotoneaster*, *Carmichaelia virgata* and *Hymenanthera alpina*. *Coprosma crassifolia* is locally abundant while there are occasional mountain tauhini (*Cassinia vauvilliersii*), manuka (*Leptospermum scoparium*), mountain ribbonwood (*Hoheria glabrata*), elderberry (*Sambucus nigra*), matagouri (*Discaria toumatou*), koromiko (*Hebe salicifolia*), inaka (*Dracophyllum longifolium*), *Olearia virgata*, *Aristotelia fruticosa*, *Hebe rakaiensis* and cabbage tree (*Cordyline australis*). Those shrub species occurring only rarely include *Melicope simplex*, *Olearia lineata*, weeping mapou (*Myrsine divaricata*), *Helichrysum aggregatum*, *Coprosma rigida* and three-finger (*Pseudopanax colensoi*).

The herb layer is dominated by mountain flax (*Phormium cookianum*), prickly shield fern (*Polystichum vestitum*), bracken fern (*Pteridium esculentum*) and fescue tussock (*Festuca novae-zelandiae*). Toe toe (*Cortaderia richardii*), *Phymatosorus diversifolius*, *Dichelachne crinita*, scotch thistle (*Cirsium vulgare*), the spleenwort *Asplenium richardii* and narrow leaved snow tussock (*Chionochloa rigida*) are occasional, while golden spaniard (*Aciphylla aurea*), *Lagenifera pinnatifida*, *Epilobium pernitens*, *E. nummularifolium* and *Gingidia montana* are rare. Of the climbing species, bush lawyer (*Rubus schmidelioides*) is abundant, whereas *Clematis marata*, *Fuchsia perscandens* and *Scandia geniculata* are rare.

### Landform

A deeply incised creek, in some places forming a narrow gorge overlooked by steep slopes and rock bluffs. The McKay Creek catchment is far more extensive than that of the Pomahaka Tributary (UMB 09) and the gradient less steep, particularly in the lower sections where the creek approaches the Pomahaka River.

Lowland yellow-brown earths derived from schist and schist loess and of silt loam and stony loam texture occur in the area identified and its immediate surroundings.

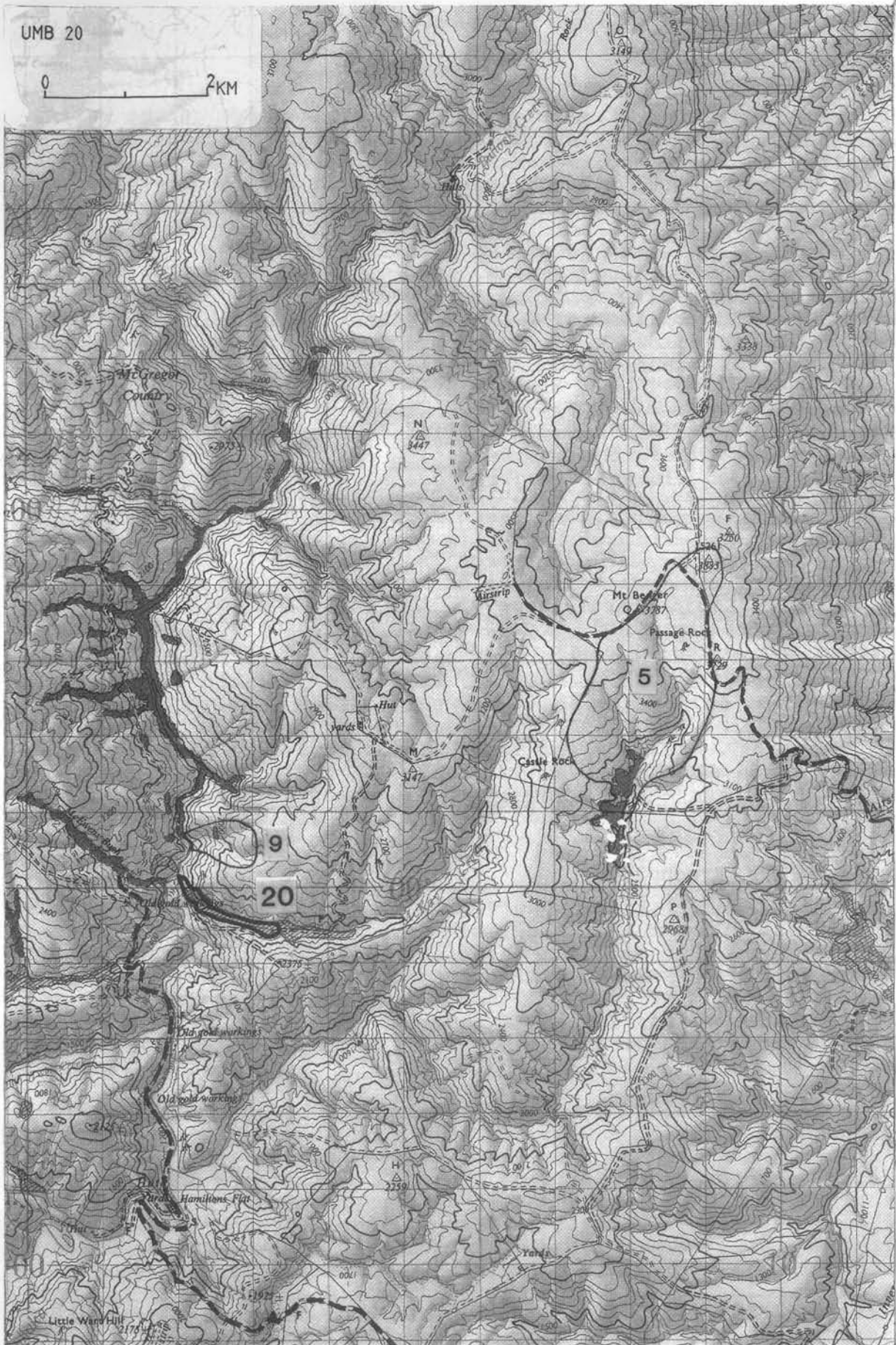
### Fauna

Bird species recorded were blackbird, yellowhammer, New Zealand pipit, skylark, yellow-breasted tit, redpoll, fantail and New Zealand falcon.

The comments for Lepidoptera given for UMB 09 also apply here.

UMB 20

0 2KM



### Discussion

Groves of *Olearia* aff. *odorata* woodland are extensive on the valley slopes bordering McKay Creek but patchy in their distribution. Generally, the shrubland remnants are more extensive on the northerly aspects whereas fescue tussock, prickly shield fern and several adventive herbaceous species dominate on southerly aspects.

Except on the steep, rocky sections the evidence of stock damage is widespread (e.g. tracks, open understorey, faeces). Possum faeces were also recorded. The margins of the lower (western) section of shrubland show evidence of recent fire with burnt manuka stems.

Dominant tussockland species are restricted to only a few isolated narrow-leaved snow tussocks on southerly aspects and a very small patch (<25% cover) on a northerly aspect near the upper (eastern) shrubland margin.

Forest dimples in the vicinity of McKay Creek on slopes above the Pomahaka River imply that beech forest was once more extensive in the area. The abundance of *Hymenanthera alpina* in this identified area compared to its sporadic occurrence in the Pomahaka Tributary must be noted. Low altitude hillsides of *Hymenanthera* are considered key sites for Lepidoptera. However, the shape and small area of the McKay Creek shrubland, together with the large adventive presence and degree of stock damage, lead to the lower priority recommendation for protection than given for UMB 09.

|                |                                                    |
|----------------|----------------------------------------------------|
| Area           | c. 20 ha                                           |
| Altitude range | 400-500 m                                          |
| Aspect         | Westerly with steep northerly and southerly slopes |
| Plot cards     | 004                                                |
| Tenure         | Freehold                                           |

## CHAPTER 6

## DISCUSSION AND GENERAL CONCLUSIONS

Without the P.N.A. survey programme the Umbrella Ecological District would probably have remained biologically little known. Few biologists had ventured into the more remote parts of the District and as a consequence the abundance and diversity of indigenous biota present in the high-altitude areas has surprised many. This realisation underlines the importance of the New Zealand-wide programme, and the urgency with which it must be undertaken given future land development options.

The current survey has shown that it is possible for one professionally trained person, plus a competent half-time field assistant, to complete the assessment of a district within 12 months. It is desirable and has been possible to pay attention not only to the landforms and plant associations plus their flora, but also to much of the fauna, thereby creating a detailed inventory of the natural values within a given district. The present survey was greatly enhanced by the knowledge of specialists, particularly in the zoological aspects and their contribution cannot be underestimated. Whilst these experts undoubtedly would have preferred to range more widely in their collections, detailed recording was concentrated in the more diverse and least modified portions of the District due to the limited time available for the survey. Nonetheless, faunal collections were made during the reconnaissance and detailed study phases of the survey, thus providing valuable distributional data from a wide range of localities. However, no claim is being made that a definitive study has been made of the District's fauna. Even so, the information made available during this P.N.A. survey has made a major contribution to the knowledge of wildlife in Otago and Southland.

The use of fixed-area plots in the survey proved to be a useful method for recording plant communities. Initially analyses were intended to make use of the randomly-placed 4 m<sup>2</sup> plot data for the non-forest types. However, this area proved too small to adequately record plant composition (see Chapter 4) and hence the data from the subjectively-placed larger (20 m x 10 m) plot were used. It is recommended that in future the larger plot size only should be used in the field and that each plot should be randomly located.

Field description of community types based on dominant species did not always agree closely with the groups differentiated using cluster analysis of presence-absence data. Nevertheless, both approaches have merit and serve to complement one another, particularly the objective assessment of the data in the recognition of community types. Floristic and quantitative information provide important data on which selection of recommended areas for protection may be based. Moreover, documentation of the little known flora of the Umbrella District by the establishment of a voucher collection has proved invaluable. In some cases field identifications have been modified after further study, including comparison with other herbarium material or consultation with individuals having expertise in particular groups. The collection provides

important reference material which may be accessed by a wider audience than those directly involved with the survey itself.

Existing protected natural areas within a District must be assessed to provide a comparison with data collected from non-protected areas. This procedure provides greater objectivity in the formulation of recommended areas for protection made as a result of survey. It is not surprising that in the Umbrella District predominantly forest habitats had been protected to date. This is consistent with the pattern for the eastern South Island (Allen 1978, Kelly 1972). The Priority 1 and 2 rankings initially proposed by the Old Man team were adopted in the present report. In the case of the Umbrella District, where much of the area is highly modified, second priority areas were not always available. Moreover, the Priority 2 areas identified are generally less viable in terms of size and lower in natural values than areas encompassing similar vegetation and landform assigned Priority 1 status. In implementing this report, emphasis should be laid on securing protection of Priority 1 areas. The present situation is particularly acute for lowland red tussock communities where only very small areas survive, and in a modified form.

The Umbrella Ecological District contains a wide range of indigenous fauna and flora. The options available for securing the best of the indigenous ecosystems remaining are decreasing rapidly. Implementation of the recommendations implicit in this report is seen as a matter of urgency.

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APPENDIX I: Plant species of the Umbrella Ecological District. Botanical names and appropriate common names are given together with general remarks relating to species distribution. Those species included in the cluster analysis classification (see Sect. 4.2) are annotated according to the Species Class (A to P) in which they occurred.

\* = Adventive species

| Species                                             | Common Name        | Species Class | Remarks                     |
|-----------------------------------------------------|--------------------|---------------|-----------------------------|
| <i>Abrotanella caespitosa</i>                       | -                  | B             |                             |
| <i>A. inconspicua</i>                               | -                  | D             | On southern Old Man Range   |
| <i>A. aff. inconspicua</i>                          | -                  | K             | On Umbrella Mountains       |
| <i>Acaena anserinifolia</i>                         | bidibid            | -             |                             |
| <i>A. anserinifolia</i> x <i>incermis</i>           | "                  | -             |                             |
| <i>A. anserinifolia</i> x undescribed "916"         | "                  | -             |                             |
| <i>A. buehananii</i>                                | "                  | -             |                             |
| <i>A. caesiiglauc</i>                               | "                  | O             |                             |
| <i>A. novae-zelandiae</i>                           | "                  | -             |                             |
| <i>A. profundeincisa</i>                            | "                  | O             |                             |
| <i>A. saecaticaulis</i>                             | "                  | -             |                             |
| <i>A. undescribed "916"</i>                         | "                  | -             |                             |
| <i>Aciphylla aurea</i>                              | golden spaniard    | D             |                             |
| <i>A. glaucescens</i>                               | speargrass         | -             |                             |
| <i>A. hectorii</i>                                  | "                  | K             | Southeastern limit          |
| <i>A. hectorii</i> x <i>aurea</i>                   |                    |               |                             |
| <i>A. hectorii</i> x <i>scott-thomsonii</i>         |                    |               |                             |
| <i>A. lecontei</i>                                  | "                  | -             |                             |
| <i>A. aff. horrida</i> ("lomondii")                 | "                  | -             |                             |
| <i>A. pinnatifida</i>                               | "                  | F             | Southeastern limit          |
| <i>A. scott-thomsonii</i>                           | "                  | K             |                             |
| <i>A. ?incermis</i>                                 | "                  | -             | One plant seen Timber Creek |
| <i>Adenochilus gracilis</i>                         | -                  | -             |                             |
| * <i>Agrostis capillaris</i>                        | browntop           | O             |                             |
| <i>A. ?dyeri</i>                                    | -                  | -             |                             |
| <i>A. mucosa</i>                                    | -                  | O             |                             |
| <i>A. pallescens</i>                                | -                  | K             |                             |
| <i>A. subulata</i>                                  | -                  | K             |                             |
| * <i>Aira caryophyllaea</i>                         | silvery hair grass | -             |                             |
| <i>Alepis flavida</i> ( <i>Flytranthé flavida</i> ) | mistletoe          | I             |                             |
| * <i>Anagallis arvensis</i>                         | scarlet pimpernel  | -             |                             |
| <i>Anemone tenuicaulis</i>                          | native anemone     | E             |                             |
| <i>Anisotome aromatica</i>                          | -                  | K             |                             |
| <i>A. aromatica</i> var. <i>flabellifolia</i>       | -                  | E             |                             |
| <i>A. brevistylis</i>                               | -                  | K             |                             |
| <i>A. flavosa</i>                                   | -                  | K             |                             |
| <i>A. hastii</i> var. <i>undescribed</i>            | -                  | -             | Southeastern limit          |
| <i>A. imbricata</i>                                 | -                  | L             | Southeastern limit          |
| <i>A. imbricata</i> var. <i>prostrata</i>           | -                  | B             | Southeastern limit          |
| * <i>Anthoxanthum odoratum</i>                      | sweet vernal       | O             |                             |
| * <i>Aphanes arvensis</i>                           | parsley piert      | -             |                             |
| <i>Apocynopsis bifolia</i>                          | -                  | D             |                             |
| * <i>Arenaria corymbifolia</i>                      | sandwort           | -             |                             |
| <i>Aristotelia fruticosa</i>                        | -                  | -             |                             |
| <i>Aristotelia serrata</i>                          | wineberry          | -             |                             |
| <i>Arthropodium candidum</i>                        | star lily          | -             |                             |
| <i>Asplenium bulbiferum</i>                         | spleenwort         | -             |                             |
| <i>A. flabellifolium</i>                            | "                  | -             |                             |
| <i>A. flavicolum</i>                                | "                  | -             |                             |
| <i>A. hookerianum</i>                               | "                  | -             |                             |
| <i>A. richardii</i>                                 | "                  | J             |                             |
| <i>A. terrestre</i>                                 | "                  | -             |                             |
| <i>Astelia fragrans</i>                             | -                  | -             |                             |
| <i>A. linearis</i>                                  | -                  | K             |                             |
| <i>A. nervosa</i>                                   | -                  | P             |                             |
| <i>A. nivicola</i>                                  | -                  | K             | Southeastern limit          |
| <i>Aucuba rubra</i>                                 | -                  | -             |                             |

| <u>Species</u>                                          | <u>Common Name</u> | <u>Species Class</u> | <u>Remarks</u>     |
|---------------------------------------------------------|--------------------|----------------------|--------------------|
| <i>Blachnum capense</i>                                 | -                  | -                    |                    |
| <i>B. plumieri</i>                                      | -                  | -                    |                    |
| <i>B. colensoi</i>                                      | -                  | -                    |                    |
| <i>B. discolor</i>                                      | -                  | I                    |                    |
| <i>B. fluviatile</i>                                    | -                  | J                    |                    |
| <i>B. membranaceum</i>                                  | -                  | -                    |                    |
| <i>B. minus</i>                                         | -                  | J                    |                    |
| <i>B. penma-marina</i>                                  | -                  | O                    |                    |
| <i>B. procerum</i>                                      | -                  | -                    |                    |
| <i>B. vulcanicum</i>                                    | -                  | -                    |                    |
| <i>Brachycome radicata</i>                              | -                  | I                    |                    |
| <i>B. sinclairii</i>                                    | -                  | L                    |                    |
| <i>Brachyglottis bellidioides</i>                       | -                  | L                    |                    |
| (= <i>Senecio bellidioides</i> )                        |                    |                      |                    |
| <i>B. buechananii</i>                                   | -                  | I                    |                    |
| (= <i>Senecio bennettii</i> )                           |                    |                      |                    |
| <i>B. cassinioides</i>                                  | -                  | -                    | Southeastern limit |
| (= <i>Senecio cassinioides</i> )                        |                    |                      |                    |
| <i>B. phaastii</i>                                      | -                  | -                    |                    |
| (= <i>Senecio haastii</i> )                             |                    |                      |                    |
| <i>B. revoluta</i>                                      | -                  | K                    |                    |
| (= <i>Senecio revolutus</i> )                           |                    |                      |                    |
| <i>B. southlandica</i> var. <i>albidula</i>             | -                  | P                    |                    |
| (= <i>Senecio southlandicus</i> var. <i>albidulus</i> ) |                    |                      |                    |
| * <i>Bromus diandrus</i>                                | ripgut brome       | -                    |                    |
| * <i>B. sterilis</i>                                    | barren brome       | -                    |                    |
| <i>Bulbinella angustifolia</i>                          | Maori onion        | O                    |                    |
| <i>Caladenia lyallii</i>                                | -                  | -                    |                    |
| <i>Callitriche stagnalis</i>                            | -                  | -                    |                    |
| <i>Caltha obtusa</i>                                    | -                  | K                    | Southeastern limit |
| <i>Calystegia tugurionum</i>                            | -                  | -                    |                    |
| * <i>Capsella bursa-pastoris</i>                        | Shepherd's purse   | -                    |                    |
| <i>Cardamine bilobata</i>                               | -                  | L                    |                    |
| <i>C. ?corymbosa</i>                                    | -                  | -                    |                    |
| <i>C. debilis</i>                                       | -                  | K                    |                    |
| <i>C. uniflora</i>                                      | -                  | D                    |                    |
| <i>Carex acicularis</i>                                 | -                  | -                    |                    |
| <i>C. berggrenii</i>                                    | -                  | K                    |                    |
| <i>C. breviculmis</i>                                   | -                  | I                    |                    |
| <i>C. buechananii</i>                                   | -                  | -                    |                    |
| <i>C. colensoi</i>                                      | -                  | D                    |                    |
| <i>C. coriacea</i>                                      | -                  | M                    |                    |
| <i>C. dissita</i>                                       | -                  | -                    |                    |
| <i>C. echinata</i>                                      | -                  | H                    |                    |
| <i>C. flagellifera</i>                                  | -                  | -                    |                    |
| <i>C. gaudichaudiana</i>                                | -                  | B                    |                    |
| <i>C. hectorii</i>                                      | -                  | C                    | Southeastern limit |
| <i>C. kirkii</i>                                        | -                  | D                    | Southeastern limit |
| <i>C. lachenalii</i>                                    | -                  | B                    |                    |
| * <i>C. ovalis</i>                                      | oval sedge         | M                    |                    |
| <i>C. pyrenaica</i> var. <i>cephalotes</i>              | -                  | C                    | Southeastern limit |
| <i>C. secta</i>                                         | niggerhead         | -                    |                    |
| <i>C. sinclairii</i>                                    | -                  | -                    |                    |
| <i>C. uncinifolia</i>                                   | -                  | -                    |                    |
| <i>C. virgata</i>                                       | -                  | -                    |                    |
| <i>C. wakatipu</i>                                      | -                  | O                    |                    |
| <i>Carmichaelia compacta</i>                            | -                  | -                    |                    |
| <i>C. ?petrei</i>                                       | -                  | -                    |                    |
| <i>C. virgata</i>                                       | -                  | -                    |                    |
| <i>Carpha alpina</i>                                    | -                  | K                    |                    |
| <i>Carpodetus serratus</i>                              | marbleleaf         | A                    |                    |
| <i>Cassinia fulvida</i>                                 | -                  | -                    |                    |
| <i>C. vauvilliersii</i>                                 | mountain tauhini   | P                    |                    |

| <u>Species</u>                                | <u>Common Name</u>         | <u>Species Class</u> | <u>Remarks</u>     |
|-----------------------------------------------|----------------------------|----------------------|--------------------|
| <i>Calmisia alpina</i>                        | mountain daisy             | R                    |                    |
| <i>C. brevifolia</i>                          | "                          | K                    | Southeastern limit |
| <i>C. densiflora</i>                          | "                          | P                    |                    |
| <i>C. glandulosa</i>                          | "                          | D                    |                    |
| <i>C. gracilentia</i>                         | "                          | O                    |                    |
| <i>C. gracilentia</i> x <i>semicordata</i>    | "                          | -                    |                    |
| <i>C. aff. graminifolia</i>                   | "                          | M                    |                    |
| <i>C. haastii</i>                             | "                          | C                    |                    |
| <i>C. hectorii</i>                            | "                          | K                    | Southeastern limit |
| <i>C. laricifolia</i>                         | "                          | L                    | Southeastern limit |
| <i>C. 'linearis'</i>                          | "                          | -                    |                    |
| <i>C. lyallii</i>                             | false spaniard             | K                    |                    |
| <i>C. prorepens</i>                           | mountain daisy             | O                    |                    |
| <i>C. ramulosa</i> var. <i>tuberculata</i>    | -                          | -                    |                    |
| <i>C. semicordata</i> var. <i>aurigans</i>    | -                          | K                    |                    |
| <i>C. semicordata</i> var. <i>striata</i>     | -                          | -                    |                    |
| <i>C. sessiliflora</i>                        | -                          | K                    |                    |
| <i>C. verbasifolia</i>                        | -                          | -                    | Southeastern limit |
| <i>C. viscosa</i>                             | -                          | K                    | Southeastern limit |
| <i>C. walkeri</i>                             | -                          | -                    | Southeastern limit |
| * <i>Centaurium erythraea</i>                 | centaury                   | -                    |                    |
| <i>Centella uniflora</i>                      | -                          | -                    |                    |
| <i>Centrolepis ciliata</i>                    | -                          | -                    |                    |
| <i>Centrolepis pallidula</i>                  | -                          | D                    |                    |
| * <i>Cerastium fontanum</i>                   | mouse-ear chickweed        | D                    |                    |
| * <i>C. glomeratum</i>                        | annual mouse-ear chickweed | -                    |                    |
| <i>Cheilanthes sieberi</i>                    | -                          | -                    |                    |
| <i>Chenopodium allanii</i>                    | -                          | -                    |                    |
| <i>Chiloglottis cornuta</i>                   | -                          | I                    |                    |
| <i>Chionochoila conspicua</i>                 | -                          | -                    |                    |
| <i>C. macra</i>                               | slim snow tussock          | K                    | Southeastern limit |
| <i>C. macra</i> x <i>rubra</i>                | -                          | -                    |                    |
| <i>C. rigida</i>                              | narrow-leaved snow tussock | O                    |                    |
| <i>C. rigida</i> x <i>macra</i>               | -                          | L                    |                    |
| <i>C. rubra</i>                               | red tussock                | M                    |                    |
| <i>C. rubra</i> x <i>rigida</i>               | -                          | M                    |                    |
| <i>Chionochebe densifolia</i>                 | -                          | L                    | Southeastern limit |
| <i>C. thomsonii</i>                           | -                          | -                    | Southeastern limit |
| * <i>Cirsium arvense</i>                      | Californian thistle        | -                    |                    |
| * <i>C. vulgare</i>                           | scotch thistle             | -                    |                    |
| <i>Clematis marata</i>                        | -                          | -                    |                    |
| <i>C. paniculata</i>                          | -                          | L                    |                    |
| <i>Colobanthus affinis</i>                    | -                          | -                    |                    |
| <i>C. aretalis</i>                            | -                          | -                    |                    |
| <i>C. buchmanii</i>                           | -                          | -                    | Southeastern limit |
| <i>C. ?cavaliolatus</i>                       | -                          | K                    | Southeastern limit |
| <i>C. strictus</i>                            | -                          | -                    |                    |
| * <i>Conium maculatum</i>                     | hemlock                    | -                    |                    |
| <i>Coprosma atropurpurea</i>                  | -                          | -                    |                    |
| <i>C. cheesemani</i>                          | -                          | P                    |                    |
| <i>C. ciliata</i>                             | -                          | J                    |                    |
| <i>C. colensoi</i>                            | -                          | A                    |                    |
| <i>C. crassifolia</i>                         | -                          | -                    |                    |
| <i>C. cuneata</i>                             | -                          | J                    |                    |
| <i>C. depressa</i>                            | -                          | -                    |                    |
| <i>C. foetidissima</i>                        | -                          | -                    |                    |
| <i>C. aff. intertexta</i> (sp. f)             | -                          | -                    |                    |
| <i>C. linariifolia</i>                        | -                          | J                    |                    |
| <i>C. lucida</i>                              | -                          | -                    |                    |
| <i>C. parviflora</i>                          | -                          | P                    |                    |
| <i>C. aff. parviflora</i>                     | -                          | -                    |                    |
| <i>C. propinqua</i>                           | -                          | J                    |                    |
| <i>C. pseudocuneata</i>                       | -                          | -                    |                    |
| <i>C. aff. pseudocuneata</i> ('alpina' sp. a) | -                          | J                    |                    |
| <i>C. pumila</i>                              | -                          | K                    |                    |
| <i>C. rhamnoides</i>                          | -                          | A                    |                    |
| <i>C. rigida</i>                              | -                          | -                    |                    |
| <i>C. rotundifolia</i>                        | -                          | -                    |                    |
| <i>C. rugosa</i>                              | -                          | -                    |                    |
| <i>C. serrulata</i>                           | -                          | -                    |                    |

| <u>Species</u>                                            | <u>Common Name</u>    | <u>Species Class</u> | <u>Remarks</u>     |
|-----------------------------------------------------------|-----------------------|----------------------|--------------------|
| <i>Cordyline australis</i>                                | cabbage tree          | -                    |                    |
| <i>Coriaria angustissima</i>                              | -                     | -                    |                    |
| <i>C. "lurida"</i>                                        | -                     | -                    |                    |
| <i>C. plumosa</i>                                         | -                     | D                    |                    |
| <i>C. sarmentosa</i>                                      | tutu                  | E                    |                    |
| <i>Corokia cotoneaster</i>                                | -                     | -                    |                    |
| <i>Cortaderia richardii</i>                               | toetoe                | -                    |                    |
| <i>Corybas trilobus</i>                                   | -                     | J                    |                    |
| <i>Cotula goyenii</i>                                     | -                     | -                    | Southeastern limit |
| <i>C. pectinata</i>                                       | -                     | K                    |                    |
| <i>C. pectinata</i> var. <i>villosa</i>                   | -                     | -                    |                    |
| <i>C. pectinata</i> var. <i>willcoxii</i>                 | -                     | -                    | Southeastern limit |
| <i>C. perpusilla</i>                                      | -                     | D                    |                    |
| <i>C. squalida</i>                                        | -                     | D                    |                    |
| <i>Craspedia lanata</i>                                   | -                     | K                    |                    |
| <i>C. minor</i>                                           | -                     | -                    |                    |
| <i>C. uniflora</i>                                        | -                     | K                    |                    |
| <i>Cranula sinclairii</i>                                 | -                     | -                    |                    |
| * <i>Crepis capillaris</i>                                | smooth hawksbeard     | -                    |                    |
| <i>Ctenopteris heterophylla</i>                           | -                     | -                    |                    |
| <i>Cyathea colensoi</i>                                   | stemless tree fern    | -                    |                    |
| <i>Cyathodes empetrifolia</i>                             | -                     | D                    |                    |
| <i>C. pumila</i>                                          | -                     | -                    |                    |
| * <i>Cynosurus cristatus</i>                              | -                     | -                    |                    |
| <i>Cystopteris tasmanica</i>                              | -                     | -                    |                    |
| * <i>Cytisus scoparius</i>                                | european broom        | -                    |                    |
|                                                           |                       |                      |                    |
| * <i>Dactylis glomerata</i>                               | cocksfoot             | -                    |                    |
| <i>Deschampsia ?novae-zelandiae</i>                       | -                     | -                    |                    |
| <i>D. novae-zelandiae</i>                                 | -                     | D                    |                    |
| <i>Deyeuxia aucklandica</i>                               | -                     | D                    |                    |
| <i>D. avenoides</i>                                       | -                     | P                    |                    |
| <i>D. avenoides</i> var. <i>brachyantha</i>               | -                     | -                    |                    |
| <i>D. youngii</i>                                         | -                     | -                    |                    |
| * <i>Dianthus armeria</i>                                 | deptford pink         | -                    |                    |
| <i>Dichelachne crinita</i>                                | -                     | -                    |                    |
| <i>Dichondra brevifolia</i>                               | -                     | -                    |                    |
| <i>D. repens</i>                                          | -                     | -                    |                    |
| * <i>Digitalis purpurea</i>                               | foxglove              | -                    |                    |
| <i>Discaria tomentosa</i>                                 | matagouri             | -                    |                    |
| <i>Dolichoglottis lyallii</i>                             | yellow snow groundsel | E                    |                    |
| (= <i>Senecio lyallii</i> )                               |                       |                      |                    |
| <i>Donatia novae-zelandiae</i>                            | -                     | E                    |                    |
| <i>Dracophyllum longifolium</i>                           | inaka                 | P                    |                    |
| <i>D. ?longifolium</i> x <i>prostratum</i>                | -                     | -                    |                    |
| <i>D. muscoides</i>                                       | -                     | K                    | Southeastern limit |
| <i>D. prostratum</i>                                      | -                     | B                    |                    |
| <i>D. uniflorum</i>                                       | turpentine scrub      | K                    |                    |
| <i>Drapetes 'bog'</i>                                     | -                     | R                    |                    |
| <i>D. dieffenbachii</i>                                   | -                     | K                    |                    |
| <i>D. laxus</i>                                           | -                     | D                    |                    |
| <i>D. aff. lyallii</i>                                    | -                     | C                    |                    |
| <i>D. villosus</i>                                        | -                     | K                    | Southeastern limit |
| <i>Drosera arcturi</i>                                    | sundew                | B                    |                    |
|                                                           |                       |                      |                    |
| <i>Elaeocarpus hookerianus</i>                            | pokaka                | I                    |                    |
| <i>Eleocharis acuta</i>                                   | spike-rush            | -                    |                    |
| <i>E. gracilis</i>                                        | -                     | -                    |                    |
| <i>Elymus rectisetus</i>                                  | wheat-grass           | D                    |                    |
| (= <i>Agropyron scabrum</i> )                             |                       |                      |                    |
| <i>Epilobium alsinoides</i> subsp. <i>atriplicifolium</i> | willowherb            | O                    |                    |
| <i>E. billardiereanum</i> subsp. <i>cinerium</i>          | "                     | -                    |                    |
| <i>E. brunneescens</i>                                    | "                     | D                    |                    |
| <i>E. chionanthum</i>                                     | "                     | -                    |                    |
| <i>E. chlorifolium</i>                                    | "                     | E                    |                    |
| <i>E. ciliatum</i>                                        | "                     | -                    |                    |
| <i>E. glabellum</i>                                       | "                     | E                    |                    |
| <i>E. komarovianum</i>                                    | "                     | B                    |                    |

| <u>Species</u>                           | <u>Common Name</u>    | <u>Species</u><br><u>Class</u> | <u>Remarks</u>     |
|------------------------------------------|-----------------------|--------------------------------|--------------------|
| <i>Epilobium macropus</i>                | willowherb            | -                              |                    |
| <i>E. melanocaulon</i>                   | "                     | -                              |                    |
| <i>E. microphyllum</i>                   | "                     | E                              |                    |
| <i>E. nummulariifolium</i>               | "                     | -                              |                    |
| <i>E. pedunculare</i>                    | "                     | J                              |                    |
| <i>E. pernitens</i>                      | "                     | D                              |                    |
| <i>E. pictum</i>                         | "                     | -                              |                    |
| <i>E. porphyrium</i>                     | "                     | K                              |                    |
| <i>E. pubens</i>                         | "                     | -                              |                    |
| <i>E. tasmanicum</i>                     | "                     | C                              | Southeastern limit |
| <i>E. sp.</i>                            | "                     | D                              |                    |
| * <i>Erodium cicutarium</i>              | storksbill            | -                              |                    |
| <i>Erythranthera australis</i>           | -                     | D                              |                    |
| <i>E. pumila</i>                         | -                     | O                              |                    |
| <i>Euphrasia australis</i>               | eyebright             | -                              |                    |
| <i>E. dyeri</i>                          | "                     | B                              |                    |
| * <i>E. nemorosa</i>                     | "                     | N                              |                    |
| <i>E. zelandica</i>                      | "                     | P                              |                    |
| <i>Festuca matthewsii</i>                | alpine fescue         | -                              |                    |
| <i>F. multinodis</i>                     | -                     | D                              |                    |
| <i>F. novae-zelandiae</i>                | fescue (hard) tussock | M                              |                    |
| <i>F. rubra</i>                          | -                     | D                              |                    |
| <i>F. sp.</i>                            | -                     | -                              |                    |
| <i>Forstera sedifolia</i>                | -                     | K                              | Southeastern limit |
| <i>F. tenella</i>                        | -                     | E                              |                    |
| <i>Fuchsia colensoi</i>                  | -                     | -                              |                    |
| <i>F. excorticata</i>                    | -                     | I                              |                    |
| <i>F. perseandens</i>                    | -                     | -                              |                    |
| <i>Grimardia setacea</i>                 | -                     | E                              |                    |
| * <i>Galium aparine</i>                  | goosegrass            | E                              |                    |
| <i>G. perpusillum</i>                    | -                     | M                              |                    |
| <i>G. propinquum</i>                     | -                     | -                              |                    |
| <i>Gastrodia ?cunninghamii</i>           | -                     | -                              |                    |
| <i>Gaultheria antipoda</i>               | fool's beech          | I                              |                    |
| <i>G. crassa</i>                         | -                     | P                              |                    |
| <i>G. depressa</i>                       | snowberry             | O                              |                    |
| <i>Gentiana amabilis</i>                 | -                     | B                              |                    |
| <i>G. bellidifolia</i>                   | -                     | K                              |                    |
| <i>G. divisa</i>                         | -                     | C                              | Southeastern limit |
| <i>G. grisebachii</i>                    | -                     | P                              |                    |
| <i>Geranium microphyllum</i>             | cranesbill            | O                              |                    |
| * <i>G. molle</i>                        | dovesfoot             | -                              |                    |
| <i>G. sessiliflorum</i>                  | cranesbill            | I                              |                    |
| <i>Geum leiospermum</i>                  | -                     | O                              |                    |
| <i>G. parviflorum</i>                    | -                     | -                              |                    |
| <i>G. uniflorum</i>                      | -                     | K                              |                    |
| <i>Gingidia baxterae</i>                 | -                     | D                              |                    |
| <i>G. enysii</i> var. <i>peninsulare</i> | -                     | -                              | Waikaia Tors only  |
| <i>G. montana</i>                        | -                     | -                              |                    |
| <i>Gnaphalium audax</i>                  | cudweed               | -                              |                    |
| <i>G. limosum</i>                        | "                     | -                              |                    |
| <i>G. luteoalbum</i>                     | Jersey cudweed        | -                              |                    |
| (= <i>pseudognaphalium luteoalbum</i> )  |                       |                                |                    |
| <i>G. mackayii</i>                       | cudweed               | K                              |                    |
| <i>G. sphaericum</i>                     | "                     | -                              |                    |
| <i>Gonocarpus aggregatus</i>             | -                     | M                              |                    |
| <i>G. micranthus</i>                     | -                     | M                              |                    |
| <i>Grammitis billardierei</i>            | -                     | A                              |                    |
| <i>G. givenii</i>                        | -                     | -                              |                    |
| <i>G. poeppigiana</i>                    | -                     | -                              |                    |
| <i>Griselinia littoralis</i>             | broadleaf             | A                              |                    |
| <i>Gumera dentata</i>                    | -                     | M                              |                    |
| <i>G. monoica</i>                        | -                     | P                              |                    |
| <i>G. prorepens</i>                      | -                     | M                              |                    |

| <u>Species</u>                                                   | <u>Common Name</u>         | <u>Species Class</u> | <u>Remarks</u>                 |
|------------------------------------------------------------------|----------------------------|----------------------|--------------------------------|
| <i>Halocarpus bidwillii</i><br>(= <i>Phorphyllum bidwillii</i> ) | bog pine                   | E                    |                                |
| <i>H. buchananii</i>                                             | -                          | -                    |                                |
| <i>H. dilatata</i>                                               | -                          | -                    |                                |
| <i>H. odora</i>                                                  | -                          | -                    |                                |
| <i>H. pauciflora</i>                                             | -                          | I                    |                                |
| <i>H. pimeleoides</i> var. <i>rustensis</i>                      | -                          | -                    | Northeastern Umbrella District |
| <i>H. poppelwellii</i>                                           | -                          | L                    | Uncommon on Umbrella Mountains |
| <i>H. propinqua</i>                                              | -                          | D                    | Southeastern limit             |
| <i>H. propinqua</i> × <i>odora</i>                               | -                          | -                    |                                |
| <i>H. aff. rakaiensis</i>                                        | -                          | P                    |                                |
| <i>H. rakaiensis</i>                                             | -                          | G                    |                                |
| <i>H. salicifolia</i>                                            | koromiko                   | J                    |                                |
| <i>H. sp. (?subulata)</i>                                        | -                          | K                    |                                |
| <i>Hectorella caespitosa</i>                                     | -                          | D                    | Southeastern limit             |
| <i>Helichrysum aggregatum</i>                                    | -                          | -                    |                                |
| <i>H. bellidioides</i>                                           | everlasting daisy          | O                    |                                |
| <i>H. filicaule</i>                                              | creeping everlasting daisy | P                    |                                |
| <i>H. selago</i>                                                 | -                          | -                    |                                |
| <i>Herpolirion novae-zeelandiae</i>                              | -                          | M                    |                                |
| * <i>Hieracium lachenalii</i>                                    | tussock hawkweed           | D                    |                                |
| * <i>H. pilosella</i>                                            | mouse-ear hawkweed         | D                    |                                |
| * <i>H. praealtum</i>                                            | king devil                 | D                    |                                |
| <i>Hierochloa equisetata</i>                                     | -                          | D                    |                                |
| <i>H. novae-zeelandiae</i>                                       | -                          | K                    |                                |
| <i>H. recurvata</i>                                              | -                          | E                    |                                |
| <i>H. redolens</i>                                               | -                          | M                    |                                |
| <i>Histiopteris incisa</i>                                       | -                          | H                    |                                |
| <i>Hoheria glabrata</i>                                          | mountain ribbonwood        | J                    |                                |
| * <i>Holcus lanatus</i>                                          | yorkshire fog              | M                    |                                |
| * <i>Hordeum murinum</i>                                         | barley grass               | -                    |                                |
| <i>Hydrocotyle heteromeria</i>                                   | -                          | H                    |                                |
| <i>H. microphylla</i>                                            | -                          | D                    |                                |
| <i>H. moschata</i>                                               | -                          | -                    |                                |
| <i>H. novae-zeelandiae</i>                                       | -                          | M                    |                                |
| <i>H. novae-zeelandiae</i> var. <i>montana</i>                   | -                          | -                    |                                |
| <i>H. sulcata</i>                                                | -                          | -                    |                                |
| <i>Hymenanthera alpina</i>                                       | -                          | K                    |                                |
| <i>Hymenophyllum bivalve</i>                                     | filmy fern                 | I                    |                                |
| <i>H. multifidum</i>                                             | "                          | A                    |                                |
| <i>H. peltatum</i>                                               | "                          | -                    |                                |
| <i>H. sanguinolentum</i>                                         | "                          | I                    |                                |
| <i>H. villosum</i>                                               | "                          | -                    |                                |
| * <i>Hypochaeris radicata</i>                                    | catsear                    | O                    |                                |
| * <i>Hypericum androsaemon</i>                                   | rolled-leaf hypericum      | -                    |                                |
| <i>Hypolepis ambigua</i>                                         | -                          | -                    |                                |
| <i>Hypolepis millefolium</i>                                     | -                          | E                    |                                |
| <i>Hypolepis rufobarbata</i>                                     | -                          | -                    |                                |
| <i>Ileostylus micranthus</i>                                     | -                          | -                    |                                |
| <i>Isolepis aucklandica</i>                                      | -                          | B                    |                                |
| <i>I. caliginis</i>                                              | -                          | -                    |                                |
| <i>I. habra</i>                                                  | -                          | E                    |                                |
| <i>Juncus antarcticus</i>                                        | -                          | D                    |                                |
| * <i>J. articulatus</i>                                          | sharp-flowered rush        | F                    |                                |
| * <i>J. bufonius</i>                                             | -                          | -                    |                                |
| <i>J. distegus</i>                                               | -                          | -                    |                                |
| * <i>J. effusus</i>                                              | soft-rush                  | M                    |                                |
| <i>J. gregiflorus</i>                                            | -                          | -                    |                                |
| <i>J. novae-zeelandiae</i>                                       | -                          | -                    |                                |
| <i>J. pusillus</i>                                               | -                          | -                    |                                |
| * <i>J. tenuis</i>                                               | -                          | -                    |                                |
| <i>Koeleria chrysosperma</i>                                     | -                          | -                    |                                |
| <i>K. novo-zeelandica</i>                                        | -                          | -                    |                                |
| <i>Kunzea ericoides</i><br>(= <i>Leptospermum ericoides</i> )    | kanuka                     | -                    | Clutha Valley                  |

| <u>Species</u>                           | <u>Common Name</u>       | <u>Species Class</u> | <u>Remarks</u>     |
|------------------------------------------|--------------------------|----------------------|--------------------|
| <i>Lachnagrostis filiformis</i>          | -                        | -                    |                    |
| <i>L. lyallii</i>                        | -                        | E                    |                    |
| <i>Lagenifera cuneata</i>                | -                        | P                    |                    |
| <i>L. petiolata</i>                      | -                        | M                    |                    |
| <i>L. pinnatifida</i>                    | -                        | -                    |                    |
| <i>L. pumila</i>                         | -                        | -                    |                    |
| <i>L. strangulata</i>                    | -                        | J                    |                    |
| * <i>Lemna minor</i>                     | duckweed                 | -                    |                    |
| * <i>Leontodon taraxacoides</i>          | hairy hawkbit            | -                    |                    |
| <i>Leptopteris hymenophylloides</i>      | crape fern               | -                    |                    |
| <i>L. superba</i>                        | Prince of Wales feathers | -                    |                    |
| <i>Leptospermum scoparium</i>            | manuka                   | M                    |                    |
| <i>Leucopneus grandiceps</i>             | edelweiss                | D                    |                    |
| <i>Leucopogon colensoi</i>               | -                        | I                    |                    |
| <i>L. fraseri</i>                        | -                        | P                    |                    |
| * <i>Leycesteria formosa</i>             | Himalaya honeysuckle     | -                    |                    |
| <i>Libertia ixioides</i>                 | native iris              | -                    |                    |
| * <i>Linum catharticum</i>               | purging flax             | -                    |                    |
| <i>lobelia linnaeoides</i>               | -                        | -                    |                    |
| * <i>Lotus pedunculatus</i>              | lotus                    | N                    |                    |
| * <i>Lupinus arboreus</i>                | tree lupin               | -                    |                    |
| <i>Luzula banksiana</i>                  | -                        | -                    |                    |
| <i>L. banksiana</i> var. <i>rhoicina</i> | -                        | -                    |                    |
| <i>L. arivita</i> var. <i>petrieana</i>  | -                        | -                    |                    |
| <i>L. leptophylla</i>                    | -                        | B                    |                    |
| <i>L. pieta</i>                          | -                        | -                    |                    |
| <i>L. pumila</i>                         | -                        | K                    | Southeastern limit |
| <i>L. rufa</i>                           | -                        | O                    |                    |
| <i>L. traversii</i>                      | -                        | -                    |                    |
| <i>L. sp.</i>                            | -                        | -                    |                    |
| <i>Luzuriaga porviflora</i>              | lanternberry             | -                    |                    |
| <i>Lycopodium australianum</i>           | club moss                | K                    |                    |
| <i>L. fastigiatum</i>                    | "                        | O                    |                    |
| <i>L. scariosum</i>                      | "                        | P                    |                    |
| <i>L. varium</i>                         | "                        | I                    |                    |
| <i>L. volubile</i>                       | "                        | -                    |                    |
| <i>Lyperanthus antarcticus</i>           | horizontal orchid        | -                    |                    |
| * <i>Malva neglecta</i>                  | dwarf mallow             | -                    |                    |
| <i>Marsippospermum gracile</i>           | -                        | K                    |                    |
| * <i>Marrubium vulgare</i>               | horehound                | -                    |                    |
| * <i>Matricaria matricarioides</i>       | pineapple weed           | -                    |                    |
| * <i>Medicago lupulina</i>               | black medick             | -                    |                    |
| <i>Melicope simplex</i>                  | -                        | -                    |                    |
| <i>Mentha cunninghamii</i>               | native mint              | M                    |                    |
| * <i>M. spicata</i>                      | spearmint                | -                    |                    |
| <i>Microlaena avenacea</i>               | -                        | J                    |                    |
| <i>M. colensoi</i>                       | -                        | -                    |                    |
| <i>Microseris scapigera</i>              | -                        | H                    |                    |
| <i>Microtis unifolia</i>                 | -                        | -                    |                    |
| * <i>Mimulus moschatus</i>               | musk                     | -                    |                    |
| <i>Montia australasica</i>               | -                        | C                    |                    |
| <i>M. fontana</i>                        | -                        | F                    |                    |
| <i>Muehlenbeckia australis</i>           | -                        | -                    |                    |
| <i>M. axillaris</i>                      | -                        | -                    |                    |
| <i>M. complexa</i>                       | -                        | M                    |                    |
| * <i>Mycelis muralis</i>                 | wall lettuce             | -                    |                    |
| <i>Myosotis elderi</i>                   | -                        | -                    |                    |
| <i>M. pulvinaris</i>                     | -                        | -                    | Southeastern limit |
| <i>M. pygmaea</i>                        | -                        | L                    |                    |
| <i>M. pygmaea</i> var. <i>drucei</i>     | -                        | -                    |                    |
| <i>Myrsine australis</i>                 | -                        | -                    |                    |
| <i>M. divaricata</i>                     | weeping mapou            | A                    |                    |
| <i>M. nummularia</i>                     | -                        | E                    |                    |
| * <i>Myriophyllum propinquum</i>         | -                        | -                    |                    |

| Species                                               | Common Name           | Species<br>Class | Remarks            |
|-------------------------------------------------------|-----------------------|------------------|--------------------|
| * <i>Nasturtium</i> sp.                               | watercress            | -                |                    |
| * <i>Murarrattia squarrosa</i>                        | Californian stinkweed | -                |                    |
| <i>Nertera halsouriana</i>                            | -                     | H                |                    |
| <i>N. ciliata</i>                                     | -                     | I                |                    |
| <i>N. depressa</i>                                    | -                     | M                |                    |
| <i>N. dichondrifolia</i>                              | -                     | J                |                    |
| <i>N. setulosa</i>                                    | -                     | M                |                    |
| <i>Nothofagus fusca</i>                               | red beech             | A                |                    |
| <i>N. menziesii</i>                                   | silver beech          | A                |                    |
| <i>N. solandri</i> var. <i>cliffortioides</i>         | mountain beech        | A                |                    |
| <i>N. solandri</i> x <i>fusca</i>                     | -                     | I                |                    |
| <i>Olearia arborescens</i>                            | -                     | J                |                    |
| <i>O. avicenniifolia</i>                              | -                     | -                |                    |
| <i>O. hectorii</i>                                    | -                     | -                |                    |
| <i>O. lineata</i>                                     | -                     | -                |                    |
| <i>O. mammulariifolia</i>                             | -                     | -                |                    |
| <i>O. odorata</i>                                     | -                     | -                |                    |
| <i>O. aff. odorata</i>                                | -                     | -                |                    |
| <i>O. virgata</i> var. <i>rugosa</i>                  | -                     | -                |                    |
| <i>Ophicoglossum coriaceum</i>                        | -                     | D                |                    |
| <i>Oreobolus impar</i>                                | -                     | -                |                    |
| <i>O. pectinatus</i>                                  | comb sedge            | B                |                    |
| <i>O. strictus</i>                                    | -                     | E                |                    |
| <i>Oreomyrrhis colensoi</i>                           | -                     | O                |                    |
| <i>O. ramosa</i>                                      | -                     | G                |                    |
| <i>Oreostylidium subulatum</i>                        | -                     | D                |                    |
| <i>Ourisia caespitosa</i>                             | -                     | D                |                    |
| <i>O. glandulosa</i>                                  | -                     | K                |                    |
| <i>Oxalis exilis</i>                                  | -                     | -                |                    |
| <i>O. magellanica</i>                                 | -                     | E                |                    |
| <i>Pachycladon novae-zelandiae</i>                    | -                     | -                | Southeastern limit |
| <i>Parahebe decora</i>                                | -                     | -                |                    |
| <i>P. lyallii</i>                                     | -                     | -                |                    |
| <i>P. trifida</i>                                     | -                     | C                | Southeastern limit |
| <i>Parsonsia</i> sp. ( <i>capsularis</i> )            | -                     | -                |                    |
| <i>Pellaea rotundifolia</i>                           | -                     | -                |                    |
| <i>Pentachondra pumila</i>                            | dwarf heath           | D                |                    |
| <i>Pernettya alpina</i>                               | -                     | C                | Southeastern limit |
| <i>P. macrostigma</i>                                 | -                     | P                |                    |
| * <i>Phileum pratense</i>                             | -                     | -                |                    |
| <i>Phormium cookianum</i>                             | mountain flax         | P                |                    |
| <i>P. tenax</i>                                       | New Zealand flax      | P                |                    |
| <i>Phyllachne colensoi</i>                            | -                     | B                |                    |
| <i>P. rubra</i>                                       | -                     | D                | Southeastern limit |
| <i>Phyllocladus asplenifolius</i> var. <i>alpinus</i> | celery pine           | G                |                    |
| <i>Phymatosorus diversifolius</i>                     | -                     | H                |                    |
| <i>Pinelea oreophila</i>                              | -                     | P                |                    |
| <i>P. popplewellii</i>                                | -                     | -                | Southeastern limit |
| <i>P. prostrata</i>                                   | -                     | -                |                    |
| <i>P. pseudolyallii</i>                               | -                     | D                |                    |
| * <i>Pinus nigra</i>                                  | Corsican pine         | -                |                    |
| * <i>P. radiata</i>                                   | radiata pine          | -                |                    |
| <i>Pittosporum tenuifolium</i>                        | matipo                | -                |                    |
| * <i>Plantago lanceolata</i>                          | plantain              | -                |                    |
| <i>P. lanigera</i>                                    | "                     | O                |                    |
| * <i>P. major</i>                                     | "                     | -                |                    |
| <i>P. novae-zelandiae</i>                             | "                     | O                |                    |
| <i>P. uniflora</i>                                    | "                     | B                |                    |
| * <i>Poa annua</i>                                    | annual poa            | -                |                    |
| <i>P. breviglumis</i>                                 | -                     | D                |                    |
| <i>P. colensoi</i>                                    | blue tussock          | O                |                    |
| <i>P. incrassata</i>                                  | -                     | C                | Southeastern limit |
| (= <i>Poa exigua</i> )                                |                       |                  |                    |
| <i>P. intrusa</i> ( <i>kirkii</i> "middle")           | -                     | -                |                    |
| <i>P. kirkii</i>                                      | -                     | K                |                    |
| <i>P. laevis</i>                                      | -                     | -                |                    |
| <i>P. muricota</i>                                    | -                     | -                |                    |
| <i>P. novae-zelandiae</i>                             | -                     | -                | Southeastern limit |

| <u>Species</u>                             | <u>Common name</u>   | <u>Species Class</u> | <u>Remarks</u>                 |
|--------------------------------------------|----------------------|----------------------|--------------------------------|
| * <i>Poa pratensis</i>                     | meadow-grass         | -                    |                                |
| <i>P. tenax</i> ("Flat" <i>lindsayii</i> ) | -                    | D                    |                                |
| <i>Podocarpus hallii</i>                   | Hall's totara        | A                    |                                |
| <i>P. nivalis</i>                          | snow totara          | G                    |                                |
| * <i>Polygonum tetraphyllum</i>            | four-leaved all-seed | -                    |                                |
| <i>Polystichum cystostegia</i>             | -                    | K                    | Southeastern limit             |
| " <i>richardii</i>                         | -                    | -                    |                                |
| <i>P. vestitum</i>                         | prickly shield fern  | O                    |                                |
| <i>Potamogeton cheesemani</i>              | pondweed             | -                    |                                |
| <i>Potentilla anserinoides</i>             | -                    | -                    |                                |
| <i>Prasophyllum colensoi</i>               | -                    | P                    |                                |
| <i>Pratia angulata</i>                     | -                    | O                    |                                |
| <i>P. macrodon</i>                         | -                    | C                    | Southeastern limit             |
| * <i>Primella vulgaris</i>                 | selfheal             | E                    |                                |
| <i>Pseudopanax colensoi</i>                | three-finger         | J                    |                                |
| <i>P. crassifolius</i>                     | lancewood            | A                    |                                |
| <i>P. simplex</i>                          | -                    | A                    |                                |
| * <i>Pseudotsuga menziesii</i>             | Douglas fir          | -                    |                                |
| <i>Pseudowintera colorata</i>              | pepper tree          | A                    |                                |
| <i>Pteridium esculentum</i>                | bracken fern         | M                    |                                |
| <i>Pterostylis australis</i>               | -                    | E                    |                                |
| <i>P. binksii</i>                          | -                    | -                    |                                |
| <i>P. venosa</i>                           | -                    | -                    |                                |
| <i>Pyrrosia serpens</i>                    | -                    | -                    |                                |
| * <i>Ranunculus acris</i>                  | meadow buttercup     | -                    |                                |
| <i>R. cheesemani</i>                       | buttercup            | F                    |                                |
| <i>R. ensifolius</i>                       | "                    | E                    |                                |
| <i>R. foliosus</i>                         | "                    | -                    |                                |
| <i>R. glabrifolius</i>                     | "                    | -                    |                                |
| <i>R. gracilipes</i>                       | "                    | B                    |                                |
| <i>R. hirtus</i>                           | "                    | I                    |                                |
| <i>R. lappaceus</i>                        | "                    | O                    |                                |
| <i>R. pachyrrhizus</i>                     | "                    | C                    | Southeastern limit             |
| * <i>R. repens</i>                         | creeping buttercup   | -                    |                                |
| <i>R. ternatifolius</i>                    | "                    | -                    |                                |
| <i>Raoulia australis</i>                   | scabweed             | -                    |                                |
| <i>R. glabra</i>                           | -                    | D                    |                                |
| <i>R. grandiflora</i>                      | -                    | K                    |                                |
| <i>R. hectorii</i>                         | -                    | L                    | Southeastern limit             |
| <i>R. hookeri</i>                          | -                    | -                    |                                |
| <i>R. hookeri</i> var. <i>apice-nigra</i>  | -                    | -                    |                                |
| <i>R. subsericea</i>                       | -                    | P                    |                                |
| <i>R. subulata</i>                         | -                    | C                    | Southeastern limit             |
| <i>R. tenuicaulis</i>                      | -                    | -                    |                                |
| * <i>Ribes uva-crispa</i>                  | gooseberry           | -                    |                                |
| * <i>Rosa rubiginosa</i>                   | sweet brier          | -                    |                                |
| <i>Rostkovia magellanica</i>               | -                    | B                    | Southeastern limit on mainland |
| <i>Rubus cissoides</i>                     | bush lawyer          | J                    |                                |
| <i>R. schmidelioides</i>                   | -                    | -                    |                                |
| <i>R. squarrosus</i>                       | -                    | -                    |                                |
| * <i>Rumex acetosella</i>                  | sheep's sorrel       | O                    |                                |
| * <i>R. crispus</i>                        | curled dock          | -                    |                                |
| <i>R. flexuosus</i>                        | Maori dock           | -                    |                                |
| * <i>R. obtusifolius</i>                   | broad-leaved dock    | -                    |                                |
| <i>Rumohra adiantiformis</i>               | -                    | -                    |                                |
| <i>Eytidosperma buchmannii</i>             | -                    | H                    |                                |
| <i>R. gracile</i>                          | -                    | P                    |                                |
| <i>R. nigricans</i>                        | -                    | D                    |                                |
| <i>R. racemosum</i>                        | -                    | -                    |                                |
| <i>R. setifolium</i>                       | -                    | -                    |                                |
| <i>R. unarede</i>                          | -                    | -                    |                                |
| * <i>Sagina procumbens</i>                 | pearlwort            | -                    |                                |
| * <i>Salix fragilis</i>                    | crack willow         | -                    |                                |
| * <i>Sambucus nigra</i>                    | elderberry           | -                    |                                |
| <i>Scandia geniculata</i>                  | -                    | -                    |                                |

| <u>Species</u>                                                       | <u>Common name</u>      | <u>Species</u><br><u>Class</u> | <u>Remarks</u>               |
|----------------------------------------------------------------------|-------------------------|--------------------------------|------------------------------|
| <i>Schizaeilema cockaynei</i>                                        | -                       | F                              |                              |
| <i>S. exiguum</i>                                                    | -                       | D                              |                              |
| <i>S. haastii</i>                                                    | -                       | -                              |                              |
| <i>S. haastii</i> var. <i>cyanopetalum</i>                           | -                       | K                              |                              |
| <i>S. trifoliolatum</i>                                              | -                       | -                              |                              |
| <i>Schoenus pauciflorus</i>                                          | -                       | K                              |                              |
| <i>Scleranthus brockiei</i>                                          | -                       | D                              |                              |
| <i>S. uniflorus</i>                                                  | -                       | D                              |                              |
| * <i>Sedum acre</i>                                                  | stonecrop               | -                              |                              |
| <i>Senecio ?biserratus</i>                                           | -                       | -                              |                              |
| * <i>S. jacobaea</i>                                                 | ragwort                 | -                              |                              |
| <i>S. minimus</i>                                                    | fireweed                | -                              |                              |
| <i>S. quadridentatus</i>                                             | cotton fireweed         | -                              |                              |
| * <i>S. sylvaticus</i>                                               | wood groundsel          | -                              |                              |
| <i>S. wairauensis</i>                                                | fireweed                | E                              |                              |
| * <i>Solanum nigrum</i>                                              | black nightshade        | -                              |                              |
| * <i>Sonchus oleraceus</i>                                           | sow thistle or puha     | -                              |                              |
| <i>Sophora microphylla</i>                                           | kowhai                  | -                              |                              |
| * <i>Spergularia rubra</i>                                           | sea spurry              | -                              |                              |
| * <i>Stellaria alsine</i>                                            | bog stitchwort          | -                              |                              |
| <i>S. gracilentia</i>                                                | chickweed               | -                              |                              |
| * <i>S. graminea</i>                                                 | lesser stitchwort       | -                              |                              |
| * <i>S. media</i>                                                    | chickweed               | -                              |                              |
| <i>S. parviflora</i>                                                 | "                       | J                              |                              |
| <i>Sticherus cunninghamii</i><br>(= <i>Gleichenia cunninghamii</i> ) | umbrella fern           | -                              |                              |
| <i>Taraxacum magellanicum</i>                                        | native dandelion        | L                              |                              |
| * <i>T. officinale</i>                                               | dandelion               | -                              |                              |
| <i>Teucrium parvifolium</i>                                          | -                       | -                              | One plant seen Devil's Gorge |
| <i>Thelymitra longifolia</i> / <i>venosa</i>                         | white/veined sun orchid | I                              |                              |
| * <i>Thymus vulgaris</i>                                             | wild thyme              | -                              |                              |
| <i>Tillaea sieberiana</i>                                            | -                       | -                              |                              |
| <i>Tmesipteris tannensis</i>                                         | -                       | -                              | One specimen seen Dusky Hill |
| * <i>Trifolium arvense</i>                                           | haresfoot trefoil       | -                              |                              |
| * <i>T. dubium</i>                                                   | suckling clover         | -                              |                              |
| * <i>T. pratense</i>                                                 | red clover              | N                              |                              |
| * <i>T. repens</i>                                                   | white clover            | M                              |                              |
| <i>Trisetum antarcticum</i>                                          | -                       | D                              |                              |
| <i>T. spicatum</i>                                                   | -                       | D                              |                              |
| <i>Typha orientalis</i>                                              | raupo                   | -                              |                              |
| * <i>Ulex europaeus</i>                                              | gorse                   | -                              |                              |
| <i>Uncinia affinis</i>                                               | hooked sedge            | M                              |                              |
| <i>U. angustifolia</i>                                               | "                       | -                              |                              |
| <i>U. aucklandica</i>                                                | "                       | P                              |                              |
| <i>U. caespitosa</i>                                                 | "                       | K                              |                              |
| <i>U. clavata</i>                                                    | "                       | J                              |                              |
| <i>U. divaricata</i>                                                 | "                       | M                              |                              |
| <i>U. drucei</i>                                                     | "                       | D                              |                              |
| <i>U. elegans</i>                                                    | "                       | -                              |                              |
| <i>U. filiformis</i>                                                 | "                       | J                              |                              |
| <i>U. fuscovaginata</i>                                              | "                       | K                              |                              |
| <i>U. nervosa</i>                                                    | "                       | D                              |                              |
| <i>U. purpurata</i>                                                  | "                       | M                              |                              |
| <i>U. rubra</i>                                                      | "                       | P                              |                              |
| <i>U. rupestris</i>                                                  | "                       | I                              |                              |
| <i>U. sinclairii</i>                                                 | "                       | D                              |                              |
| <i>U. uncinata</i>                                                   | "                       | -                              |                              |
| <i>U. viridis</i>                                                    | "                       | D                              |                              |
| <i>U. zotovi</i>                                                     | "                       | -                              |                              |
| <i>Urtica incisa</i>                                                 | stinging nettle         | -                              |                              |
| * <i>U. urens</i>                                                    | small nettle            | -                              |                              |
| <i>Utricularia monanthos</i>                                         | bladderwort             | E                              |                              |

| <u>Species</u>                                         | <u>Common name</u> | <u>Species</u><br><u>Class</u> | <u>Remarks</u> |
|--------------------------------------------------------|--------------------|--------------------------------|----------------|
| * <i>Verbascum thapsus</i>                             | woolly mullein     | -                              |                |
| * <i>V. virgatum</i>                                   | twiggy mullein     | -                              |                |
| * <i>Veronica serpyllifolia</i>                        | turf speedwell     | -                              |                |
| * <i>Vicia sativa</i>                                  | common vetch       | -                              |                |
| <i>Viola cunninghamii</i>                              | white violet       | O                              |                |
| <i>V. filicaulis</i>                                   | forest violet      | J                              |                |
| <i>Vittadinia australis</i>                            | white fuzzweed     | -                              |                |
| * <i>V. gracilis</i><br>(= <i>Vittadinia triloba</i> ) | purple fuzzweed    | -                              |                |
| <br><i>Wahlenbergia albomarginata</i>                  | <br>harebell       | <br>O                          |                |

APPENDIX II: Species list together with notes made by Mr A.P. Druce for the Umbrella Mountains, 8-9 March 1986.

+ = seen in Gem Lake catchment,  
# = seen elsewhere in Umbrella Mountains;  
l = appended notes.

Note: This list has not been incorporated into the species list presented for the District (Appendix I).

SPECIES

- |                                                     |                                                      |
|-----------------------------------------------------|------------------------------------------------------|
| +# <i>Abrotanella caespitosa</i>                    | # <i>Carmichaelia arborea</i>                        |
| +# <i>A. inconspicua</i> 1                          | +# <i>Carpina alpina</i>                             |
| # <i>Acaena anserinifolia</i>                       | # <i>Carpodetus serratus</i>                         |
| # <i>A. caesiiglaucia</i>                           | # <i>Cassinia vauvilliersii</i>                      |
| +# <i>A. 'Old Man'</i>                              | +# <i>Celmisia</i> sp. (cf. <i>C. alpina</i> )       |
| +# <i>A. profundeincisa</i>                         | +# <i>C. brevifolia</i>                              |
| +# <i>A. saccaticupula</i>                          | +# <i>C. densiflora</i> (incl. <i>C. prorepens</i> ) |
| # <i>Aciphylla glaucescens</i>                      | +# <i>C. glandulosa</i>                              |
| +# <i>A. hectorii</i>                               | +# <i>C. haastii</i>                                 |
| +# <i>A. pinnatifida</i>                            | +# <i>C. hectorii</i>                                |
| +# <i>A. scott-thomsonii</i> 2                      | +# <i>C. laricifolia</i>                             |
| +# <i>Agrostis capillaris</i>                       | +# <i>C. lyallii</i>                                 |
| +# <i>A. mucosa</i>                                 | +# <i>C. ramulosa</i> 5                              |
| +# <i>A. pallescens</i>                             | +# <i>C. rhizomatous</i>                             |
| +# <i>A. sp.</i> (unnamed aff. <i>A. subulata</i> ) | +# <i>C. semicordata</i> var. <i>aurigans</i>        |
| +# <i>Anemone tenuicaulis</i>                       | +# <i>C. sessiliflora</i>                            |
| +# <i>Anisotome aromatica</i>                       | +# <i>C. viscosa</i>                                 |
| +# <i>A. brevistylis</i>                            | +# <i>C. walkeri</i> 6                               |
| +# <i>A. flexuosa</i>                               | # <i>Chionochoa conspicua</i>                        |
| # <i>A. imbricata</i> S.S.                          | +# <i>C. macra</i>                                   |
| +# <i>A. sp.</i> (aff. <i>A. capillifolia</i> )     | +# <i>C. rigida</i>                                  |
| # <i>Aristotelia fruticosa</i>                      | +# <i>C. rubra</i> x <i>C. macra</i>                 |
| # <i>Asplenium flaccidum</i> S.S.                   | +# <i>Chionohebe densifolia</i>                      |
| # <i>A. richardii</i>                               | +# <i>C. thomsonii</i>                               |
| +# <i>Astelia linearis</i>                          | # <i>Clematis marata</i>                             |
| # <i>A. nervosa</i> S.S.                            | +# <i>Colobanthus apetalus</i>                       |
| +# <i>A. nivicola</i>                               | +# <i>C. buchananii</i> 7                            |
| # <i>Blechnum procerum</i>                          | +# <i>Coprosma atropurpurea</i>                      |
| +# <i>B. penna-marina</i>                           | +# <i>C. cheesemani</i> S.S.                         |
| +# <i>'Brachyscome glabrous'</i> 3                  | +# <i>C. ciliata</i> 8                               |
| +# <i>'B. glandular'</i>                            | # <i>C. propinqua</i>                                |
| +# <i>'Brachyglottis orbiculata'</i>                | +# <i>C. 'pseudocuneata'</i> (sp. 'a' unnamed)       |
| +# <i>B. southlandica</i> 4a                        | +# <i>C. pumila</i>                                  |
| # <i>Bulbinella angustifolia</i>                    | # <i>Coriaria plumosa</i>                            |
|                                                     | # <i>C. sarmentosa</i>                               |
| +# <i>Caltha obtusa</i>                             | # <i>Corokia cotoneaster</i>                         |
| +# <i>Cardamine</i> sp.                             | # <i>Cortaderia richardii</i>                        |
| +# <i>Carex berggrenii</i>                          | # <i>Corybas macranthus</i>                          |
| # <i>C. comans</i>                                  | +# <i>Cotula pectinata</i>                           |
| # <i>C. coriacea</i>                                | +# <i>'Craspedia elongata'</i>                       |
| +# <i>C. gaudichaudiana</i>                         | +# <i>C. lanata</i> (?) 9                            |
| +# <i>C. hectorii</i>                               | +# <i>C. sp.</i>                                     |
| +# <i>C. kirkii</i>                                 |                                                      |
| +# <i>C. lachenalii</i>                             |                                                      |
| +# <i>C. pterocarpa</i> 4b                          |                                                      |
| +# <i>C. pyrenaica</i> var. <i>cephalotes</i>       |                                                      |
| +# <i>C. wakatipu</i> S.S.                          |                                                      |

## APPENDIX II CONTD:

SPECIES

- +# *Deschampsia chapmanii*  
 +# D. *novae-zelandiae*  
 +# D. *pusilla* 10  
 +# D. sp. (unnamed) 'tall'  
 # *Discaria toumatou*  
 +# *Dolichoglottis lyallii*  
 +# *Donatia novae-zelandiae*  
 # *Dracophyllum longifolium*  
 +# D. *muscoides* (incl. D. *prostratum*)  
 +# D. *uniflorum* 11  
 +# *Drapetes* 'bog' sp. 'm' aff. *laxus*  
 +# D. *dieffenbachii*  
 +# D. *laxus*  
 +# D. sp. 'ch' aff. *lyallii*  
 +# D. *villosus* S.S.  
 +# *Drosera arcturi*
- +# *Epilobium atriplicifolium*  
 # E. *brunnescens* S.S.  
 +# E. sp. (unnamed) aff. *glabellum*  
 +# E. *chlorifolium*  
 +# E. *cockayneianum*  
 +# E. *minutiflorum*  
 # E. *nerteroides*  
 # E. *nummularifolium*  
 +# E. *pernitens*  
 +# E. *tasmanicum*  
 +# *Erythranthera australis*  
 +# E. *pumila*  
 +# *Euphrasia dyeri*  
 +# E. *zelandica*  
 +# E. sp. (aff. *cheesemani*)
- # *Festuca novae-zelandiae*  
 +# F. sp. ('*rubra* N.Z.')  
 +# *Forstera sedifolia*  
 +# F. *tenella*  
 # *Fuchsia excorticata*
- +# *Gaultheria crassa*  
 +# G. 'novae-zelandiae'  
 +# G. *crassa* x *Permettya alpina*  
 +# *Gentiana amabilis*  
 +# G. sp. (unnamed; aff. *G. bellidifolia*)  
 +# *Geranium microphyllum*  
 +# *Geum parviflorum* agg.  
 +# G. *uniflorum*  
 +# *Gnaphalium mackayi*  
 +# G. sp. (unnamed; aff. *G. mackayi*)  
 +# *Gonocarpus aggregatus*  
 # *Grammitis billardierei*  
 # G. *givenii*  
 +# G. *poeppigiana*
- # *Griselinia littoralis*
- +# *Hebe dilatata*  
 +# H. *odora* S.S.  
 +# H. sp. (unnamed; aff. *H. odora*)  
 +# H. *pauciramosa* S.S.  
 +# H. *propinqua*  
 +# H. *subulata*  
 +# *Hectorella caespitosa*  
 +# *Helichrysum bellidioides* S.S.  
 +# *Hierochloa equisetata*  
 +# H. *recurvata*  
 # *Histiopteris incisa*  
 # *Hoheria lyallii*  
 +# '*Hydrocotyle montana*'  
 +# *Hymenanthera alpina* S.S.  
 +# *Hymenophyllum multifidum*  
 +# H. *villosum*  
 +# *Hypochaeris radicata*  
 +# *Hypolepis millefolium*
- +# *Isolepis aucklandica*  
 +# I. *caligenis*
- +# *Juncus antarcticus*  
 # J. *gregiflorus*  
 +# J. *novae-zelandiae*  
 +# J. *pusillus*
- +# *Koeleria novo-zelandica* agg.
- +# '*Lachnagrostis semi-glabra*'  
 +# L. sp.  
 +# *Leucogenes grandiceps*  
 +# *Luzula* sp. (*L. migrata*?)  
 +# '*Luzula petriana*'  
 +# L. *pumila*  
 +# L. *rufa* S.S.  
 +# L. sp. (aff. *L. rufa* rhizomatous)  
 +# *Lycopodium australianum*
- +# *Marsippospermum gracile*  
 # *Microlaena* sp. (aff. *M. colensoi*)  
 +# *Montia australasica* agg.  
 +# M. *fontana* S.S.  
 +# *Myosotis pulvinaris*  
 +# M. 'drucei'  
 +# *Myrsine nummularia*
- # *Nothofagus fusca*  
 # N. *menziesii*  
 # N. *solandri* var. *cliffortioides*

## APPENDIX II CONTD:

SPECIES

- # *Olearia arborescens*  
 # *O.* sp. (cf. *O. odorata*)  
 +# *Oreobolus pectinatus*  
 +# '*Oreomyrrhis bog*'  
 +# '*O.* snow-bank' 12  
 +# *O.* *ramosa*  
 +# *Ourisia caespitosa*  
 +# *O.* *glandulosa*  
 # *Oralis exilis*  
 +# *O.* *lactea* 'glaucous' (another sp.?)  
 # *Parahebe lyallii*  
 +# *P.* *trifida*  
 +# *Pentachondra pumila*  
 # *Phormium cookianum*  
 +# *Phyllachne colensoi*  
 +# *Pimelea poppelwellii*  
 +# *Pimelea oreophila* 13  
 # *Pittosporum tenuifolium*  
 +# *Plantago lanigera*  
 +# *P.* *novae-zelandiae*  
 +# *P.* *uniflora*  
 +# *Poa annua*  
 +# *P.* *breviglumis*  
 +# *P.* *colensoi*  
 +# *P.* *exigua*  
 +# *P.* sp. (cf. *P. kirkii*)  
 +# *P.* sp. (undetermined)  
 +# *P. lindsayi*  
 +# '*P. subvestita*'  
 # *Podocarpus cunninghamii* (*hallii*)  
 +# *Polystichum cystostegia*  
 +# *P.* *vestitum*  
 +# *Prasophyllum colensoi*  
 +# *Pratia angulata*  
 +# *P.* sp. (unnamed; aff. *P. macrodon*)  
 # *Pseudopanax crassifolius*  
 # *Pteridium esculentum*  
 +# *Ranunculus* sp. (aff. *R. cheesemani*)  
 +# *R.* *berggrenii*  
 +# *R.* *foliosus*  
 +# *R.* *gracilipes*  
 +# *R.* *pachyrrhizus*  
 +# *Raoulia grandiflora*  
 +# *R.* *hectorii*  
 +# *R.* *subsericea*  
 +# *R.* *subulata*  
 +# *R.* *hectorii* x *Leucogenes grandiceps*  
 +# *Rostkovia magellanica*  
 # *Rubus cissoides*  
 # *R.* *schmidelioides* var. *subpauperatus*  
 +# *Rumex acetosella*  
 +# *Rytidosperma setifolium*  
 # *Salix fragilis*  
 # *Sambucus nigra*  
 +# *Schizeilema cockaynei*  
 +# *Schoenus pauciflorus*  
 +# *Scleranthus uniflorus*  
 # *Senecio minimus*  
 +# *Stellaria graminea* (or related sp.)  
 +# *S.* *gracilentia*  
 +# *Taraxacum magellanicum*  
 +# '*Trisetum slender*'  
 +# *T.* *spicatum* agg.  
 +# '*T.* *tenellum*'  
 # *Uncinia olavata*  
 +# *U.* *divaricata*  
 +# *U.* *drucei*  
 +# *U.* *fuscovaginata*  
 +# *U.* *sinclairii*  
 +# *U.* *viridis*  
 # *Urtica incisa*  
 +# *Viola cunninghamii*  
 +# *Wahlenbergia albomarginata*
- 
- 1 = no apparent difference between Umbrella and Garvie specimens;  
 2 = prefer to call this *A. colensoi* var. *maxima*;  
 3 = either could be *B. radicata* or *B. sinclairii*;  
 4a= checked type at National Museum;  
 4b= collected one plant of this;  
 5 = prefer to call this *Celmisia monroi* var. (*C. semicordata* var. *aurigans*);  
 6 = *Celmisia brevifolia* x *C. hectorii*;  
*C. hectorii* x *C. ramulosa*;  
*C. sessiliflora* x *C. sp.*;  
*C. monroi* x *C. lyallii* (?) hybrids seen.  
 7 = may be another species also;  
 8 = *Coprosma parviflora* not in S. Island.  
 9 = have plant to grow on further;  
 10= snow-bank *Deschampsia*;  
 11= looks different to northern S. Island plants;  
 12= doubtful whether either is *O. colensoi* (almost certainly '*O. snow-bank*' is not);  
 13= prefer to call this *Pimelea suteri* var. (*P. oreophila*).

APPENDIX III: The percentage frequency of each species included in the Cluster Analysis, within each species class (A to P) for each of the 17 quadrat groups differentiated.

| CLASS A                                               | QUADRAT GROUP |     |     |     |    |   |   |    |    |    |    |    |     |     |     |    |    |
|-------------------------------------------------------|---------------|-----|-----|-----|----|---|---|----|----|----|----|----|-----|-----|-----|----|----|
|                                                       | 1             | 2   | 3   | 4   | 5  | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13  | 14  | 15  | 16 | 17 |
| <i>Caryodetus serratus</i>                            | -             | 54  | 88  | -   | 60 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Griselinia littoralis</i>                          | -             | 92  | 82  | -   | 60 | - | 9 | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Pseudopanax crassifolius</i>                       | 20            | 81  | 75  | -   | 40 | - | 4 | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Mnrasine divaricata</i>                            | 40            | 23  | 56  | -   | -  | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Pseudocitrona colorata</i>                         | 20            | 46  | 63  | 20  | 20 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Podocarpus hallii</i>                              | -             | 38  | 50  | -   | 20 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Coprosma colensoi</i>                              | 90            | 100 | 94  | 40  | 20 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Nothofagus menziesii</i>                           | 100           | 100 | 100 | 100 | 60 | - | - | -  | 6  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Nothofagus fusca</i>                               | 90            | 100 | 69  | -   | 40 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Coprosma rhymoides</i>                             | 50            | 97  | 100 | -   | 40 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Grammitis billardierei</i>                         | 90            | 81  | 75  | 60  | 20 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Hymenophyllum multifidum</i>                       | 100           | 62  | 38  | 60  | 20 | - | 4 | -  | 6  | -  | -  | -  | -   | -   | 50  | -  | -  |
| <i>Nothofagus solandri</i> var. <i>cliffortioides</i> | 70            | 50  | 50  | -   | 20 | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Pseudopanax simplex</i>                            | 20            | 42  | 56  | 20  | -  | - | - | -  | -  | -  | -  | -  | -   | -   | -   | -  | -  |
| <i>Onoclea angustifolia</i>                           | 90            | 38  | 6   | -   | -  | - | - | -  | 6  | -  | -  | -  | -   | -   | -   | -  | -  |
| <hr/>                                                 |               |     |     |     |    |   |   |    |    |    |    |    |     |     |     |    |    |
| CLASS B                                               | 1             | 2   | 3   | 4   | 5  | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13  | 14  | 15  | 16 | 17 |
| <i>Achrotanella caespitosa</i>                        | -             | -   | -   | -   | -  | - | - | -  | -  | -  | 12 | -  | 8   | 20  | -   | 66 | 14 |
| <i>Phyllachne colensoi</i>                            | -             | -   | -   | -   | -  | - | - | 5  | -  | 4  | 29 | 35 | 38  | 80  | 25  | 83 | 29 |
| <i>Dracophyllum prostratum</i>                        | -             | -   | -   | -   | -  | - | - | -  | -  | 4  | -  | 12 | 8   | 100 | 100 | 45 | -  |
| <i>Isoplepis Aucklandia</i>                           | -             | -   | -   | -   | -  | - | - | 11 | 6  | 21 | -  | 41 | 46  | 40  | 100 | 76 | 14 |
| <i>Creobolus pectinatus</i>                           | -             | -   | -   | -   | -  | - | - | 8  | 6  | 14 | -  | 29 | 8   | 80  | 100 | 83 | 29 |
| <i>Rostkovia magellanica</i>                          | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | -   | 40  | -   | 48 | -  |
| <i>Anisotome imbricata</i> var. <i>prostrata</i>      | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | 31  | -   | -   | 62 | 43 |
| <i>Carex lachenalii</i>                               | -             | -   | -   | -   | -  | - | - | -  | -  | -  | 6  | -  | 8   | -   | -   | 52 | 14 |
| <i>Drapetes 'bog'</i>                                 | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | 15  | 20  | -   | 62 | 14 |
| <i>Epilobium komarovianum</i>                         | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | -   | 20  | -   | 41 | 14 |
| <i>Euphrasia dyeri</i>                                | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | -   | -   | -   | 72 | 14 |
| <i>Luzula leptophylla</i>                             | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | 15  | -   | -   | 66 | 14 |
| <i>Carex gaudichaudiana</i>                           | -             | -   | -   | -   | -  | - | - | -  | -  | 11 | -  | -  | 8   | 60  | 25  | 69 | 86 |
| <i>Colmisia alpina</i>                                | -             | -   | -   | -   | -  | - | - | 5  | -  | -  | -  | -  | -   | 80  | 25  | 93 | 43 |
| <i>Gentiana amabilis</i>                              | -             | -   | -   | -   | -  | - | - | -  | -  | 4  | -  | 6  | -   | 100 | 50  | 93 | 86 |
| <i>Ranunculus gracilipes</i>                          | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | -   | -   | -   | 72 | 86 |
| <i>Drosera arcturi</i>                                | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | -   | 60  | 75  | 45 | 86 |
| <i>Plantago uniflora</i>                              | -             | -   | -   | -   | -  | - | - | 3  | 48 | 11 | -  | 12 | -   | -   | -   | 48 | 66 |
| <hr/>                                                 |               |     |     |     |    |   |   |    |    |    |    |    |     |     |     |    |    |
| CLASS C                                               | 1             | 2   | 3   | 4   | 5  | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13  | 14  | 15  | 16 | 17 |
| <i>Carex hectorii</i>                                 | -             | -   | -   | -   | -  | - | - | -  | -  | 11 | 6  | 47 | 31  | -   | -   | 3  | 14 |
| <i>Fraxia macrodon</i>                                | -             | -   | -   | -   | -  | - | - | -  | -  | 21 | 18 | 35 | 53  | -   | -   | 3  | -  |
| <i>Drapetes</i> aff. <i>lyallii</i>                   | -             | -   | -   | -   | -  | - | - | -  | -  | -  | 12 | 24 | 69  | -   | -   | -  | -  |
| <i>Fernettya alpina</i>                               | -             | -   | -   | -   | -  | - | - | -  | -  | 7  | 6  | 24 | 69  | -   | -   | 21 | 14 |
| <i>Carex pyrenaica</i> var. <i>cephalotes</i>         | -             | -   | -   | -   | -  | - | - | -  | -  | 4  | -  | 29 | 62  | -   | -   | 28 | 14 |
| <i>Colmisia haastii</i>                               | -             | -   | -   | -   | -  | - | - | 3  | -  | 11 | 18 | 47 | 100 | -   | -   | 14 | 29 |
| <i>Epilobium tasmanicum</i>                           | -             | -   | -   | -   | -  | - | - | -  | 12 | 25 | 29 | 24 | 100 | -   | -   | -  | -  |
| <i>Fox inervassata</i>                                | -             | -   | -   | -   | -  | - | - | -  | -  | 4  | 18 | 29 | 85  | -   | -   | 3  | -  |
| <i>Montia australasica</i>                            | -             | -   | -   | -   | -  | - | - | -  | -  | 4  | -  | 18 | 62  | -   | -   | -  | 14 |
| <i>Parahebe trifida</i>                               | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | 85  | -   | -   | 3  | -  |
| <i>Ranunculus pachyrrhizus</i>                        | -             | -   | -   | -   | -  | - | - | -  | -  | -  | -  | -  | 100 | -   | -   | -  | -  |
| <i>Psoulia subulata</i>                               | -             | -   | -   | -   | -  | - | - | 11 | -  | -  | -  | 12 | 85  | -   | -   | -  | -  |

| CLASS D                             | 1 | 2 | 3 | 4 | 5 | 6 | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|-------------------------------------|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|
| <i>Abrotanella inconspicua</i>      | - | - | - | - | - | - | -  | -  | -  | -  | -  | 24 | 15 | -  | -  | 7  | -  |
| <i>Hectorella caespitosa</i>        | - | - | - | - | - | - | -  | -  | -  | -  | 6  | 12 | 15 | -  | -  | -  | -  |
| <i>Gentiana divisa</i>              | - | - | - | - | - | - | -  | -  | -  | -  | -  | -  | 23 | -  | -  | -  | -  |
| <i>Uncinia drucei</i>               | - | - | - | - | - | - | -  | -  | -  | -  | 6  | -  | 15 | -  | -  | -  | -  |
| <i>Phyllachne rubra</i>             | - | - | - | - | - | - | -  | -  | -  | -  | -  | 6  | 31 | -  | -  | -  | -  |
| <i>Schizeilema exiguum</i>          | - | - | - | - | - | - | -  | -  | -  | -  | -  | 12 | 8  | -  | -  | -  | -  |
| <i>Aciphylla aurea</i>              | - | - | - | - | - | - | 17 | 3  | 6  | -  | 4  | -  | -  | -  | -  | -  | -  |
| <i>Isolepis</i> sp.                 | - | - | - | - | - | - | -  | 3  | -  | -  | -  | -  | 8  | -  | -  | -  | -  |
| <i>Epilobium</i> sp.                | - | - | - | - | - | - | 26 | -  | -  | -  | -  | 12 | -  | -  | -  | -  | -  |
| <i>Hebe propinqua</i>               | - | - | - | - | - | - | 26 | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Elymus rectisetus</i>            | - | - | - | - | - | - | 11 | -  | 12 | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Cardamine uniflora</i>           | - | - | - | - | - | - | -  | -  | -  | 4  | -  | 6  | -  | -  | -  | -  | -  |
| <i>Deyeuxia</i> sp.                 | - | - | - | - | - | - | -  | -  | 12 | 4  | -  | -  | -  | 20 | -  | -  | 14 |
| <i>Carex kirkii</i>                 | - | - | - | - | - | - | -  | 5  | -  | 18 | -  | 6  | 38 | 20 | -  | -  | 14 |
| <i>Festuca multinodis</i>           | - | - | - | - | - | - | -  | -  | 6  | 7  | 6  | 6  | 8  | -  | -  | -  | -  |
| # <i>Poa breviglumis</i>            | - | - | - | - | - | - | -  | -  | -  | 7  | -  | -  | 8  | -  | -  | -  | -  |
| <i>Centrolepis pallida</i>          | - | - | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | 20 | -  | 7  | -  |
| <i>Deschampsia novae-zealandiae</i> | - | - | - | - | - | - | -  | 3  | -  | 4  | -  | 18 | 8  | -  | -  | 31 | -  |
| <i>Cotula perpusilla</i>            | - | - | - | - | - | - | -  | 14 | -  | -  | -  | 24 | -  | -  | -  | -  | -  |
| <i>Drapetes laxus</i>               | - | - | - | - | - | - | 52 | 27 | 6  | 14 | 12 | 24 | -  | -  | -  | -  | -  |
| <i>Hieraceum lachenallii</i>        | - | - | - | - | - | - | -  | 22 | -  | -  | -  | 24 | -  | -  | -  | -  | -  |
| <i>Uncinia viridus</i>              | - | - | - | - | - | - | -  | 22 | 12 | 25 | 18 | 41 | 23 | -  | -  | -  | 14 |
| # <i>Poa breviglumis</i>            | - | - | - | - | - | - | -  | -  | -  | 7  | 6  | 12 | -  | -  | -  | 3  | -  |
| <i>Poa</i> sp.                      | - | - | - | - | - | - | -  | -  | -  | 4  | 6  | 6  | -  | -  | -  | 7  | 14 |
| <i>Trisetum spicatum</i>            | - | - | - | - | - | - | -  | -  | -  | -  | 6  | 12 | -  | -  | -  | 3  | -  |
| <i>Oreostylidium subulatum</i>      | - | - | - | - | - | - | -  | 5  | 6  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia nervosa</i>              | - | - | - | - | - | - | -  | 5  | -  | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Aporostylis bifolia</i>          | - | - | - | - | - | - | 17 | 11 | 12 | 11 | -  | -  | -  | -  | 80 | -  | -  |
| <i>Pentachondra pumila</i>          | - | - | - | - | - | - | -  | 16 | 6  | 11 | -  | -  | -  | -  | 50 | -  | -  |
| <i>Pimelea pseudolyalli</i>         | - | - | - | - | - | - | 4  | 11 | -  | 7  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hierochloë equisetata</i>        | - | - | - | - | - | - | -  | 3  | -  | 11 | 6  | -  | -  | -  | -  | -  | -  |
| <i>Rytidosperma nigricans</i>       | - | - | - | - | - | - | 4  | 11 | 12 | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Celmisia glandulosa</i>          | - | - | - | - | - | - | -  | 3  | -  | -  | -  | -  | -  | -  | -  | 10 | 43 |
| <i>Cotula squalida</i>              | - | - | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | 43 |
| <i>Deyeuxia aucklandica</i>         | - | - | - | - | - | - | -  | 8  | -  | -  | -  | 6  | -  | -  | -  | 10 | 29 |
| <i>Hieraceum praealtum</i>          | - | - | - | - | - | - | -  | 8  | -  | -  | -  | -  | -  | -  | -  | -  | 14 |
| <i>Epilobium brumescens</i>         | - | - | 6 | - | - | - | -  | -  | 6  | 4  | -  | -  | -  | -  | -  | 10 | 43 |
| <i>Erythranthera australis</i>      | - | - | - | - | - | - | -  | -  | 6  | -  | -  | 12 | -  | -  | -  | 24 | 57 |
| <i>Epilobium pernitens</i>          | - | - | - | - | - | - | -  | -  | -  | -  | 6  | -  | 15 | -  | -  | 10 | 14 |
| <i>Hydrocotyle microphylla</i>      | - | - | - | - | - | - | 30 | -  | 6  | -  | -  | 12 | -  | -  | -  | 21 | 57 |
| <i>Juncus antarcticus</i>           | - | - | - | - | - | - | -  | -  | -  | 4  | -  | -  | -  | -  | -  | 14 | 29 |
| <i>Trisetum antarcticum</i>         | - | - | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | 7  | 14 |
| <i>Uncinia sinclairii</i>           | - | - | - | - | - | - | -  | 5  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Carex colensoi</i>               | - | - | - | - | - | - | 4  | -  | -  | -  | -  | -  | -  | -  | -  | 3  | -  |
| <i>Festuca rubra</i>                | - | - | - | - | - | - | 4  | -  | -  | -  | -  | 6  | -  | -  | -  | -  | 14 |
| <i>Gingidia barterae</i>            | - | - | - | - | - | - | 4  | -  | -  | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Leucogenes grandiceps</i>        | - | - | - | - | - | - | -  | -  | -  | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Cyathodes empetrifolia</i>       | - | - | - | - | - | - | 9  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hydrocotyle</i> sp.              | - | - | - | - | - | - | 4  | -  | -  | -  | -  | -  | 8  | -  | -  | -  | -  |
| <i>Ophioglossum coriaceum</i>       | - | - | - | - | - | - | 9  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Scleranthus brockiei</i>         | - | - | - | - | - | - | 13 | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hieraceum pilosella</i>          | - | - | - | - | - | - | -  | -  | 6  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Scleranthus uniflora</i>         | - | - | - | - | - | - | -  | -  | 12 | 7  | 6  | 29 | -  | -  | -  | -  | -  |
| <i>Ourisia caespitosa</i>           | - | - | - | - | - | - | 4  | -  | 18 | -  | 12 | 6  | -  | -  | -  | -  | -  |
| <i>Raoulia glabra</i>               | - | - | - | - | - | - | 13 | -  | 12 | -  | -  | 6  | -  | -  | -  | -  | -  |

| CLASS E                                              | 1  | 2 | 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15  | 16 | 17 |
|------------------------------------------------------|----|---|---|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|
| <i>Anemone tenuicaulis</i>                           | -  | - | - | -  | -  | -  | 4  | 8  | 24 | 18 | -  | -  | -  | -  | -   | -  | -  |
| <i>Anisotome aromatica</i> var. <i>flabellifolia</i> | -  | - | - | -  | -  | 75 | -  | 5  | 29 | 14 | -  | -  | -  | -  | -   | -  | -  |
| <i>Dolichoglottis lyallii</i>                        | -  | - | 6 | 20 | -  | -  | -  | -  | 29 | 7  | 6  | -  | 8  | -  | -   | -  | -  |
| <i>Epilobium chlorifolium</i>                        | -  | - | - | -  | -  | -  | -  | 3  | 12 | 4  | -  | -  | -  | -  | -   | -  | -  |
| <i>Trisetum</i> sp.                                  | -  | - | - | -  | -  | -  | -  | 3  | 6  | -  | -  | 8  | -  | -  | -   | -  | -  |
| <i>Epilobium glabellum</i>                           | -  | - | - | -  | -  | -  | 4  | 3  | 6  | 7  | 6  | -  | 8  | -  | -   | -  | -  |
| <i>Hypolepis millefolium</i>                         | -  | - | 6 | -  | 60 | -  | -  | -  | 35 | 14 | -  | -  | -  | -  | -   | -  | -  |
| <i>Oxalis magellanica</i>                            | -  | - | - | -  | -  | -  | -  | 14 | 53 | 18 | 6  | -  | 15 | -  | -   | 7  | 29 |
| <i>Rytidosperma</i> sp.                              | -  | - | - | 20 | -  | -  | 4  | -  | 18 | 7  | -  | -  | -  | -  | -   | -  | -  |
| <i>Cardamine</i> sp.                                 | -  | - | - | -  | 20 | -  | -  | -  | 12 | -  | 6  | 15 | 8  | -  | -   | -  | -  |
| <i>Galium</i> sp.                                    | -  | - | - | -  | -  | -  | -  | -  | 6  | -  | -  | -  | -  | -  | -   | -  | -  |
| # <i>Poa breviglumis</i>                             | -  | - | - | -  | -  | -  | -  | -  | 6  | -  | -  | 6  | -  | -  | -   | -  | -  |
| <i>Coriaria plumosa</i>                              | -  | - | - | -  | -  | -  | -  | -  | 12 | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Prunella vulgaris</i>                             | -  | - | 6 | -  | -  | 25 | 4  | -  | 6  | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Coriaria sarmentosa</i>                           | -  | - | - | -  | -  | -  | 13 | -  | 6  | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Lachnagrostis lyallii</i>                         | -  | - | - | -  | -  | -  | 4  | -  | 18 | -  | -  | -  | -  | -  | -   | 3  | 14 |
| <i>Pterostylis</i> sp.                               | 10 | 4 | 6 | -  | -  | -  | 4  | -  | 24 | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Epilobium microphyllum</i>                        | -  | - | - | -  | -  | -  | -  | -  | 12 | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Senecio wairauensis</i>                           | -  | - | - | -  | -  | -  | -  | -  | 12 | -  | -  | -  | -  | -  | -   | -  | -  |
| <i>Oreobolus strictus</i>                            | -  | - | - | -  | -  | -  | -  | 3  | 18 | 4  | -  | -  | -  | -  | 50  | -  | -  |
| <i>Forstera tenella</i>                              | -  | - | - | -  | -  | -  | 4  | 5  | 29 | 11 | -  | -  | -  | -  | 50  | -  | 29 |
| <i>Isolepis habra</i>                                | -  | - | 6 | -  | -  | 25 | 4  | -  | 24 | 7  | -  | -  | -  | -  | -   | -  | -  |
| <i>Ranunculus ensyis</i>                             | -  | - | - | -  | -  | -  | -  | 5  | 18 | 4  | 12 | 12 | 15 | -  | -   | -  | -  |
| <i>Donatia novae-zelandiae</i>                       | -  | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | 20 | 100 | 7  | -  |
| <i>Halocarpus bidwillii</i>                          | -  | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | 100 | -  | -  |
| <i>Hieracium recurvata</i>                           | -  | - | - | -  | -  | -  | -  | -  | -  | 11 | 6  | -  | -  | -  | 25  | -  | -  |
| <i>Myrsine nummularia</i>                            | -  | - | - | -  | -  | -  | -  | -  | -  | 11 | 6  | -  | -  | -  | 75  | -  | -  |
| <i>Gaimardia setacea</i>                             | -  | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | 20 | 25  | 3  | -  |
| <i>Utricularia monanthos</i>                         | -  | - | - | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -   | 7  | -  |

## CLASS F

|                              |   |   |   |   |   |    |   |   |   |   |   |   |   |   |   |    |    |
|------------------------------|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|----|----|
| <i>Aciphylla pinnatifida</i> | - | - | - | - | - | -  | - | - | - | - | - | - | - | - | - | 3  | 29 |
| <i>Ranunculus cheesemani</i> | - | - | - | - | - | 25 | - | - | - | - | - | - | - | - | - | 10 | 29 |
| <i>Juncus articulatus</i>    | - | - | - | - | - | -  | - | - | - | - | - | - | - | - | - | 7  | -  |
| <i>Schizanthus cockaynei</i> | - | - | - | - | - | 25 | - | - | - | - | - | - | - | - | - | 3  | -  |
| <i>Montia fontana</i>        | - | - | 6 | - | - | -  | - | - | - | - | - | - | - | - | - | 7  | -  |

## CLASS G

|                                    |   |   |   |    |   |    |   |   |    |   |   |   |   |   |    |   |   |
|------------------------------------|---|---|---|----|---|----|---|---|----|---|---|---|---|---|----|---|---|
| <i>Hebe rakaiensis</i>             | - | - | - | -  | - | -  | - | - | 12 | - | - | - | - | - | -  | - | - |
| <i>Oreomyrrhis ramosa</i>          | - | - | - | -  | - | 25 | 9 | - | 18 | - | - | - | - | - | -  | - | - |
| <i>Phyllocladus aspleniifolius</i> | - | - | - | 20 | - | -  | - | - | 6  | - | - | - | - | - | 25 | - | - |
| <i>Podocarpus nivalis</i>          | - | - | - | -  | - | -  | - | - | 6  | - | - | - | - | - | -  | - | - |

## CLASS H

|                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
|---------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|
| <i>Carex echinata</i>           | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7 | 29 |
| <i>Hydrocotyle heteromeria</i>  | - | - | - | - | - | - | - | - | 6 | - | - | - | - | - | - | 3 | 14 |
| <i>Nertera balfouriana</i>      | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 29 |
| <i>Rytidosperma buechananii</i> | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 29 |
| <i>Microseris scopigera</i>     | - | - | - | - | - | - | - | - | - | 4 | - | - | - | - | - | - | 14 |

| CLASS I                                    | 1  | 2  | 3  | 4  | 5  | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|--------------------------------------------|----|----|----|----|----|---|---|---|---|----|----|----|----|----|----|----|----|
| <i>Lycopodium varium</i>                   | -  | -  | -  | -  | 40 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Asplenium flaccidum</i>                 | 20 | 12 | 22 | -  | 60 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Phymatosorus diversifolius</i>          | -  | 12 | 19 | -  | 40 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Histiopteris incisa</i>                 | 10 | 4  | 13 | -  | 60 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Brachycome radicata</i>                 | -  | -  | -  | -  | 20 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Brachyglottis buehananii</i>            | -  | -  | -  | 20 | 20 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Nertera ciliata</i>                     | -  | -  | 6  | 20 | 20 | - | 4 | - | - | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Ranunculus hirtus</i>                   | -  | -  | 6  | -  | 20 | - | - | 3 | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Carex breviculmis</i>                   | -  | -  | 6  | -  | 40 | - | 4 | - | - | -  | -  | 6  | 8  | -  | -  | -  | -  |
| <i>Hebe pauciramosa</i>                    | -  | -  | -  | -  | 40 | - | - | - | - | -  | -  | -  | -  | -  | -  | 10 | 43 |
| <i>Geranium sessiliflorum</i>              | -  | -  | -  | -  | 40 | - | - | - | - | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia</i> sp.                         | -  | -  | -  | -  | 20 | - | - | 3 | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Alepis flavida</i>                      | -  | 8  | 13 | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Gaultheria antipoda</i>                 | -  | 9  | 13 | -  | 20 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Elaeocarpus hookerianus</i>             | -  | -  | 13 | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Fuchsia excoartata</i>                  | -  | -  | 6  | -  | 20 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Blechnum discolor</i>                   | -  | 54 | 19 | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia rupestris</i>                   | -  | 42 | 44 | -  | 40 | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Clematis paniculata</i>                 | -  | 4  | 31 | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hymenophyllum sanguinolentum</i>        | -  | 12 | 6  | 20 | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Thelymitra</i> sp.                      | -  | 15 | -  | -  | 40 | - | 4 | - | - | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Leucopogon colensoi</i>                 | -  | 19 | 19 | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hymenophyllum bivaive</i>               | -  | 15 | -  | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Nothofagus fusca</i> X <i>solanarii</i> | 10 | 12 | 6  | -  | -  | - | - | - | - | -  | -  | -  | -  | -  | -  | -  | -  |

| CLASS J                       | 1  | 2  | 3   | 4   | 5  | 6  | 7  | 8 | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|-------------------------------|----|----|-----|-----|----|----|----|---|----|----|----|----|----|----|----|----|----|
| <i>Asplenium richardii</i>    | -  | -  | 13  | -   | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Olearia arborescens</i>    | -  | -  | 6   | -   | -  | -  | 4  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hebe salicifolia</i>       | -  | -  | 13  | -   | -  | -  | 9  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Coprosma cuneata</i>       | -  | 4  | 19  | 80  | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Hoheria glabrata</i>       | -  | -  | 6   | 40  | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Coprosma pseudocuneata</i> | -  | 4  | 31  | 20  | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Chiloglottis cornuta</i>   | 20 | -  | -   | 40  | -  | -  | -  | 3 | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Pseudopanax colensoi</i>   | -  | 4  | -   | 20  | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Coprosma linariifolia</i>  | -  | -  | 19  | -   | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Epilobium pedunculare</i>  | -  | -  | 13  | -   | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Stellaria parviflora</i>   | 10 | -  | 25  | 20  | 20 | 25 | -  | 3 | 6  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Viola filicaulis</i>       | -  | -  | 31  | -   | -  | -  | -  | 5 | -  | 4  | -  | -  | -  | -  | -  | -  | 14 |
| <i>Blechnum fluviatile</i>    | -  | 15 | 27  | 60  | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Rubus cissoides</i>        | 10 | 23 | 75  | -   | 60 | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Blechnum minus</i>         | 30 | 58 | 81  | 40  | 60 | -  | 26 | - | 12 | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Nertera dichondrifolia</i> | 40 | 58 | 75  | 60  | -  | -  | -  | - | 6  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Lagenifera strangulata</i> | 30 | 8  | 88  | 100 | 40 | 25 | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia clavata</i>        | 20 | 19 | 100 | 100 | 60 | -  | 13 | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Coprosma propinqua</i>     | 60 | 4  | 50  | 20  | 60 | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia filiformis</i>     | 40 | 4  | 19  | 80  | -  | -  | 9  | - | -  | -  | -  | -  | -  | -  | 25 | -  | -  |
| <i>Microlaena avenacea</i>    | 10 | -  | 13  | -   | -  | -  | -  | - | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Coprosma ciliata</i>       | 20 | 12 | 13  | 40  | 20 | -  | 4  | - | 24 | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Corybas trilobus</i>       | 20 | -  | 38  | 20  | -  | -  | -  | - | 6  | -  | -  | -  | -  | -  | -  | -  | -  |

| CLASS K                                             | 1 | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17  |
|-----------------------------------------------------|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| <i>Abrotanella aff. inconspicua</i>                 | - | - | -  | -  | -  | -  | -  | -  | -  | 4  | 24 | 12 | -  | 40 | -  | -  | -   |
| <i>Cotula pectinata</i>                             | - | - | -  | -  | -  | -  | -  | -  | -  | 4  | 29 | 16 | 8  | -  | -  | -  | -   |
| <i>Celmisia brevifolia</i>                          | - | - | -  | -  | -  | -  | -  | -  | -  | -  | 59 | 12 | 16 | -  | -  | -  | -   |
| <i>Marsippospermum gracile</i>                      | - | - | -  | -  | -  | -  | -  | -  | -  | -  | 41 | 24 | 38 | -  | -  | -  | -   |
| <i>Celmisia lyallii</i>                             | - | - | -  | -  | -  | -  | -  | 9  | -  | 7  | 65 | 6  | -  | -  | -  | -  | -   |
| <i>Celmisia viscosa</i>                             | - | - | -  | -  | -  | -  | -  | -  | -  | -  | 12 | -  | -  | -  | -  | -  | -   |
| <i>Hymenanthera alpina</i>                          | - | - | -  | -  | 40 | -  | -  | -  | 12 | 4  | 24 | 6  | -  | -  | -  | -  | -   |
| <i>Aciphylla scott-thomsonii</i>                    | - | - | -  | -  | -  | -  | -  | 3  | 12 | 24 | 29 | 12 | -  | -  | -  | -  | -   |
| <i>Hierochloë novae-selandiae</i>                   | - | - | -  | -  | -  | -  | -  | 3  | 6  | 11 | 41 | 6  | 8  | -  | -  | -  | -   |
| <i>Polystichum cystostegia</i>                      | - | - | -  | -  | -  | -  | -  | -  | 6  | 24 | 35 | 18 | 31 | -  | -  | 3  | -   |
| <i>Cardamine debilis</i>                            | - | - | 16 | 20 | -  | -  | -  | 3  | 6  | 11 | 24 | 12 | -  | -  | -  | -  | -   |
| <i>Anisotome brevistylis</i>                        | - | - | -  | -  | -  | -  | -  | 3  | -  | 4  | 29 | -  | 8  | -  | -  | -  | -   |
| <i>Celmisia hectorii</i>                            | - | - | -  | -  | -  | -  | -  | -  | -  | 4  | 12 | -  | 23 | -  | -  | 3  | -   |
| <i>Epilobium porphyrium</i>                         | - | - | -  | -  | -  | -  | -  | -  | -  | 7  | 12 | -  | -  | -  | -  | -  | -   |
| <i>Ourisia glandulosa</i>                           | - | - | -  | -  | -  | -  | -  | -  | -  | 4  | 12 | 12 | 23 | -  | -  | -  | -   |
| <i>Forstera sedifolia</i>                           | - | - | -  | -  | -  | -  | -  | 5  | -  | 4  | 12 | -  | 8  | -  | -  | -  | -   |
| <i>Schizellera haastii</i> var. <i>cyanopetalum</i> | - | - | -  | -  | -  | -  | -  | 8  | 6  | 4  | 6  | -  | -  | -  | -  | -  | -   |
| <i>Poa kirkii</i> / <i>P. intrusa</i>               | - | - | -  | -  | -  | -  | -  | 3  | -  | -  | 12 | -  | -  | -  | -  | -  | -   |
| <i>Aciphylla hectorii</i>                           | - | - | -  | -  | -  | -  | -  | 8  | -  | 11 | 12 | 12 | -  | -  | -  | -  | -   |
| <i>Astelia linearis</i>                             | - | - | -  | -  | -  | -  | -  | -  | -  | 11 | -  | -  | -  | -  | 25 | 3  | -   |
| <i>Hebe</i> sp. (subulata)                          | - | - | -  | -  | -  | -  | -  | -  | -  | 18 | 6  | 6  | 8  | -  | -  | -  | -   |
| <i>Anisotome aromatica</i>                          | - | - | -  | -  | -  | -  | 4  | 14 | 18 | 32 | 18 | -  | 8  | -  | 50 | 21 | -   |
| <i>Drapetes dieffenbachii</i>                       | - | - | -  | -  | -  | -  | 9  | 14 | 24 | 32 | 24 | 12 | -  | -  | -  | -  | -   |
| <i>Raoulia grandiflora</i>                          | - | - | -  | -  | -  | -  | -  | -  | -  | 18 | 29 | 12 | 38 | -  | -  | -  | -   |
| <i>Astelia nivicola</i>                             | - | - | -  | -  | -  | -  | -  | 5  | -  | 54 | 6  | 12 | -  | -  | 25 | -  | -   |
| <i>Geum uniflora</i>                                | - | - | -  | -  | -  | -  | -  | -  | 6  | 21 | 6  | 6  | 8  | -  | -  | -  | -   |
| <i>Carex berggrenii</i>                             | - | - | -  | -  | -  | -  | -  | -  | 6  | 25 | -  | 24 | -  | -  | -  | 3  | 14  |
| <i>Carpus alpina</i>                                | - | - | -  | -  | -  | -  | -  | 3  | 12 | 32 | -  | 12 | -  | 20 | -  | 21 | 100 |
| <i>Schoenus pauciflorus</i>                         | - | - | -  | -  | -  | -  | 4  | 8  | 12 | 61 | 29 | 24 | 15 | -  | -  | 17 | 86  |
| <i>Craspedia lanata</i>                             | - | - | -  | -  | -  | 25 | -  | 11 | -  | 14 | 6  | 12 | -  | -  | -  | 7  | 43  |
| <i>Uncinia caespitosa</i>                           | - | - | -  | -  | -  | -  | -  | 5  | 6  | 39 | 29 | 12 | 31 | -  | -  | -  | 14  |
| <i>Brachyglottis revoluta</i>                       | - | - | -  | -  | -  | -  | -  | 16 | 35 | 54 | 76 | 12 | 8  | -  | -  | -  | 14  |
| <i>Celmisia semicordata</i>                         | - | - | -  | -  | -  | -  | 9  | 8  | 53 | 86 | 82 | 12 | 8  | -  | -  | 3  | 43  |
| <i>Uncinia fuscovaginata</i>                        | - | - | -  | -  | -  | -  | 4  | 16 | 29 | 39 | 53 | 12 | -  | -  | -  | 3  | -   |
| <i>Dracophyllum uniflorum</i>                       | - | - | -  | -  | 20 | -  | 9  | 14 | 12 | 46 | 47 | 12 | 8  | -  | 75 | -  | -   |
| <i>Lycopodium australicum</i>                       | - | - | -  | -  | -  | -  | -  | -  | 6  | 11 | 41 | 12 | -  | -  | -  | -  | -   |
| <i>Agrostis subulata</i> / <i>pallidescens</i>      | - | - | -  | -  | -  | -  | 4  | 9  | -  | 32 | 24 | 47 | 85 | -  | -  | 48 | 14  |
| <i>Coprosma pumila</i>                              | - | - | -  | -  | -  | -  | -  | 11 | 6  | 25 | 12 | 6  | 69 | 20 | -  | 41 | 43  |
| <i>Caltha obtusa</i>                                | - | - | -  | -  | -  | -  | -  | 5  | -  | 39 | 12 | 35 | 15 | 20 | -  | 48 | 43  |
| <i>Chionochoila macra</i>                           | - | - | -  | -  | -  | -  | -  | 11 | -  | 36 | 94 | 88 | 77 | -  | -  | 48 | 14  |
| <i>Gnaphalium mackayii</i>                          | - | - | -  | -  | -  | -  | -  | 57 | -  | 75 | 59 | 76 | 46 | -  | -  | 72 | 86  |
| <i>Anisotome flexuosa</i>                           | - | - | -  | -  | -  | -  | 4  | 16 | 41 | 25 | 18 | 88 | 54 | -  | -  | -  | -   |
| <i>Colobanthus</i> spp.                             | - | - | -  | -  | -  | -  | -  | -  | 6  | 4  | 24 | 53 | 69 | -  | -  | 7  | 29  |
| <i>Luzula pumila</i>                                | - | - | -  | -  | -  | -  | -  | 5  | -  | 14 | 53 | 82 | 92 | 40 | -  | 3  | -   |
| <i>Gentiana bellidifolia</i>                        | - | - | -  | -  | 20 | -  | 26 | 30 | 18 | 29 | 18 | 59 | 46 | -  | -  | 7  | -   |
| <i>Celmisia sessiliflora</i>                        | - | - | -  | -  | -  | -  | -  | -  | -  | 7  | 6  | 41 | 15 | -  | -  | 17 | 14  |
| <i>Dracophyllum muscoides</i>                       | - | - | -  | -  | -  | -  | -  | 5  | -  | 21 | 18 | 53 | -  | -  | -  | -  | -   |
| <i>Drapetes villosus</i>                            | - | - | -  | -  | -  | -  | -  | 14 | -  | 4  | -  | 29 | 8  | -  | -  | -  | -   |

| CLASS L                                          | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|--------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| <i>Anisotome imbricata</i> var. <i>imbricata</i> | - | - | - | - | - | - | - | - | - | -  | 6  | 12 | -  | -  | -  | -  | -  |
| <i>Raoulia hectorii</i>                          | - | - | - | - | - | - | - | - | - | -  | 12 | 18 | -  | -  | -  | -  | -  |
| <i>Chionohebe densifolia</i>                     | - | - | - | - | - | - | - | - | - | 4  | 6  | 29 | -  | -  | -  | -  | -  |
| <i>Brachycome sinclairii</i>                     | - | - | - | - | - | - | - | - | 6 | -  | -  | 12 | -  | -  | -  | -  | -  |
| <i>Brachyglottis bellidioides</i>                | - | - | - | - | - | - | - | - | - | -  | -  | 18 | -  | -  | -  | -  | -  |
| <i>Celmisia laricifolia</i>                      | - | - | - | - | - | - | - | - | - | 11 | 12 | 12 | -  | -  | -  | -  | -  |
| <i>Chionochoa rigida</i> X <i>masra</i>          | - | - | - | - | - | - | - | - | - | 14 | 12 | 12 | -  | -  | -  | -  | -  |
| <i>Hebe poppelwellii</i>                         | - | - | - | - | - | - | - | - | - | -  | 6  | 6  | -  | -  | -  | -  | -  |
| <i>Cardamine bilobata</i>                        | - | - | - | - | - | - | - | - | - | 4  | 29 | -  | 15 | -  | -  | -  | -  |
| <i>Taraxacum magellanicum</i>                    | - | - | - | - | - | - | - | - | - | -  | 24 | 12 | 8  | -  | -  | -  | -  |
| <i>Myosotis pygmaea</i>                          | - | - | - | - | - | - | - | - | - | -  | 18 | 6  | 8  | -  | -  | -  | -  |

CLASS M

|                               |    |   |    |    |    |    |    |    |    |   |   |    |   |   |   |    |
|-------------------------------|----|---|----|----|----|----|----|----|----|---|---|----|---|---|---|----|
| Carex sp.                     | -  | - | -  | 20 | -  | -  | -  | 6  | 7  | - | - | 8  | - | - | 7 | -  |
| Chionochoila rubra X rigida   | -  | - | -  | -  | -  | 25 | 26 | -  | -  | - | - | -  | - | - | - | -  |
| Hieropolirion novae-zelandiae | -  | - | -  | -  | -  | -  | 26 | -  | -  | - | - | -  | - | - | - | -  |
| Gonocarpus micranthus         | -  | - | -  | -  | -  | 50 | 9  | -  | 6  | - | - | -  | - | - | - | 43 |
| Gunnera dentata               | -  | - | -  | -  | -  | 25 | 13 | -  | -  | - | - | -  | - | - | - | -  |
| Uncinia affinis               | -  | - | -  | -  | 20 | -  | 9  | -  | -  | - | - | -  | - | - | - | -  |
| Uncinia purpurata             | -  | - | -  | -  | -  | -  | 13 | -  | -  | - | - | -  | - | - | - | -  |
| Chionochoila rubra            | -  | - | -  | -  | -  | 75 | 22 | -  | -  | - | - | -  | - | - | - | -  |
| Gonocarpus aggregatus         | -  | - | -  | -  | -  | 75 | 48 | -  | -  | - | - | -  | - | - | - | -  |
| Galium perpusillum            | -  | - | -  | -  | -  | 75 | 35 | 8  | 6  | - | - | 12 | - | - | - | 3  |
| Festuca novae-zelandiae       | -  | - | -  | -  | 20 | 25 | 61 | -  | 18 | - | - | -  | - | - | - | -  |
| Leptospermum scoparium        | -  | - | -  | -  | 40 | 25 | 30 | -  | -  | - | - | -  | - | - | - | -  |
| Holcus lanatus                | -  | - | -  | -  | 20 | 75 | 43 | 3  | 35 | 4 | - | -  | - | - | - | -  |
| Trifolium repens              | -  | - | -  | -  | 40 | 75 | 48 | -  | 29 | 4 | - | -  | - | - | - | -  |
| Carex coriacea                | -  | - | -  | -  | -  | 75 | 17 | -  | 12 | - | - | -  | - | - | - | -  |
| Juncus effusus                | -  | - | -  | -  | 20 | 75 | 24 | -  | -  | - | - | -  | - | - | - | -  |
| Celmisia aff. graminifolia    | -  | - | -  | -  | 20 | 25 | 17 | 3  | 12 | - | - | -  | - | - | - | -  |
| Carex ovalis                  | -  | - | -  | -  | -  | 50 | -  | -  | -  | - | - | -  | - | - | - | -  |
| Pentha cunninghamii           | -  | - | -  | -  | -  | 75 | 4  | -  | -  | - | - | -  | - | - | - | -  |
| Lagenifera petiolata          | -  | - | -  | -  | -  | 75 | 9  | -  | 12 | - | - | -  | - | - | - | -  |
| Gunnera prorepens             | -  | - | -  | -  | -  | 25 | 4  | -  | -  | - | - | -  | - | - | - | -  |
| Hierochloë redolens           | -  | - | -  | -  | -  | 50 | -  | -  | 12 | - | - | -  | - | - | - | -  |
| Xertera depressa              | 10 | - | 13 | -  | -  | 25 | 9  | -  | 18 | 4 | - | -  | - | - | - | -  |
| Uncinia divaricata            | -  | - | -  | -  | -  | -  | -  | 8  | 29 | - | 6 | -  | 8 | - | - | -  |
| Hydrocotyle novae-zelandiae   | -  | - | 13 | -  | -  | 50 | 13 | 11 | 18 | - | - | 18 | - | - | - | -  |
| Euchlenbeckia complexa        | -  | - | -  | -  | -  | -  | 4  | 3  | -  | - | - | -  | - | - | - | -  |
| Permettys X Gaultheria        | -  | - | -  | -  | -  | -  | 4  | -  | 6  | - | - | -  | - | - | - | -  |
| Xertera setulosa              | -  | - | -  | -  | -  | -  | 9  | -  | -  | - | - | -  | - | - | - | -  |
| Pteridium esculentum          | -  | - | -  | -  | -  | 25 | 9  | -  | -  | - | - | -  | - | - | - | -  |

CLASS N

[illegible]

| CLASS O                           | 1  | 2  | 3  | 4   | 5   | 6   | 7   | 8  | 9   | 10 | 11 | 12 | 13 | 14 | 15  | 16 | 17 |
|-----------------------------------|----|----|----|-----|-----|-----|-----|----|-----|----|----|----|----|----|-----|----|----|
| <i>Acaena caesiiglauc</i>         | -  | -  | -  | -   | 20  | -   | 43  | 24 | 53  | 11 | -  | 12 | -  | -  | -   | -  | 14 |
| <i>Ranunculus lappaceus</i>       | -  | -  | -  | -   | 20  | 50  | 43  | 16 | 65  | -  | 18 | 24 | 23 | -  | -   | -  | -  |
| <i>Cerastium fontanum</i>         | -  | -  | 6  | -   | 60  | 50  | 17  | 3  | 35  | -  | 6  | 12 | 8  | -  | -   | -  | 43 |
| <i>Blechnum penna-marina</i>      | 10 | 4  | 44 | 100 | 100 | 100 | 78  | 41 | 82  | 50 | 12 | 18 | -  | -  | 25  | -  | 14 |
| <i>Polystichum vestitum</i>       | 20 | 4  | 69 | 100 | 80  | -   | 35  | 22 | 53  | 25 | -  | -  | 8  | -  | -   | -  | -  |
| <i>Acaena</i> sp.                 | -  | -  | 6  | -   | 40  | 25  | 17  | 38 | 35  | 18 | 12 | 35 | -  | -  | -   | -  | -  |
| <i>Plantago novae-zelandiae</i>   | -  | -  | -  | 20  | -   | -   | 4   | 32 | 53  | 25 | 6  | -  | -  | -  | -   | 3  | -  |
| <i>Eulbinella angustifolia</i>    | -  | -  | -  | -   | -   | 50  | 22  | 32 | 76  | 39 | -  | -  | -  | -  | 25  | -  | 43 |
| <i>Fraxia angulata</i>            | -  | -  | 6  | -   | 20  | 50  | 9   | 41 | 41  | 32 | 12 | 18 | -  | -  | -   | 3  | 57 |
| <i>Agrostis capillaris</i>        | -  | -  | 13 | -   | 100 | 100 | 91  | 70 | 82  | 32 | 29 | 47 | 8  | -  | -   | 10 | 29 |
| <i>Oreomyrrhis colensoi</i>       | -  | -  | -  | -   | 60  | 25  | 61  | 84 | 76  | 21 | 6  | 6  | -  | -  | -   | 7  | -  |
| <i>Anthoxanthum odoratum</i>      | -  | -  | -  | 20  | 80  | 75  | 96  | 59 | 94  | 32 | 12 | 24 | 15 | -  | -   | 21 | 86 |
| <i>Chionochloa rigida</i>         | -  | -  | -  | -   | 40  | -   | 65  | 95 | 100 | 82 | 24 | 6  | -  | 20 | 100 | 14 | 57 |
| <i>Geranium microphyllum</i>      | -  | -  | -  | -   | 20  | 75  | 100 | 78 | 94  | 57 | 41 | 47 | 8  | -  | -   | -  | -  |
| <i>Helichrysum bellidioides</i>   | -  | -  | 13 | -   | 40  | 25  | 70  | 84 | 88  | 25 | 12 | 35 | -  | -  | -   | -  | 14 |
| <i>Hypochaeris radicata</i>       | -  | 12 | 25 | 20  | 100 | 75  | 100 | 89 | 88  | 50 | 6  | 35 | 8  | -  | -   | -  | 14 |
| <i>Celmisia gracilentia</i>       | -  | -  | -  | -   | -   | 75  | 74  | 70 | 47  | 25 | 6  | 24 | -  | 20 | -   | 7  | 71 |
| <i>Wahlenbergia albomarginata</i> | -  | -  | -  | -   | 20  | 25  | 70  | 54 | 76  | 14 | 6  | 35 | 8  | -  | -   | -  | -  |
| <i>Viola cunninghamii</i>         | -  | -  | -  | -   | 40  | 100 | 52  | 49 | 82  | 32 | 35 | 29 | 15 | -  | -   | 17 | 71 |
| <i>Agrostis muscosa</i>           | -  | -  | -  | -   | -   | -   | -   | 38 | 12  | 46 | 12 | 71 | 77 | -  | -   | -  | -  |
| <i>Plantago lanigera</i>          | -  | -  | -  | -   | -   | -   | -   | 24 | 6   | 39 | 12 | 47 | 46 | -  | -   | 3  | 14 |
| <i>Erythranthera pumila</i>       | -  | -  | -  | -   | -   | -   | 4   | 62 | 18  | 50 | 6  | 24 | 15 | -  | -   | -  | -  |
| <i>Rumex acetosella</i>           | -  | -  | -  | -   | -   | -   | 4   | 57 | 29  | 46 | 6  | 71 | 38 | -  | -   | 3  | 14 |
| <i>Carex wakatipu</i>             | -  | -  | -  | -   | 20  | -   | 35  | 59 | 29  | 39 | 35 | 41 | 8  | -  | -   | -  | 29 |
| <i>Lycopodium fastigiatum</i>     | -  | -  | 6  | -   | 40  | -   | 65  | 68 | 53  | 18 | 47 | 53 | 8  | -  | -   | -  | -  |
| <i>Celmisia prorepens</i>         | -  | -  | -  | -   | -   | -   | 9   | 35 | 41  | 68 | 53 | 29 | 8  | -  | -   | -  | 14 |
| <i>Epilobium alsinoides</i>       | -  | -  | 6  | -   | 60  | 40  | 39  | 68 | 35  | 43 | 65 | 76 | 15 | -  | -   | 10 | 57 |
| <i>Gaultheria depressa</i>        | -  | -  | -  | -   | 80  | 25  | 65  | 89 | 88  | 82 | 47 | 82 | -  | -  | 50  | -  | 14 |
| <i>Poa colensoi</i>               | -  | -  | -  | -   | 20  | -   | 74  | 92 | 71  | 82 | 94 | 82 | 54 | 40 | -   | 45 | -  |
| <i>Geum leiospermum</i>           | -  | -  | -  | -   | 40  | -   | -   | 92 | 47  | 64 | 65 | 88 | 69 | -  | -   | 3  | 14 |
| <i>Luzula rufa</i>                | -  | -  | -  | 20  | -   | -   | 22  | 84 | 71  | 71 | 59 | 35 | -  | -  | -   | -  | 43 |

| CLASS P                            | 1  | 2  | 3  | 4  | 5   | 6   | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|------------------------------------|----|----|----|----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|
| <i>Astelia nervosa</i>             | -  | 8  | 38 | 60 | 40  | -   | 30 | 8  | 6  | 4  | -  | -  | -  | -  | 75 | -  | -  |
| <i>Coprosma parviflora</i>         | 20 | 50 | 50 | -  | 80  | 25  | 52 | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Brachyglottis southlandicus</i> | -  | -  | -  | 40 | 40  | 25  | 43 | -  | -  | 7  | -  | -  | -  | -  | -  | -  | -  |
| <i>Uncinia Aucklandica</i>         | -  | -  | 6  | 20 | 20  | -   | 22 | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Dracophyllum longifolium</i>    | -  | -  | -  | -  | 60  | -   | 22 | -  | 29 | -  | -  | -  | -  | -  | 25 | -  | -  |
| <i>Lycopodium scariosum</i>        | -  | -  | 6  | -  | 20  | -   | 35 | -  | 24 | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Phormium cookianum</i>          | -  | -  | 6  | -  | 20  | -   | 17 | -  | 6  | 4  | -  | -  | -  | -  | 25 | -  | -  |
| <i>Cassinia vauvilliersii</i>      | -  | -  | -  | -  | 20  | 50  | 83 | 27 | 59 | 21 | -  | -  | -  | -  | -  | -  | -  |
| <i>Hebe aff. rakaiensis</i>        | -  | -  | 6  | -  | 40  | 25  | 87 | 35 | 59 | 54 | 18 | 12 | -  | -  | -  | -  | -  |
| <i>Celmisia densiflora</i>         | -  | -  | -  | -  | -   | -   | 83 | 3  | 53 | 32 | 47 | 18 | -  | -  | -  | -  | -  |
| <i>Rytidosperma gracile</i>        | -  | -  | -  | -  | 20  | 25  | 65 | 19 | 47 | 11 | 6  | 6  | -  | -  | 25 | -  | -  |
| <i>Coprosma cheesemanii</i>        | -  | -  | -  | -  | -   | 25  | 87 | 14 | 12 | 7  | -  | -  | -  | -  | -  | -  | -  |
| <i>Permettya macrostigma</i>       | -  | -  | 6  | -  | 20  | 100 | 91 | 16 | 6  | -  | -  | -  | -  | -  | 25 | -  | -  |
| <i>Uncinia rubra</i>               | -  | -  | -  | -  | 40  | 50  | 87 | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| <i>Helichrysum filicaule</i>       | -  | -  | -  | -  | 60  | 50  | 83 | 24 | 24 | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Deyeuxia avenoides</i>          | -  | -  | -  | -  | -   | -   | 30 | 14 | 29 | -  | -  | -  | -  | -  | -  | 3  | -  |
| <i>Uncinia sp.</i>                 | -  | -  | -  | -  | -   | -   | 22 | 19 | -  | -  | -  | 6  | -  | -  | -  | -  | -  |
| <i>Gentiana grisebachii</i>        | -  | -  | -  | -  | -   | 40  | 30 | 14 | 41 | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Lagenifera cuneata</i>          | -  | -  | 6  | -  | -   | -   | 9  | 30 | 29 | 4  | -  | -  | -  | -  | -  | -  | -  |
| <i>Prasophyllum colensoi</i>       | -  | -  | -  | -  | 20  | -   | 9  | 24 | 35 | 4  | -  | -  | -  | -  | -  | -  | 14 |
| <i>Leucopogon fraseri</i>          | -  | -  | -  | -  | 60  | 25  | 39 | 32 | 24 | -  | -  | 6  | -  | -  | -  | -  | -  |
| <i>Pimelea oreophila</i>           | -  | -  | -  | -  | -   | 25  | 74 | 22 | 29 | 18 | 6  | 6  | -  | -  | -  | -  | -  |
| <i>Raculia subsericea</i>          | -  | -  | -  | -  | -   | -   | 35 | 32 | 47 | 7  | 6  | 12 | -  | -  | -  | -  | -  |
| <i>Euphrasia zelandica</i>         | -  | -  | -  | -  | -   | -   | 35 | 3  | 41 | 4  | -  | 6  | -  | -  | -  | -  | -  |
| <i>Gaultheria crassa</i>           | -  | -  | -  | -  | 20  | -   | 35 | 3  | 35 | -  | -  | 6  | -  | -  | -  | -  | -  |
| <i>Gunnera monoica</i>             | -  | -  | -  | -  | 100 | -   | 30 | 8  | 35 | 4  | -  | -  | -  | -  | -  | -  | -  |

# = *Poa breviglumis* was extremely variable in the field, and specimens were often mis-identified. Closer study after data analysis revealed specimens were apparently the same species (Dr E. Edgar, pers. comm.).

Note: Specimens of particular genera (e.g. *Galium*, *Cardamine*) which could not accurately be identified to species level are denoted as sp. only.

APPENDIX IV : Birds recorded from the new woolshed, Pomahaka valley  
(S152 GR: 015 003) to the Gem Lake area, Umbrella Mountains  
by Mr P. and Mrs M. Child, 8-9 March 1986.

| <u>BIRD SPECIES</u>                | <u>COMMENTS</u>                                                                                                                                          |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Paradise shelduck                  | Noted 3.2.2.2. in vicinity of lake and bogs.<br>Breed here.                                                                                              |
| Redpoll*                           | Very common in areas of beech forest and<br>scrubby gullies on way in; not on the high<br>summits.                                                       |
| New Zealand pipit                  | Common throughout grassland and high<br>tussocklands.                                                                                                    |
| Silvereye                          | Small numbers noted in scrubby gullies.                                                                                                                  |
| Chaffinch*                         | Present in beech forest and scrubby gullies.                                                                                                             |
| Grey warbler                       | " " " " " "                                                                                                                                              |
| Australian magpie*                 | A few seen and heard in the lower country,<br>vicinity woolshed.                                                                                         |
| Australasian harrier               | Three singletons recorded fairly high up.                                                                                                                |
| Skylark*                           | Only one seen, but should be more common.                                                                                                                |
| Goldfinch*                         | Present in scrubby gullies.                                                                                                                              |
| Hedgesparrow*                      | " " " "                                                                                                                                                  |
| New Zealand falcon                 | Not seen by us, but reported by runholder to<br>be 'quite common' on occasions.                                                                          |
| Kea                                | Not recorded by us, but up to eight have been<br>seen on rock outcrops in the area - probably<br>occasional visitors from the Garvies/Hectors<br>region. |
| Southern black-backed gull         | Not recorded by us, but undoubtedly here in<br>the summer; a recent nest seen on a large<br>boulder near the lake.                                       |
| Banded dotterel                    | Not recorded by us, but small numbers<br>probably breed in the tundra areas in summer.                                                                   |
| South Island pied<br>oystercatcher | Not recorded by us, but probably here in small<br>numbers in summer; one old nest-site seen.                                                             |
| Spur-winged plover                 | Small numbers lower down, probably in grassland<br>and clearings up to c. 1000m.                                                                         |

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\* = introduced species

NOTE: Undoubtedly several other small passerines in the scrub and beech forest.

APPENDIX V: Lichen species, together with their general habitat and abundance, recorded by Mr. P. and Mrs. M. Child in the Gem Lake/Mt. Whitecomb areas, Umbrella Mountains, 8-9 March 1986.

| Species                            | Abundance | Substrate                           |  |  |                                 |
|------------------------------------|-----------|-------------------------------------|--|--|---------------------------------|
| 1. <i>Alaetoria nigricans</i>      | O         | On low tundra veg.                  |  |  | Rocks                           |
| 2. <i>Arthrographis citrinella</i> | X         | Damp soil                           |  |  | Decaying veg.                   |
| 3. <i>Brigantiaea fuscoluteum</i>  | X         | Decaying veg.                       |  |  |                                 |
| 4. <i>Bryoria austromontana</i>    | X         | Rocks, among                        |  |  | Rocks                           |
| 5. <i>Condelariaella vitellina</i> | X         | Rocks, lakeside bird roosts.        |  |  | Rocks, lakeside bird roosts     |
| 6. <i>Cetraria islandica</i>       | O         | Tundra hollows                      |  |  | Damp bases of rocks             |
| 7. <i>Cladia aggregata</i>         | O         | Soil in grassland and tundra.       |  |  | Top surfaces of rocks           |
| 8. <i>Cladonia leptoclada</i>      | O         | " " " "                             |  |  | " " " "                         |
| 9. <i>Cladonia auri</i>            | C         | Soil in grassland and tundra.       |  |  | " " " "                         |
| 10. <i>C. carassensis</i>          | O         | " " " "                             |  |  | " " " "                         |
| 11. <i>C. deformis</i>             | X         | Soil in grassland.                  |  |  | Base of veg. in grassland       |
| 12. <i>Coelocaulon anileatum</i>   | O         | Soil in tundra.                     |  |  | " " " "                         |
| 13. <i>Collena durvillii</i>       | O         | Damp banks in grassland.            |  |  | " " " "                         |
| 14. <i>Hypogymnia lugubris</i>     | C         | Among low veg. and in rock ledges.  |  |  | " " " "                         |
| 15. <i>Lecanora atra</i>           | C         | Rocks.                              |  |  | Rocks                           |
| 16. <i>L. blanda</i>               | O         | "                                   |  |  | Damp soil                       |
| 17. <i>L. brocchia</i>             | C         | Decaying tussock bases              |  |  | " " "                           |
| 18. <i>L. polytricha</i>           | O         | Rocks                               |  |  | Damp soil on rock ledges        |
| 19. <i>Lecidea dumetina</i>        | X         | "                                   |  |  | Mosses & rock in crevices       |
| 20. <i>L. subleptocida</i>         | A         | "                                   |  |  | Soil & low veg. in tundra       |
| 21. <i>Lepuraria neglecta</i>      | C         | Damp soil and mosses on rock ledges |  |  | Damp soil in tundra & grassland |
| 22. <i>Menegazzia cartonea</i>     | O         | Shady sides of rocks.               |  |  | Soil in tundra                  |
| 23. <i>Neofuscelia adicta</i>      | O         | Rocks                               |  |  | Top surfaces of rocks           |
| 24. <i>N. pictada</i>              | O         | "                                   |  |  | N faces of tors                 |
| 25. <i>Neuropogon acromelanus</i>  | A         | Tors                                |  |  | Tors                            |
| 26. <i>N. citiatius</i>            | A         | "                                   |  |  | "                               |
| 27. <i>N. subcapillaris</i>        | X         | "                                   |  |  | Top surfaces of rocks           |
|                                    |           |                                     |  |  | Top surfaces of rocks           |
|                                    |           |                                     |  |  | Low veg. in tundra              |
|                                    |           |                                     |  |  | Top surfaces of rocks           |
|                                    |           |                                     |  |  | Lakeside rocks                  |
|                                    |           |                                     |  |  | Rock (bluff systems SW of lake) |

+ several other species, especially crustose ones on rock outcrops.

A = abundant, C = common, O = occasional, X = rare

Appendix VI: Alphabetical list of common plant names used in the text together with their corresponding botanical names

| * adventive species        |                                                       |                            |                                                       |                     |                               |
|----------------------------|-------------------------------------------------------|----------------------------|-------------------------------------------------------|---------------------|-------------------------------|
| Bidibid                    | <i>Acaena</i> spp.                                    | Flax                       | <i>Phormium tenax</i>                                 | * Radiata pine      | <i>Pinus radiata</i>          |
| Bladderwort                | <i>Utricularia monanthos</i>                          | Pool's beech               | <i>Gaultheria antipoda</i>                            | Red beech           | <i>Nothofagus fusca</i>       |
| Bog pine                   | <i>Halocarpus bidwillii</i>                           | * Foxglove                 | <i>Digitalis purpurea</i>                             | * Red clover        | <i>Trifolium pratense</i>     |
| Bracken fern               | <i>Pteridium esculentum</i>                           |                            |                                                       | Red tussock         | <i>Chionochloa rubra</i>      |
| Broadleaf                  | <i>Griselinia littoralis</i>                          | Gentian                    | <i>Gentiana amabilis</i>                              |                     |                               |
| * Browntop                 | <i>Agrostis capillaris</i>                            |                            | <i>G. bellidifolia</i>                                | * Scotch thistle    | <i>Cirsium vulgare</i>        |
| Bush lawyer                | <i>Rubus cissoides</i>                                | Golden spaniard            | <i>G. divisa</i>                                      | * Sheep's sorrel    | <i>Rumex acetosella</i>       |
| Buttercup                  | <i>Ranunculus</i> spp.                                | * Gooseberry               | <i>G. grisebachii</i>                                 | Silver beech        | <i>Nothofagus menziesii</i>   |
|                            |                                                       | * Corse                    | <i>Aciphylla aurea</i>                                | Slim snow tussock   | <i>Chionochloa macrocarpa</i> |
|                            |                                                       |                            | <i>Ribes uva-crispa</i>                               | * Smooth hawksbeard | <i>Crepis capillaris</i>      |
|                            |                                                       |                            | <i>Ulex europaeus</i>                                 | Speargrass          | <i>Aciphylla glaucescens</i>  |
|                            |                                                       |                            |                                                       |                     | <i>A. aff. horrida</i>        |
| Cabbage tree               | <i>Cordyline australis</i>                            | Hall's totara              | <i>Podocarpus hallii</i>                              |                     | <i>A. scott-thomsonii</i>     |
| * Californian thistle      | <i>Cirsium arvense</i>                                | Inaka                      | <i>Dracophyllum longifolium</i>                       | Spleenwort          | <i>Asplenium bulbiferum</i>   |
| * Catsear                  | <i>Hypochaeris radicata</i>                           |                            |                                                       |                     | <i>A. flabellifolium</i>      |
| Celery pine                | <i>Phyllocladus asplenifolius</i> var. <i>alpinus</i> | Kanuka                     | <i>Kunzea (Leptospermum) ericoides</i>                |                     | <i>A. flaccidum</i>           |
| Comb sedge                 | <i>Oreobolus pectinatus</i>                           | Kowhai                     | <i>Sophora microphylla</i>                            |                     | <i>A. hookerianum</i>         |
| * Corsican pine            | <i>Pinus nigra</i>                                    |                            |                                                       |                     | <i>A. richardii</i>           |
| * Crack willow             | <i>Salix fragilis</i>                                 | Lancewood                  | <i>Pseudopanax crassifolius</i>                       | Snowberry           | <i>A. terrestre</i>           |
| Cranesbill                 | <i>Geranium microphyllum</i>                          | * Lotus                    | <i>Lotus pedunculatus</i>                             | Snow totara         | <i>Gaultheria depressa</i>    |
| Creeping everlasting daisy | <i>Helichrysum filicaule</i>                          |                            |                                                       | Sundew              | <i>Podocarpus nivalis</i>     |
| Crape fern                 | <i>Leptopteris superba</i>                            | Manuka                     | <i>Leptospermum scoparium</i>                         | * Sweet brier       | <i>Drosera arcturi</i>        |
|                            |                                                       | Maori onion                | <i>Bulbinella angustifolia</i>                        | * Sweet vernal      | <i>Rosa rubiginosa</i>        |
| * Douglas fir              | <i>Pseudotsuga menziesii</i>                          | Marbleleaf                 | <i>Carpodactylus serratus</i>                         |                     | <i>Anthoxanthum odoratum</i>  |
| Edelweiss                  | <i>Leucogenes grandiceps</i>                          | Matagouri                  | <i>Discaria toumatou</i>                              | Three finger        | <i>Pseudopanax colensoi</i>   |
| * Elderberry               | <i>Sambucus nigra</i>                                 | Matipo                     | <i>Pittosporum tenuifolium</i>                        | Toetoe              | <i>Cortaderia richardii</i>   |
| Everlasting daisy          | <i>Helichrysum bellidoides</i>                        | Mountain beech             | <i>Nothofagus solandri</i> var. <i>cliffortioides</i> | Turpentine scrub    | <i>Dracophyllum uniflorum</i> |
| Eyebright                  | <i>Euphrasia australis</i>                            | Mountain daisy             | <i>Celmisia</i> spp.                                  |                     |                               |
|                            | <i>E. dyeri</i>                                       | Mountain flax              | <i>Phormium cookianum</i>                             | Weeping mapou       | <i>Myrsine divaricata</i>     |
|                            | * <i>E. nemorosa</i>                                  | Mountain ribbonwood        | <i>Hoheria glabrata</i>                               | * White clover      | <i>Trifolium repens</i>       |
|                            | <i>E. zelandica</i>                                   | Mountain tauhini           | <i>Cassinia vauvillierii</i>                          | * Wild thyme        | <i>Thymus vulgaris</i>        |
|                            |                                                       | * Mouse-ear chickweed      | <i>Cerastium fontanum</i>                             | Wineberry           | <i>Aristotelia coccinea</i>   |
|                            |                                                       |                            |                                                       | * Woolly mullein    | <i>Verbascum thapsus</i>      |
| Pescue tussock             | <i>Festuca novae-zelandiae</i>                        | Narrow-leaved snow tussock | <i>Chionochloa rigida</i>                             |                     |                               |
| Filmy fern                 | <i>Hymenophyllum bivalve</i>                          |                            |                                                       | * Yorkshire fog     | <i>Holcus lanatus</i>         |
|                            | <i>H. multifidum</i>                                  | Pepper tree                | <i>Pseudowintera colorata</i>                         |                     |                               |
|                            | <i>H. peltatum</i>                                    | Pokaka                     | <i>Elaeocarpus hookerianus</i>                        |                     |                               |
|                            | <i>H. sanguinolentum</i>                              | Prickly shield fern        | <i>Polystichum vestitum</i>                           |                     |                               |
|                            | <i>H. villosum</i>                                    |                            |                                                       |                     |                               |

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