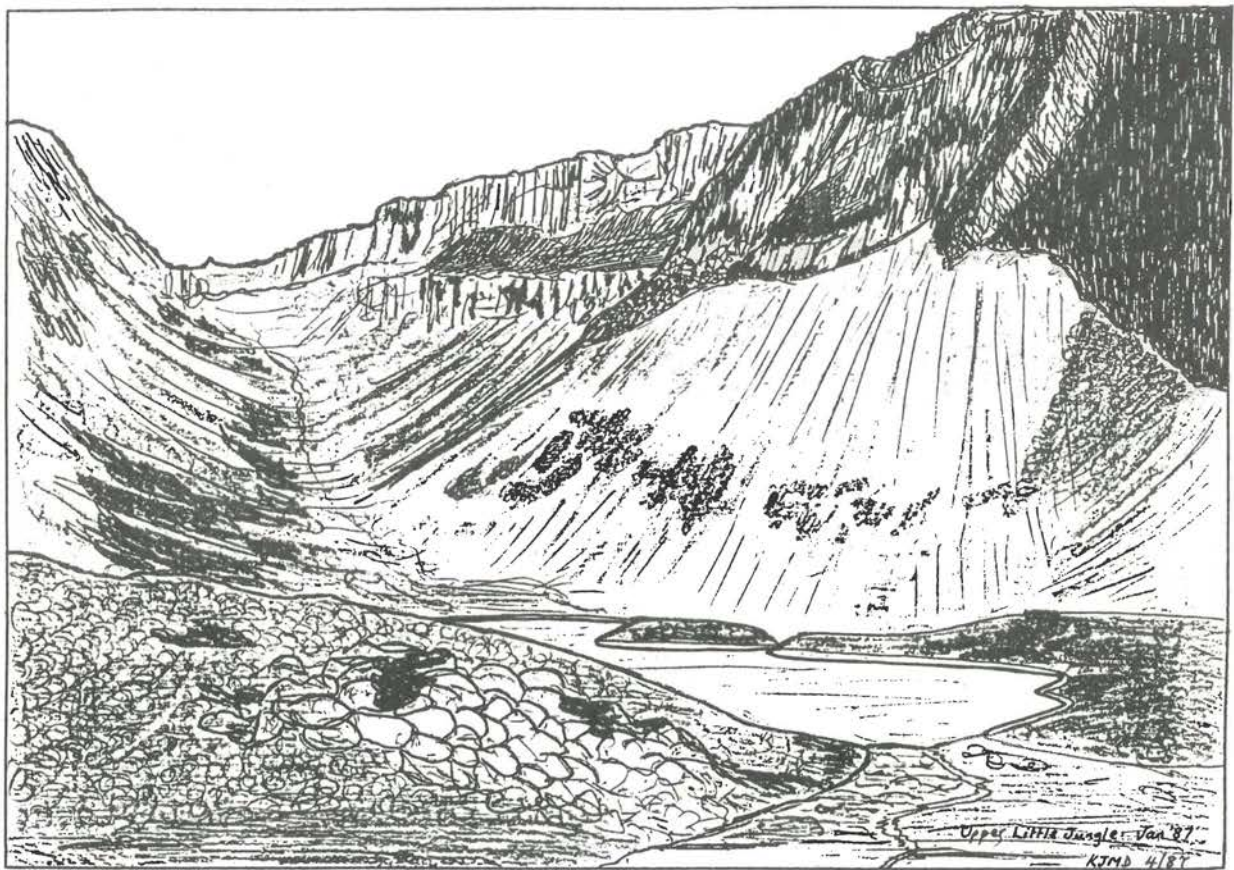


Eyre Ecological District



AN ECOLOGICAL SURVEY OF THE CENTRAL PART

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EYRE ECOLOGICAL DISTRICT
MAVORA ECOLOGICAL REGION

An ecological survey of the central part.

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Report prepared as a contribution to the New Zealand
Protected Natural Areas Programme
May, 1987

COVER: Mid-reaches of Little Jungle Creek, Eyre Catchment, from c.1050 m.

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AN ECOLOGICAL SURVEY OF THE CENTRAL PART
OF THE EYRE ECOLOGICAL DISTRICT,
NORTHERN SOUTHLAND, NEW ZEALAND

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ABSTRACT

A Protected Natural Areas type survey of c. 30,000 ha in the central part of the 197,500 ha Eyre Ecological District, one of three in the Mavora Ecological Region, revealed a wide spectrum of values for nature conservation. These justify much of the area being formally protected. The District's environment, flora and vegetation, and fauna are generally intermediate between those of the Fiordland Ecological Region to the west and the Central Otago Region to the east. Exceptional natural features, particularly relating to biota and vegetation condition, occur in the District.

Indigenous forest, shrubland, grassland, fellfield, bluff, scree and snowbank communities were sampled and the resulting data analysed by standard computer techniques. Important and diverse vegetation sequences were confirmed from the montane to nival zone at the highest elevation (2035 m). Some substantial relic stands of beech forest persist. Proportions of Nothofagus menziesii (silver beech) and N. fusca (red beech) in the

predominantly N. solandri var. cliffortioides (mountain beech) forests, decline steadily from the wetter western to the drier eastern parts. These forest areas harbour strong populations of the vulnerable yellow crowned parakeet.

Shrublands and indigenous grasslands in particularly good condition occur on the two Crown land blocks (Eyre Creek and Cainard comprising c. 34,000 ha). Burning and stock grazing on their upper slopes have been virtually absent since these blocks were resumed by the Crown in 1962-63 for water and soil conservation, and vegetation rehabilitation purposes. Some low-altitude grasslands are characterised by Elymus rectisetus (blue wheatgrass) rather than Festuca novae-zelandiae (hard tussock). This feature could contribute to resolution of long-standing differences in interpretation of the natural cover of lowland and montane fescue tussock grasslands. Snow tussock grasslands at higher altitudes, because of the vigour, size and prolific flowering of the individual tussocks, were unusually tall and dense.

The survey also confirmed the importance of the District for its relatively high level of endemism. Among the most notable endemics, substantial range extensions were recorded for an undescribed scree species of Ranunculus, for Celmisia philocremna, and also for C. thomsonii (many plants of which have spectacular mauve flower heads). Other endemics are generally widespread - Aciphylla spedenii, Cheesemanii wallii, Ranunculus haastii ssp. piliferus. First records for the District were made for several other plant species with generally limited distributions: Epilobium purpuratum, Hebe dilatata, Pimelea poppelwellii.

The District also forms the distribution limit for many vascular plant species, particularly alpine.

Among the avifauna, four separate high-altitude populations of rock wrens were found. These are the first records east of the Southern Alps. New Zealand falcon were widespread on

mid-altitude tussocklands.

Notable invertebrates collected include the rare landsnail Powelliphanta spedeni ssp. spedeni from one location.

Lepidoptera species were generally very diverse with some 90 taxa recorded, representing elements from both Fiordland and Central Otago, as well as distinctive endemics, particularly at high altitudes. The diverse range of large weevils recorded is considered to reflect the species diversity of their host Aciphylla spp. in the District. Dry shrublands (Olearia - Discaria - Corokia spp.) in the lower reaches of Eyre Creek support a particularly rich insect fauna.

A priority place for protection (PPP) of c. 33,000 ha and embracing much of the area surveyed has been documented and justified on the basis of the high natural values present. These complement those present in two scenic reserves of c. 1200 ha on the District's eastern boundary plus a proposed protected area of c. 3200 ha in the southwest with special ecological features including a third endemic Celmisia associated with ultramafic outcrops. The PPP embraces a high proportion of the District's two Crown land blocks (Eyre Creek and Cainard) plus its two areas of Unalienated Crown Land (U.C.L.) and that portion of Eyre State Forest contained within the Irthing and Cromel catchments. The mid and upper reaches of the Gorge Burn catchment, within the retirement area of Mt Nicholas Station, on the western slopes of the District, has also been included. Collectively, the PPP would form an extensive upland and mountainous area of high biological, ecological, scenic and recreational value.

Some 55 per cent of the District's area is associated with land that has either very limited or no potential for sustained grazing because of an erosion hazard (Land Use Capability, Classes 7e and 8e, respectively). The area identified as having high natural values for either representative ecosystems, and/or for their endemic biota are generally associated with these classes of land. Thus, the conflict between conservation and development is relatively minor. For the two Crown land blocks,

92.5 per cent of the 18,330 ha area included in the proposed PPP is Class 8e and 7e land; the balance (1490 ha) is Class 6e land on valley floors where some limited grazing might be acceptable.

Completion of the District survey should be accorded high priority in the P.N.A. Programme.

Keywords: Nature conservation, Protected Natural Areas survey, Eyre Ecological District, Indigenous vegetation, Forest, Shrubland, Tussock grassland, Fellfield, Scree, Snowbanks, Rock bluffs, Vascular flora, Fauna, Avifauna, Coleoptera, Lepidoptera, Mollusca, Endemic biota.

INTRODUCTION

An ecological survey of the central part of the Eyre Ecological District, one of three in the Mavora Ecological Region, was conducted by a group of 13 biologists along the lines of a Protected Natural Areas (P.N.A.) survey (Kelly & Park 1986) over a 10-day period in early January 1987.

The District had been ranked as the lowest (third) priority for P.N.A. survey by the Biological Resources Centre, D.S.I.R., (Myers, 1984). However, urgency resulted from the need to provide nature conservation resource information for the exercise of allocating Crown Land between the Department of Conservation and Landcorp as part of the restructuring of environmental administration in New Zealand.

The botanical significance of the Eyre District in relation to several endemic alpine plant species was known among biologists (Given 1981, Myers 1984) from early collections of several amateur botanists, particularly Poppelwell (1913) and Speden between 1912-16; as well as Wall, and Simpson and Scott-Thomson (1926) in the 1920s. More recently information has been provided by professionals, particularly on the alpine ranunculi (Fisher 1965), Celmisia (Given 1971, 1975), alpine plants (Mark and Adams 1973) and surveys of condition and trend

of the forests, shrublands and indigenous grasslands of the District (Hayward 1969, Evans 1973).

These studies established that the areas of highest natural values within the District are likely to be centred around its higher peaks, particularly the higher altitudes of Eyre Creek and Cainard Crown land blocks which have been virtually retired since being resumed by the Crown. Some 1700 ha of severely depleted and abandoned land on the Eyre Creek block was resumed for soil conservation purposes and rehabilitation management in 1955, the entire Cainard block was resumed in 1962 and the balance of Eyre Creek in 1963 (Lands and Survey Department 1982).

While the present survey concentrated on these areas of Crown Land some time was spent in the Mt Bee-Helen Peaks area within Eyre State Forest and on Unalienated Crown Land, as well as in the Gorge Burn catchment, on the western slopes of Jane Peak, within the retirement area of Mt Nicholas Station (Fig. 1). The area actually surveyed is included in Figure 2.

EYRE ECOLOGICAL DISTRICT

The Eyre District of some 197,500 ha is defined by the southern shore of Lake Wakatipu in the north and northeast, the Von and Oreti Valleys in the west, the Mossburn-Five Rivers highway in the south and State Highway 6 in the east (Fig. 1). Altitude ranges from c. 260 m near Mossburn to 2035 m at the summit of Jane Peak.

1. Geology and Geomorphology

The District embraces a broad west-east transition from greywacke through low grade semischist to finely foliated chlorite schist (Wood 1962, 1966). The greywacke-schist boundary, which follows the southeast-trending South Von Fault, is aligned along Eyre Creek (Turnbull 1980). Scree slopes are extensive, together with a range of generally impressive topography, particularly on the higher slopes that have been extensively



Figure 1. Eyre Ecological District showing land tenure (see text for details).

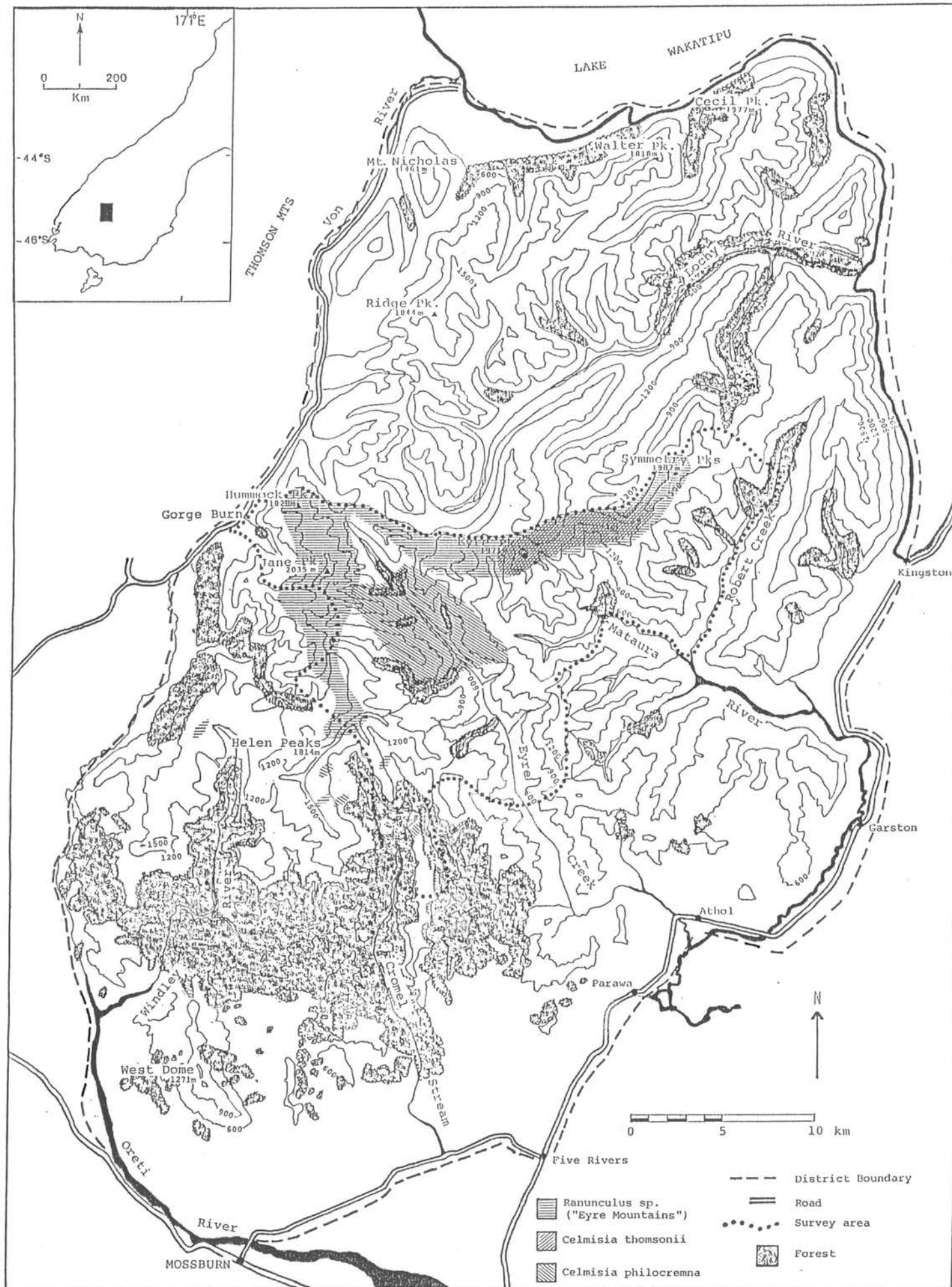


Figure 2. Eyre Ecological District showing the area covered by the survey plus distribution of three of the District's endemic vascular plant species. Areas of indigenous forest are also shown.

glaciated. The wide range of glacial landforms include cirques (with and without lakes), moraines, hanging valleys and aretes.

The southwest corner of the District contains a band of basalt, dolerite and andesite, known as the Livingstone Volcanics. This volcanic sequence also contains outcrops of undifferentiated basic volcanic flow rocks plus areas of ultramafite belonging to the Dun Mountain Ophiolite Belt (Wood 1966; Coombs et al. 1976; McIntosh and Lee 1986).

Valley floors are generally covered with alluvial or glacial outwash gravels, which form extensive plains in the Oreti and Mataura catchments on the eastern and southern margins of the District. Conspicuous morainic deposits are preserved south of Kingston on the District's eastern margin. Apart from a serpentine quarry near West Dome, a small limestone outcrop near Mt Nicholas, and traces of manganese (Turnbull 1980) the area lacks significant mineral deposits. Several large old landslides are known and the Moonlight Fault, a major fault of possible pre-Tertiary origin (Turnbull 1980) with associated active traces, runs southwest along the northwest margin of the District and coincides with Von and Oreti Valleys.

Climate

Climatically the District is intermediate between the wet Fiordland region to the west and the drier more severe environment of Central Otago to the east. A similar climatic gradient, but of smaller magnitude, occurs within the District (Hayward 1969), accentuated by a series of high peaks close to 2000 m elevation, along the District's main crest.

The only rainfall records available are for the northern, eastern and southern borders of the District, all at relatively low altitudes. Cecil Peak (351 m) in the north has a long-term (30 year) mean of 809 mm, five stations along the eastern margin (Kingston, Garston, Eyre Creek, Athol and Mid Dome) at 244-386 m receive 767-995 mm, while in the southwest, West Dome (274 m), Chimneys Flat (501 m), The Haycocks (385 m) and Centre Hill

(380 m) receive somewhat more, 1012-1341 mm (N.Z. Meteorological Service 1973, undated). Of these stations only Mid Dome records temperature. Here long term (30 yr) mean monthly air temperatures range seasonally from 14.8°C (Jan) to 3.7°C (July), mean monthly maxima from 21.1°C to 8.3°C, and mean daily minima from 8.4°C to -1.0°C (N.Z. Meteorological Service 1983).

Five bioclimatic zones can be recognised from the lowest (c. 260 m) to the highest altitude (2035 m) within the District. The Lowland Zone is not represented. The Montane Zone encompasses both forest and non-forest indigenous vegetation. Its upper limit at c. 900 m can be characterised by the upper limit of Nothofagus fusca (red beech), Griselinia littoralis (broadleaf) and Blechnum procerum in forest communities and by Discaria toumatou (matagouri) and Elymus rectisetus (blue wheatgrass) in non-forest communities. The Subalpine Zone extends to the upper limits of forest and tall shrubland and hence coincides with the limits of Nothofagus menziesii and N. solandri var. cliffortioides (silver and mountain beech), plus Phyllocladus aspleniifolius var. alpinus (celery pine), Podocarpus nivalis (snow totara) and Coprosma ciliata at c. 1200 m. In non-woody communities Pernettya macrostigma (snowberry), Festuca novae-zelandiae (hard tussock) and Leucopogon colensoi reach a similar altitude. The Low-alpine Zone extends to the upper limits of closed vegetation at c. 1550 m which coincides with that of Chionochloa rigida (narrow-leaved snow tussock), Aciphylla aff. horrida, the endemic Celmisia philocremna, Geum uniflorum, Pentachondra pumila and Astelia nervosa. The High-alpine Zone extends to the highest peaks at c. 2000 m and is characterised by Grammitis poepiggiana, Polystichum cystostegia the endemic Aciphylla spedenii, A. simplex, Celmisia hectori, Haastia sinclairii, Ranunculus buchananii, Chionohebe ciliolata, Pachycladon novae-zelandiae and Colobanthus buchananii. The negligible plant cover above c. 1850 m, together with the occurrence of some extensive areas of permanent snow on south to east aspect slopes to below this altitude, could be interpreted as the lower limit of a Nival Zone. Only one vascular plant species, Parahebe birleyi, is

essentially confined to this zone. These zones are 100-150 m higher than comparable ones in the Umbrella District to the east (Dickinson 1986) despite both districts being similar distances from the coast (c. 100 km from the west and east coasts, respectively).

The higher slopes of the Eyre Mountains are occasionally subjected to high intensity rain storms which may generate large floods with accompanying accelerated erosion in the Eyre Creek, upper Mataura and upper Oreti catchments. The most recent such event was in March 1987. Records of flood flows indicate that these rivers respond more rapidly than the Waikaia River to the east which is in part due to the relatively weak vegetative cover on the Eyre Mountains (Mr N.A. McMillan, Southland Catchment Board pers. comm.).

Soils

Much of the District is covered by high-country yellow brown earths, Kaikoura and Dunstan soil types predominating at the higher altitudes with Tekoa and Bealey types present on the mid-altitude slopes and upper valley floors. The lower rolling foothill country and valley floors under lower rainfall are associated with southern yellow grey earths. Steepland soils related to the southern brown granular loams are associated with the volcanic rocks in the southwest corner of the District. These Windley soils are stony clay loams which are particularly prone to erosion.

Land Capability, Land Use and Tenure

Much of the District has been assigned Class 8e or 7e in the Land Use Capability Classification system (Ministry of Works and Development, 1971) (Fig. 3), indicating that such areas are either unable to sustain grazing use (Class 8) or have very severe limitations for such use (Class 7) because of actual or potential erosion hazard (e). According to the data extracted from the New Zealand Land Resource Inventory computer database, using computer program LADEDA, 24.7 per cent of the District's area (197,523 ha) has been assigned Class 8e, and 34.0 per cent,

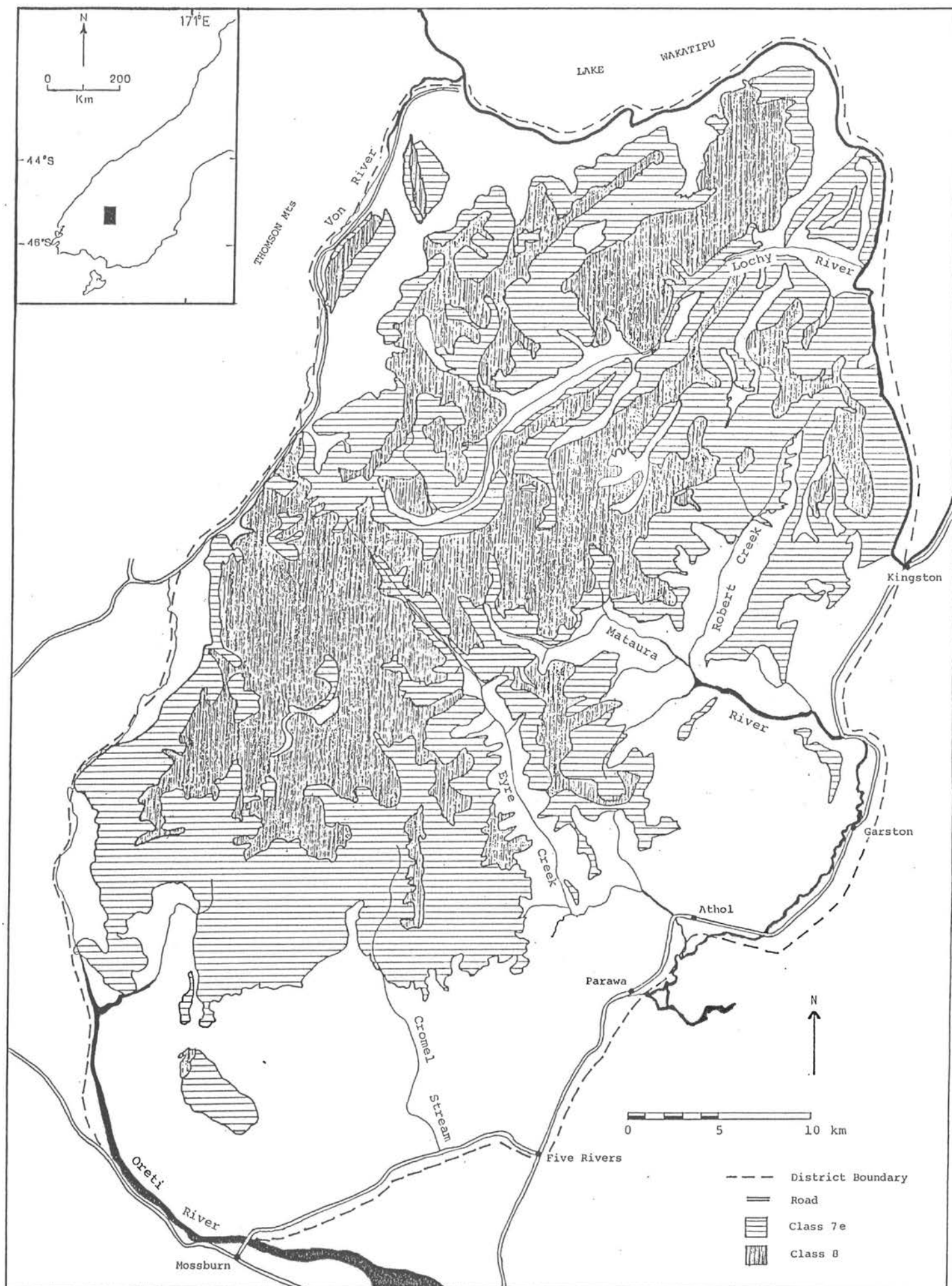


Figure 3. Eyre Ecological District showing distribution of areas of Classes 8e and 7e in the Land Use Capability Classification. Information extracted from New Zealand Land Resource Inventory computer database by Ministry of Works and

7e. Of the remainder, 26.0 per cent is Class 6e and no other category exceeds 5 per cent.

The two Crown land farm settlement blocks (Cainard and Eyre Creek) have even higher proportions of Class 8e and 7e land (72.5% and 70.5% respectively) than for the District as a whole. The two areas of Unalienated Crown Land (U.C.L. - see Fig. 1) also have relatively high proportions of these two classes (Fig. 3), but they carry no stock. Eyre State Forest, together with an c. 8000 ha area acquired by the Forest Service from West Dome Station in 1982 for exotic afforestation, also have a considerable amount of Classes 8e and 7e land as do the seven high country leasehold properties (Figs. 1 and 3). Six of these are pastoral leases (Mt Nicholas, Cecil Peak, Halfway Bay, Allendale, Greenvale and Fairlight) while one (Walter Peak) is held under a Special Lease. Constraints have been imposed by the Crown on the use of the high-altitude areas contained in three of these leases that abut the Crown land areas. The 36,219 ha Mt Nicholas Station has stock limitations, including a completed water and soil conservation run plan which provides for retirement of the entire area south of North Branch, Von River. A requirement for surrender of this area from the lease has not been effected as yet. Halfway Bay (16,733 ha) also has stock limitations and an operative run conservation plan which retires (except for cattle grazing by limitation) 9,112 ha from the property, including all the high-altitude slopes of the Symmetry Peaks-Eyre Peak divide. The Walter Peak lease (25,758 ha) has provision for destocking any part of it for soil conservation purposes. Ardno and West Dome pastoral leases in the south were reclassified as 'farm land' in 1981 and 1983, respectively and are now occupied under Renewable Leases. The adjacent Acton Downs is a freehold property.

METHODS

The ecological survey of the central part of the Eyre Ecological District involved three broad phases as follows:

1. Preparation.

Time constraints and logistics dictated that the survey concentrate on those areas thought likely (on the basis of existing information) to contain the highest natural values as well as the greatest representation of indigenous ecosystems remaining within the District. Areas chosen for detailed study were further refined using aerial photographs and topographic maps, plus the local knowledge of some individuals within the group. Once general study areas were chosen the relevant land holders were contacted and permission for access obtained.

2. Field Survey

(A) Vegetation and flora: Vegetation types were subjectively defined, on the basis of dominant species plus flora, along altitudinal transects within the areas selected for survey. Transects were chosen following leading ridge crests as well as traversing valley floors and slopes. Recording followed standard P.N.A. Survey methodology (Kelly and Park 1986). Cover of each species on a 1-6 scale (1 = <1%, 2 = 1-<5%, 3 = 5-<25%, 4 = 25-<50%, 5 = 50-<75%, 6 = >75%) was recorded within fixed height strata as follows: >12 m (tier 6), 5-<12 m (5), 2-<5 m (4), 0.4-<2 m (3), 0.1-<0.4 m (2), <0.1 m (1) within single 20 m x 10 m plots randomly located within each vegetation type. Topographic parameters - altitude, aspect and slope - were recorded for each plot. Species recorded outside the plot but within the vegetation type were listed separately. In addition, notes were made on vegetation condition, landform, fauna and flora. Sufficient plots were recorded to adequately represent and document the range of vegetation types within the survey area.

Vegetation types were described in the field according to the Atkinson classification system (Atkinson 1962, 1985) which is based on dominant species. Where sites were unsuitable for

quadrat placement, as with rock bluffs, species lists were obtained, aided by binoculars as necessary.

Plant specimens were collected only for identification purposes or because the record was of particular significance. Those of uncertain status were subsequently verified, often with assistance from individuals with expertise in particular groups. Specimens are housed in the Botany Department herbarium, Otago University (OTA). Nomenclature follows Brownsey et al. (1985) for pteridophytes, Allan (1961) for gymnosperms and dicotyledons, Cheeseman (1925) for Poaceae, Moore and Edgar (1976) for other monocotyledons, except for more recent updates (Edgar 1986; Edgar and Connor 1987).

Following species identification, plot records were corrected where necessary. Problems with field identification necessitated grouping some plants within the following genera: Acaena, Cardamine, Clematis, Epilobium, Gentiana, Gnaphalium, Agrostis, Carex, Lachnagrostis, Luzula, Poa, Thelymitra and Uncinia.

Presence-absence data were entered onto computer files and manipulated using the computer package GOLLIWOG (J.B. Wilson, unpublished). Normal Cluster Analysis employing the 'City-block' distance measure, flexible sorting strategy ($\beta = -0.15$) and excluding double-zero matches, sorted quadrats according to their species composition. Species were sorted using an Inverse Cluster Analysis with the same analytical parameters. Species with frequencies of occurrence ≤ 2 were excluded from the analyses. Quadrat and species groupings were displayed and assessed as dendrograms and as a two-way nodal table.

(B) Fauna: General observations and collections were made throughout the survey while individuals having expertise with particular faunal groups made detailed observations and/or collections along altitudinal transects. Of the invertebrates, Lepidoptera and Coleoptera were the most intensively studied, but only in the upper Eyre Creek and Robert Creek areas. All faunal

records were supplemented by the limited information already existing for the District.

For Coleoptera and Lepidoptera field collecting over four days (5-8 January 1987) was concentrated at four main sites: (1) Slate Basin in upper Eyre Creek where one afternoon was spent between 650 m and the highest point above the basin at c. 1500 m. (2) The Little Jungle Creek, tributary of Eyre Creek, where one day was spent in the cirque on the southeastern side of Jane Peak. Most of the collecting was carried out at 900-1350 m, covering the basin and lower slopes of the hanging valley and tarns in the area. (3) Way Spur, Robert Creek where one afternoon was spent collecting along the leading ridge of Way Spur with further time here the following day on the way to Symmetry Peaks. (4) Symmetry Peaks. The eastern peak was visited by following the ridge along Way Spur to the crest of the cirque at c. 1600 m and on to the summit of Symmetry Peaks at 1860 m. Collecting was carried out by hand, either by beating shrubs and other vegetation or directly by hand searching through plants and turning rocks or by use of a hand net. The weather conditions for the entire study period were hot and dry as it had been for the preceding week or more.

Specimens of Lepidoptera, Acrididae and Cicadidae have been placed in B.H. Patrick's private collection, beetles have been placed in B.I.P. Barratt's private collection and the Diptera, Orthoptera and Myriapoda, which were identified by Mr P.M. Johns, are retained by him at the Zoology Department, Canterbury University.

Regarding vertebrates, the Wildlife Service Fauna Survey Unit had surveyed the headwaters of the Mataura River in 1982 as part of the national inventory of sites of wildlife significance. With this, every ten thousand yard grid square was visited, and a bird species list recorded. In addition, every identifiable wildlife habitat such as forest or wetland was documented and a standard record was made of its vegetative structure, bird species, its rank in terms of importance (status: after Bell

1986) evaluated giving reasons for rating, and suggestions made for protection. Specialised colonies of particular species were also sought by searching appropriate habitats. The opportunity was taken in January 1987 to participate with a multidisciplinary team in a survey of the less accessible parts of the Eyre Mountains. On this survey Robert Creek, the upper Matura River, Eyre Creek and Gorge Burn were visited. Eyre State Forest, Cromel Stream and the Mt Bee Ridge were documented during the 1982 survey. A significant part of the Eyre Ecological District outside the 1987 survey area was also surveyed at this earlier time.

3. Selection of Priority Places for Protection (PPPs): On the basis of the information gathered during the present survey plus existing supplementary material, several PPPs were identified. These were chosen so as to represent, as fully as possible, the range of indigenous ecosystems and biota remaining in the area surveyed and which are considered to have the highest natural values. Criteria for selection were based on vegetation, flora, fauna and landform, according to Kelly and Park (1986).

For reasons of viability and integrity, PPPs were identified so as to contain the greatest contiguous altitudinal ranges available while satisfying the other selection criteria and coinciding, where possible, with catchment boundaries.

RESULTS

1. The Plant Communities

Each of the ten communities recognised on the basis of the twelve species classes differentiated using Cluster Analysis, will be discussed in turn. These communities have been arranged largely according to elevation, from high-altitude boulderfields and fellfields down to forest and the lower-altitude grasslands and shrublands. Species classes are discussed under the quadrat group (community) within which they achieve their highest frequency. These are indicated in Figure 4 which presents

results for the Normal and Inverse Cluster Analyses plus the percentage presence values for all species in each class, within each of the ten quadrat groups.

a. High-altitude boulderfields (Quadrat Group 1): The highest altitude community (mean $\pm$ SE elevation = 1530 $\pm$ 47 m) is characterised by a strong predominance and relatively high frequency (44%) of Species Class A, which achieves its maximum within this group (Fig. 4). Other species classes with high representation are B (25%), C (21%) and E (7%), though with the exception of the latter (which shares its peak with Group 4) none reach their maximum within this community (Fig. 4).

The ten samples included were located along the main mountain crest within the surveyed area, extending from Helen Peaks in the south to near Symmetry Peaks in the north.

Among the 14 plant species included within Class A (see Appendix Table 1) are those tolerant of prolonged snow lie - the large palatable herb Ranunculus buchananii, the sprawling shrubs Celmisia hectori and Hebe petriei, the rush Marsippospermum gracile, the sedge Carex pyrenaica var. cephalotes, the summergreen fern Polystichum cystostegia and the endemic speargrass Aciphylla spedenii. Chionochoa macra (slim snow tussock) may provide up to 25 per cent cover on the most sheltered sites but it rarely exceeds 40 cm in height (tier 2).

At three of the ten sites no plants were greater than 10 cm tall (tier 1). Despite the high altitude and generally sparse plant cover (usually <25%), species richness was moderate (27.1 $\pm$ 2.8; see Fig. 4).

The associated landforms are mostly boulderfields or rock slides on ridge crests or relatively stable debris slopes of moderate angle (5-24°), generally with a southerly aspect (east through to west).

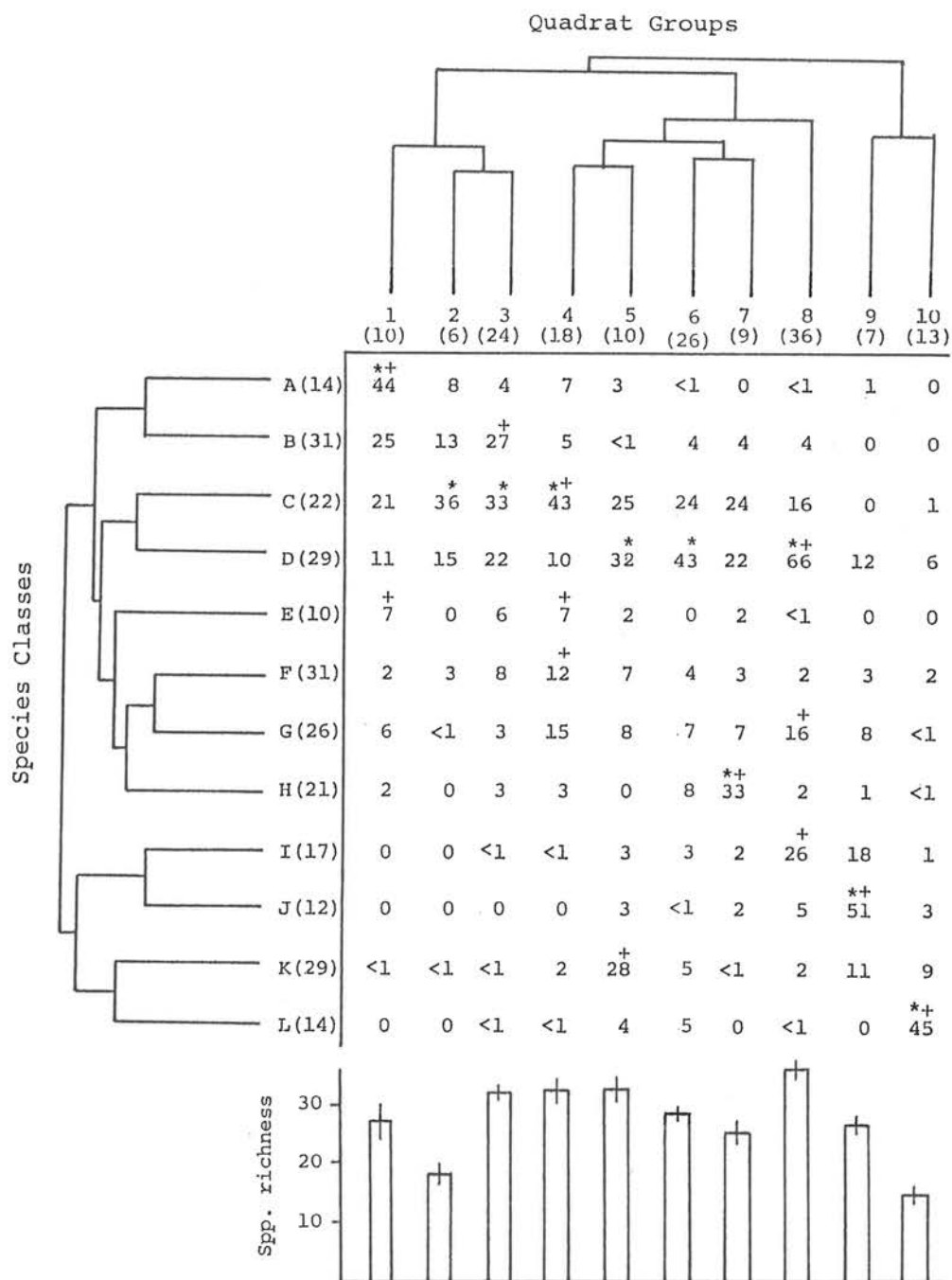


Figure 4. Two way nodal table including dendrograms showing relationships among the ten quadrat groups and 12 species classes. Numbers of quadrats in each group and species in each class are shown in brackets while the matrix presents the percentage presence values for all species in each class within each of the ten quadrat groups. + denotes maximum values within species classes; * are maximum values within quadrat groups. Species richness (mean $\pm$ S.E.) for each of the ten quadrat groups (communities) is shown at the base.

b. High-altitude moist snow tussock grassland (Quadrat Group 2):
Six high-altitude sites (1439 $\pm$ 33 m), located between Helen Peaks in the south and Eyre Saddle in the north, with a dominant snow tussock cover, have been separated on the basis of their high incidence of Species Class C (36% frequency; see Fig. 4). This Class will be described in detail under Quadrat Group 4, where it reaches its maximum frequency. In addition to containing Chionocholea macra and C. crassiuscula (curled snow tussock) this class includes other species that characterise relatively moist high-altitude sites, particularly forbs - Astelia nivicola, Ourisia sessilifolia, Dolichoglottis lyallii, Anemone tenuicaulis, Coprosma pumila, Celmisia semicordata ssp. aurigans, C. verbascifolia, C. lyallii and Geum leiospermum, plus the shrubs Hebe hectori and Brachyglottis revoluta.

The relatively low species richness (18 $\pm$ 1.8 species - Fig. 4) probably reflects the high altitude, and extended snow-lie associated with the north to northeast aspects of these sites (8-25° magnetic). All six sites were on vegetated debris or colluvial slopes.

c. Mid- to high-altitude snow tussock grassland (Quadrat Group 3):
Twenty-four samples from mid- to high-altitude sites (1386 $\pm$ 24 m), classed under the Atkinson system as tussockland, tussock-shrubland or shrub-tussock-rockland because of the general importance of a snow tussock cover, are characterised by relatively high frequencies of Species Classes C (33%), B (27%) and D (22% - see Fig. 4), the former shared with Quadrat Group 2 (see above). Species Class B, which achieves its highest frequency overall within this community, contains 31 species that generally frequent relatively exposed and well-drained sites. They include many cushion and prostrate species - Abrotanella inconspicua, Phyllachne colensoi, Luzula pumila, Colobanthus buechananii, Hectorella caespitosa, Celmisia laricifolia, C. sessiliflora, Raoulia buechananii, R. grandiflora, Chionohebe thomsonii, C. densifolia, Dracophyllum muscoides, Cotula pectinata, Drapetes villosus and Oreobolus impar, plus some low shrubs - Hebe buechananii, Dracophyllum pronum, Pimelea

pseudolyallii, and Coprosma aff. pseudocuneata and herbs - Gentiana divisa, Celmisia viscosa, Haastia sinclairii, Anisotome flexuosa and Ourisia spathulata.

Chionochloa rigida and/or C. macra dominate most of the sites (C. crassiuscula is only rarely present) with their canopies exceeding 40 cm on more than half of the sites. Among the co-dominant shrubs Dracophyllum uniflorum and Hebe aff. odora are the most common while H. propinqua and H. hectori are occasionally present. Species richness is relatively high (31.8 ± 1.6 - see Fig. 4).

The sites are widely distributed through the area surveyed, from Helen Peaks in the south to Way Spur at the upper reaches of Robert Creek, in the north. They also occupy a wide range of slopes ($0-38^{\circ}$), aspects and landforms, from ridge crests to colluvial and debris slopes.

d. Mid-altitude snow tussock grassland (Quadrat Group 4): Some 18 mid-altitude (1251 ± 29 m) sites are characterised by relatively high frequencies of Species Classes C (43%), E (7%), F (12%) and G (15%). With the exception of Class G all achieve maximum frequencies within this Quadrat Group (Fig. 4).

Classes E and F both consist of mid- to high-altitude species: a group of ten mostly rockfield and bluff species constitute Class E (Colobanthus strictus, Epilobium glabellum, E. porphyrium, Raoulia hectori, Anisotome capillifolia, A. haastii, Euphrasia revoluta, Schizeilema haastii, Ranunculus haastii ssp. piliferus and Celmisia walkeri), whereas Class F consists of 31 mostly tussockland species (Appendix Table 1), among them Gentiana montana, Geum uniflorum, G. parviflorum, Aciphylla lecomtei, Ourisia glandulosa, O. caespitosa, Celmisia brevifolia, C. ramulosa, C. angustifolia, Uncinia divaricata, Forstera sedifolia, Poa kirkii, Lobelia linnaeoides and Brachyglottis southlandica. Species Class C consists of 22 mostly wet tussockland species, including two snow tussocks (Chionochloa macra and C. crassiuscula), several shrubs

(Brachyglottis revoluta, Coprosma cheesemanii, Myrsine nummularia and Hebe hectori) and forbs (Anemone tenuicaulis, Epilobium chlorifolium, Geum leiospermum, Uncinia fuscovaginata, Celmisia verbascifolia, C. semicordata ssp. stricta, C. lyallii, Brachyglottis bellidioides, Ourisia sessilifolia, Astelia nivicola, Coprosma pumila and Schoenus pauciflorus).

Most samples included in this Quadrat Group were described as tussocklands under the Atkinson notation. Dominance was shared among three snow tussock species (Chionochloa rigida, C. macra and C. crassiuscula) with generally a minor shrub component. Snow tussocks exceeded 40 cm in height (tier 3), at most sites reaching up to 1.2 m tall with cover in excess of 75%.

Species richness (32.3 ± 1.9) was relatively high and similar to both the previous and the following community (Fig. 4). Topographic factors (aspect, slope, landform) and location were variable.

e. Mid-altitude shrubland (Quadrat Group 5): A mixed subalpine (1018 ± 27 m) shrubland, often associated with treeline beech forests and characterised by high frequencies of Species Classes D (32%) and K (28%). It was sampled at ten sites, mostly in upper Eyre Creek and its tributaries. Species Class K in particular distinguishes this community (Fig. 4). It includes several dominant species - Brachyglottis cassinioides, Hoheria glabrata, Podocarpus nivalis, Coprosma parviflora, C. ciliata, C. aff. parviflora, C. rugosa, Hebe rakaiensis, Olearia moschata, O. nummularifolia var. cymbifolia, Phormium cookianum, Aristotelia fruticosa and Hymenanthera alpina, plus several typical understorey herbs - Oreomyrrhis ramosa, Hypolepis millefolium, Ranunculus reflexus, Aciphylla glaucescens, Senecio wairauensis and Polystichum vestitum.

The canopy ranged from 1-3.5 m tall while species richness was relatively high (32.5 ± 2.3 - Fig. 4).

Aspect and slope are variable but landforms are mostly debris or colluvial slopes, occasionally moraine or alluvium.

f. Mid-altitude mixed snow tussock-shrubland (Quadrat Group 6):
A large quadrat group recorded at 26 sites at moderate altitudes (1095 ± 33 m) over a wide range of localities (Helen Peaks in the south to Symmetry Peaks in the north). None of the species classes achieve their maximum frequency here but Classes C (25%) and D (32%) are relatively well represented (Fig. 4). All other classes have frequencies of occurrence $<10\%$. Sites are dominated or co-dominated by a variety of shrub species such as Dracophyllum longifolium (inaka), Phyllocladus aspleniifolius var. alpinus, Brachyglottis cassinioides, Podocarpus nivalis and Dracophyllum uniflorum (turpentine scrub). In places the shrub canopy exceeds 2 m in height, but it may co-dominate with Chionocholea rigida and/or C. macra which often exceed 40 cm height and 50% cover. Where drainage appears impeded C. crassiuscula may achieve codominance. Under the Atkinson system the community is described as tussockland, shrubland or combinations thereof. Species richness (28.5 ± 1.3) is in the lower portion of the range recorded during the survey (Fig. 4).

The community occupies a variety of aspects, slopes and landforms.

g. Mid-altitude curled snow tussock-sedgeland (Quadrat Group 7):
Documented at nine sites, this community occurs at moderate altitudes (1064 ± 65 m) and is characterised chiefly by species of Class H which achieves its maximum frequency (33%) here (Fig. 4). Twenty-one species occur within this class, predominantly those tolerant of impeded drainage. Included here are the herbs Abrotanella caespitosa, Celmisia alpina, Drosera arcturi, Forstera tenella and Plantago triandra, the graminoids Carpha alpina, Carex gaudichaudiana, C. coriacea, Uncinia viridis, U. rubra, Oreobolus pectinatus and O. strictus, plus the shrubs Hebe pauciramosa, Dracophyllum prostratum and Pimelea poppelwellii. Other Species Classes relatively well represented within this Quadrat Group are C (24%) and D (22%) in which the

tussockland species occur. Species richness (25.7 ± 2.4) is in the lower portion of the range encountered in the survey (Fig. 4).

Canopy height most commonly is 0.4 m or less but in places where shrub species encroach, the third (0.4-2 m) tier may be reached. Cover of tussock species is generally greater than 25% in the latter tier.

The sites sampled are widespread, occurring from the Helen Peaks area in the south to Robert Creek in the north. Landform varies from ridge crest to valley slope situations but the majority are in localised flushes. Slopes are highly variable (2° - 35°) on a range of aspects.

h. Modified mid-altitude tussocklands (Quadrat Group 8): This is the largest quadrat group, represented by 36 mid-altitude (963 ± 37 m) sites. The group is characterised by maximum frequencies within Species Classes D (66%), G (16%) and I (26%) (Fig. 4). Class D contains 29 species, many of which are widespread in tussockland communities, such as Chionochloa rigida, Poa colensoi (blue tussock) and Festuca matthewsii (alpine fescue tussock), the pteridophytes Blechnum penna-marina and Lycopodium fastigiatum, the herb Bulbinella angustifolia (Maori onion) together with the shrubs Cassinia vauvilliersii (mountain tauhini) and Gaultheria depressa (snowberry).

Class G includes 26 species also of widespread occurrence through tussockland communities. Amongst these are the herbs Acaena caesiiglauca, Geranium microphyllum, Ranunculus lappaceus, Plantago novae-zelandiae and Gnaphalium mackayii. The adventives, Cerastium fontanum (mouse-ear chickweed), Rumex acetosella (sheep's sorrel) and Lotus pedunculatus are also included here. Class I also contains exotic species notably Agrostis capillaris (browntop), and Holcus lanatus (Yorkshire fog) but it is further characterised by the native grasses Festuca novae-zelandiae (fescue tussock), Rytidosperma gracile, Elymus rectisetus (blue wheatgrass) and Dichelachne crinita (plume grass).

Canopy height rarely reaches the 2-5 m tier with both tussock and shrub canopy species most commonly included in the 0.4-2 m category where, in some cases, tussock cover exceeds 75%. Total cover within this tier invariably exceeds 50%.

The community is the most species rich (36.2 ± 1.4) of those differentiated using Cluster Analysis (Fig. 4), possibly a reflection of its wide distribution through the survey area. Most sites were sampled on a variety of colluvial slopes of differing topography.

i. Low-altitude shrub-grassland (Quadrat Group 9): A distinctive group comprising seven low-altitude (511 ± 23 m) sites, all sampled in the mid reaches of Eyre Creek. At 26.6 ± 1.5 , species richness is relatively low compared to the mid-altitude tussockland communities with species representation greatest in Class J (51%) which peaks within this group (Fig. 4). Species included here are the shrubs Carmichaelia virgata, Coprosma propinqua, Corokia cotoneaster and Discaria toumatou (matagouri). The adventives, Trifolium dubium (suckling clover), T. repens (white clover), Dactylis glomerata (cocksfoot), Cirsium vulgare (scotch thistle) and Crepis capillaris (smooth hawksbeard), widespread at these altitudes, also characterise this species class.

The shrub component in places reaches the 2-5 m tier where it may contribute up to 25% cover. However, almost continuous cover is achieved in the 0.4-2 m tier over ground tiers incorporating an admixture of introduced and native species.

j. Beech forest (Quadrat Group 10): All 13 sites sampled within forest are included in this group. Confined to relatively low altitudes (800 ± 44 m) their characteristic species are from Class L (45%) which has very low frequencies in all other quadrat groups (Fig. 4). This class includes species that occur only rarely beyond forest habitats. Apart from two of the beech species, Nothofagus menziesii and N. solandri var.

cliffortioides, which average 12-18 m canopy height, those included are the shrubs Coprosma pseudocuneata, Phyllocladus aspleniifolius var. alpinus, Pseudopanax colensoi (three finger), P. simplex and Pittosporum tenuifolium which most commonly extend up to the 2-5 m stratum. Astelia nervosa, Lagenifera strangulata, Uncinia clavata, U. uncinata and Corybas trilobus are common in the herb layers (0-0.4 m).

Forest remnants occur in many valleys throughout the survey area where they cover a wide range of slopes, aspects and landforms. Species richness is relatively poor (15.0 ± 1.7) when compared to the non-forest communities (Fig. 4).

k. Rock bluffs: Species lists were recorded for bluffs at altitudes ranging from 900 to 1700 m throughout the survey area. Generally, shaded moist aspects harboured a greater number of species at a particular elevation than those of drier, northerly facing situations. Species richness varied according to the size of the bluffs and often the surrounding vegetation type, with which many bluff species are shared. Conversely, certain species were found that were largely or entirely restricted to bluff sites, for example the shrubs Helichrysum selago and Coprosma serrulata, plus the herbs Ranunculus buechananii, Cheesemanian wallii, Anisotome pilifera, Celmisia thomsonii, C. philocremna, Grammitis poepigiana, Leucogenes grandiceps and Carex acicularis. Above 1500 m, species such as the endemic Aciphylla spedenii, Haastia sinclairii, Raoulia youngii and various other high-altitude species appear on bluff sites. Many of the species endemic to the Eyre District occur on the rock bluff sites which are numerous in this strongly dissected landscape.

2. Flora

The area surveyed within the Eyre Ecological District supports a rich and diverse flora (Appendix Table 1). Of the 427 indigenous taxa recorded, 28 (7%) are pteridophytes, 3 (<1%) are gymnosperms, 304 (71%) are dicotyledons and there are 92 (22%) monocotyledons. In addition, 28 exotics and 13 hybrids were

recorded. In 13 genera some individuals were not identifiable to species level (see p.). Several earlier studies and collections within the District, but beyond the area covered in the present survey, extended the floristic list - Allan (1961), Dr C.D. Meurk (pers. comm.), Hayward (1969) and Evans (1973) from several areas; McIntosh and Lee (1986) from West Dome; Mr N.C. Simpson and Dr W.G. Lee (pers. comm.) from Glen Allen and Te Kere Haka Scenic Reserves near Kingston; and Poppelwell (1913) plus Simpson and Thomson (1926) from the Rugged Peaks - Walter Peak area in the north. Using some discretion with the early papers, a further 129 indigenous and 32 exotic vascular species have been added to the list (Appendix Table 1). Note that specimens assigned to Hebe pinguifolia may be H. biggarii (see Allan 1961 and Given 1981).

Among the many widespread species are those that are more common in the wetter regions to the west, along or close to the main divide. Among these are: Celmisia hectori, C. walkeri, C. verbascifolia, Coprosma serrulata, Olearia moschata, Raoulia buechananii, Chionohebe ciliolata var. fiordensis, Chionochoa pallens, Dolichoglottis scorzonoides, Myosotis macrantha, Hebe cockayniana, Cotula pectinata spp. wilcoxii, and Parahebe planopetiolata. Indeed, the last seven appear to reach their eastern limit in the Eyre District. Conversely, several of the widespread species are of greater importance to the east of the District: Celmisia angustifolia, C. brevifolia, Chionohebe densifolia, Dracophyllum muscoides, Bulbinella angustifolia, Caltha obtusa, Celmisia prorepens, Hebe propinqua and Abrotanella inconspicua. The last four probably reach their western limit in the District. Three other widespread species, Ranunculus crithmifolius, Chionohebe ciliolata and Parahebe birleyi likely reach their southern limits here. Indeed, R. crithmifolius apparently has not previously been recorded south of the Pisa Range in central Otago. In addition, some widespread species probably achieve their greatest development within the Eyre District, such as Brachyglottis cassinioides.

The Eyre Ecological District is noted not only for its several endemic species but also for the very local distributions of some of these (Given 1971, 1975, 1981). However, there is little published information on the flora of the District or indeed on the distribution of known rare and/or local taxa within it. The District is perhaps best known for its endemic species of Celmisia, C. spedenii, C. philocremna and C. thomsonii, a genus represented here by at least 21 species (Appendix Table 1). The known distributions of two of the Celmisia endemics were substantially extended during the present survey (Fig. 2). C. philocremna forms hard compact cushions up to 80 cm diameter on steep bluffs or broken rock, mostly on exposed sites. The largest population, distributed over c. 5 km² in the vicinity of Slate Basin, upper Eyre Creek has already been documented (Given 1971). During the survey smaller populations were recorded over a larger area in upper Eyre Creek extending to Little Jungle Creek and the slopes opposite Windley Creek, plus small disjunct populations at the northern end of the Mt Bee ridge and at two sites south of the upper forest margin in the Cromel catchment (Fig. 2). This species remains unplaced in the subgeneric classification of the genus (Given and Gray 1986).

By contrast, Celmisia thomsonii is confined to shaded sites on rock bluffs in the upper Mataura-Robert Creek catchments. Given (1975) implies a very localised distribution, having recorded it only "on a leading ridge at the head of the Mataura Valley to the south-east of the summit (of Eyre Peak) ... between 1500 and 1800 m altitude" where it is "locally frequent". In the present survey the species was found to be not uncommon over an area of several square kilometres about and to the north of Eyre Peak (Fig. 2). While Given (1975) reports that the taxonomic position of this species is "extremely puzzling" (apparently the closest relative is C. bellidioides - Given and Gray 1986) there is no record of the distinctive and spectacular mauve coloured capitula that were found in at least five per cent of the population throughout its range. Curiously, there was some variation in the strength of colour, between and apparently even within clones. Indeed, a mixture of coloured and white

capitula were sometimes present in what appeared to be single clones. Some capitula even had mixtures of pink and white ray florets. While such colour has been recorded for the underside of ray florets in two species of Celmisia, C. viscosa and C. hectori (Mark and Adams 1973), and coloured florets have been seen in a single cushion of C. sessiliflora (on the Old Man Range, Central Otago by one of us - A.F.M.), full coloration has only been recorded as a feature of the high-altitude Australian species, C. sp. ("costineana") (Dr D.R. Given, pers. comm.). In addition to the two endemic Celmisia species recorded here, another, C. spedenii, is confined to ultramafic outcrops near West Dome towards the southwest of the District (McIntosh and Lee 1986).

Among the District's other endemic species is the undescribed though distinct (Dr P. Garnock Jones pers. comm.) "Eyre Mountains" Ranunculus (Mark and Adams 1973). This was widespread in its preferred habitat throughout the area surveyed (Fig. 2) and is not uncommon, though extremely inconspicuous as plants are mostly buried on areas of fine scree usually with surface clay. While the distribution of R. haastii spp. piliferus is generally similar to that of the undescribed species, it is restricted to coarse debris slopes. Previously considered to be confined to the Eyre District (apart from a dubious single specimen from the Takitimu Mountains - Fisher 1965), a locally abundant population was found recently on East Dome, in the adjacent Nokomai Ecological District (Dickinson unpublished). Fisher (1965) suggests an "introgressive origin" for this endemic subspecies, involving R. buechananii which is widespread on moist shaded bluffs in the Eyre Mountains. As Fisher reports, hybrids between the two species are not uncommon, usually on those screes where they occur in close proximity. Indeed, this is the only District where the two species overlap in their distribution (Fisher 1965). Within the Nokomai District R. buechananii is known only from the boundary with the Old Man District, remote from East Dome. The Eyre District is also notable for the

absence of both of the two related snowbank species of Ranunculus, the western R. sericophyllus and the Central Otago R. pachyrrhizus (Fisher 1965).

Two other presumed endemic species, Aciphylla spedenii and Cheesemanii wallii have been recorded in the north of the District (Poppelwell 1913, Simpson and Scott-Thomson 1926) and appear to be widespread throughout on alpine fellfield and rock bluffs, respectively. However, the distribution of C. wallii recently has been extended to the Old Man (Brumley et al. 1986) and Nokomai Districts (Dickinson unpublished). There is a single unconfirmed record of Aciphylla spedenii from Gertrude Saddle, Fiordland.

The very rare willowherb Epilobium purpuratum (Raven and Raven 1976) was found on moist fine debris in the shade of rock bluffs in two localities, Helen Peaks and Symmetry Peaks. At the latter site plants were locally abundant.

Among the 16 Hebe species recorded during the survey, H. dilatata, previously unknown from the District, was found in the Irthing catchment. Its distribution has been extended with recent records from the Old Man (Brumley et al. 1986), Umbrella (Dickinson 1986) and Nokomai (Dickinson unpublished) Ecological Districts. The undescribed Hebe aff. odora, already recorded in the Umbrella and Nokomai P.N.A. surveys (Dickinson 1986, unpublished), appears intermittently through the Eyre survey area. Adopting a habit apparently intermediate between those of Hebe odora and H. pauciramosa. H. cockayniana, a species widespread in Fiordland, was found at a few localities within the upper Eyre Creek catchment. Of the whipcord species, only H. propinqua and H. hectori were recorded. The localised Hebe sp. (?subulata), known from the adjacent Waikaia Ecological Region (Dickinson 1986, unpublished) was not found during the Eyre survey.

The apparently rare shrub Pimelea poppelwellii was found to be widespread through the survey area. Although unrelated to Hebe, P. poppelwellii in the vegetative state may be confused

with Hebe odora. It is locally common and fairly widespread in both the Umbrella and Nokomai Ecological Districts (Dickinson 1986, unpublished) but was not reported from the Old Man District survey (Brumley et al. 1986) despite the Garvie Mountains within that District being the species' type locality (Allan 1961). Confusion with certain Hebe species may account for the former apparently restricted distribution ascribed to this species.

3. Altitudinal Sequences

The P.N.A. Programme seeks to identify, within each Ecological District, sites of the highest natural value which are representative of the remaining indigenous ecosystems. Much research and debate has centred around the size and configuration needed for protected areas to retain their viability and integrity (e.g. Myers et al. 1984, Kelly and Park 1986). However, it is generally accepted that protected area boundaries, which are defined on a catchment basis and which contain representative altitudinal sequences, are the most valuable and viable.

It is relevant, therefore, to describe each of the major catchments considered during the present survey in terms of their altitudinal sequences of ecosystems and their representativeness.

a. Upper Mataura Catchment including Eyre Peak (but excluding Robert Creek)

The survey area extended from c. 600 m to 1971 m (Eyre Peak) within this catchment. With Quadrat Groups 1 to 8, and 10, represented here, the upper Mataura contains one of the most complete altitudinal sequences recorded in a major catchment of the survey area. Transitions from mountain-silver beech forest (Bowels-of-the-Earth remnant) in the montane and subalpine zones to shrublands and tussock-shrubland combinations in the subalpine zone are succeeded in turn by the shorter low-alpine tussockland vegetation. The high-alpine zone is well represented in the vicinity of Eyre Peak by rock bluffs, fellfields, boulderfields and snowbanks characteristic of these high elevations and strongly dissected topography. Much of the

limited range of the distinctive endemic Celmisia, C. thomsonii is embraced by the upper reaches of this catchment.

A feature of the sequence in this catchment is the presence of an extensive area of montane grassland in which Elymus rectisetus (blue wheatgrass) is an important co-dominant. This mixed grassland was among the most species-rich and in the best condition of any sampled within the montane zone. It may represent the closest approximation to a natural grassland within this zone because of the very low levels of stocking it has received in the 25 years since the Cainard Block was resumed by the Crown (see O'Connor 1986 pp. 27-8).

The beech forest remnants occupy a variety of landforms within the main catchment and the Bowels-of-the-Earth tributary, including alluvial terraces, colluvial slopes and boulderfans. Mid-altitude tussock and shrubland communities occur on colluvial slopes, vegetated debris slopes, and on valley floors where moraines are a feature. The high-altitude communities may be found on exposed ridge crests and rock bluffs as well as on the associated screes. Prominent, and sharp, high-altitude ridge crests are a distinctive feature of all of the mountain summits within the area of the District surveyed, but particularly on the upper Mataura divide.

b. Upper Eyre Creek including Jane Peak

West of the upper Mataura catchment, upper Eyre Creek appears to have a somewhat moister climatic regime. The area surveyed extends between Scrubby Creek (c. 500 m) and Eyre Saddle (c. 1200 m), and includes all tributaries. Little Jungle Creek extends to Jane Peak (2035 m), the highest in the District. Sites sampled from this catchment were representative of the complete range of Quadrat Groups (1 to 10). The transition was documented from low-altitude dry shrublands, dominated variously by Coprosma spp., Discaria toumatou, Hebe aff. odora, Olearia hectori and Corokia cotoneaster, to montane and subalpine moist shrublands and beech forest with all three local Nothofagus species present. Immediately above treeline various mixed shrub

and tussockland combinations occur with Brachyglottis cassinioides and Hoheria glabrata being prominent. These stands grade into the low-alpine zone where snow tussock and/or herbfield communities predominate. The high-alpine zone is well represented in the Jane Peak area where snowbanks, fellfields, boulderfields, rock bluffs and screes are all common.

This catchment is also the stronghold for the extremely rare endemic Celmisia philocremna, while the screes plus rock bluffs provide important adjacent habitats for Ranunculus haastii ssp. piliferus and R. buchananii, respectively. Active hybridisation between these two species is a feature of the moist screes in the upper reaches of the Little Jungle tributary of this catchment.

Beech forest remnants occupy the main drainage channel of Eyre Creek as well as several of the tributary valleys with a relatively large stand in Windley Creek. Landforms supporting forest vary from alluvial terraces to colluvial slopes and boulderfans. Low-altitude shrublands are found on river terraces, boulderslides and colluvial slopes, the latter with a variety of rock cover.

Tussock and shrubland combinations above treeline are widespread on colluvial slopes and often dominate on debris slopes, moraines and creek sides. Moraine features are particularly prominent in the catchment of the Little Jungle Creek where several distinctive moraine-dammed lakes occur among tall dense narrow-leaved snow tussock grassland at 1000-1100 m.

Indeed, the upper portions of the Eyre Creek catchment and its tributaries testify to a history of strong glacial activity with various combinations of steep headwalls, cirques, aretes, U-shaped valleys, and moraines.

c. Gorge Burn catchment including Jane Peak

During the present survey the tributary creeks of the Gorge Burn which drain the slopes of Hummock Peak (1828 m) were

sampled. Information gained from previous visits to the upper Gorge Burn supplemented the data collected here. The Quadrat Groups represented during the present survey are 1, 3, 4, 6, 7 and 10, thus documenting the altitudinal range from beech forest remnants in the montane and subalpine zones to a diverse range of tussocklands plus flushes and herbfields in the low-alpine zone. Boulderfields, screes, rock bluffs, fellfields and snowbanks are characteristic of the high-alpine zone with both Ranunculus haastii ssp. piliferus and the undescribed "Eyre Mountains" Ranunculus well represented on screes on the upper slopes to c. 1700 m.

Relatively small beech forest remnants occur within the deeply incised Gorge Burn valley, beyond which a moraine-dammed lake is surrounded by tussockland communities on colluvial and vegetated debris slopes. Tussocklands on colluvial slopes grade into steep boulderslides which lead to the surrounding rock bluffs, screes and extremely rugged topography of the main crest which reaches its highest point at Jane Peak. The fellfields here contain the only populations of the high-alpine to nival species, Parahebe birleyi, seen in the District. Deeply eroded gullies are a feature of the sub- and low-alpine zones within this catchment.

d. Upper Irthing Catchment including the Irthing/Cromel Divide and Helen Peaks.

Forming the southernmost catchment of the surveyed area, sites sampled within the upper Irthing Stream basin extended from c. 750 m on the valley floor to c. 1800 m on the main ridge adjacent to Helen Peaks. Quadrat Groups 1, 2, 4, 6-8 and 10 were represented. Only the subalpine zone of Eyre State Forest was documented as an account of the forest communities is available elsewhere (Hayward, 1969).

The valley floor within the subalpine and low-alpine zones was distinguished by dense tussock-shrubland communities. One of these was the only pure red-tussock (Chionochloa rubra) dominated community (up to 75% cover) recorded during the survey. Bog pine

(Halocarpus bidwillii) was a distinctive feature of this community, being present in tier 3. The community was characteristic of small river terraces along the valley floor. Furthermore, the only record for Hebe dilatata was made within the valley floor shrublands of the Irthing catchment. A further feature of this catchment was the only recorded occurrence found of subalpine wire rush bogs dominated by Empodisma minus. Empodisma was also a minor component of the red tussock community but above treeline on the Irthing/Cromel divide it dominates the ground tier on the margins of a Chionochoa crassiuscula tussock-sedgeland.

The valley slopes and ridges comprising the sub- and low-alpine zones were generally dominated by snow tussock grassland interspersed with some screes and shrublands. The fine screes within this zone contained the southernmost colonies of the distinctive endemic "Eyre Mountains" Ranunculus sp. while coarse screes had R. haastii subsp. piliferus. In addition, broken rocky ground, just above treeline at the northern end of the Mt Bee ridge supported a southern outlier of Celmisia philocremna.

Screes and rockbluffs are well represented in the high-alpine zone of this catchment, and associated with them the distinctive flora of these habitats. Helen Peaks was one of only two localities recorded for the rare willowherb Epilobium purpuratum, and one of three for Raoulia hectori var. mollis.

Eyre State Forest is the largest remaining forest area in the Ecological District. Within the area surveyed, beech stands occupy a wide variety of landforms from ridges and colluvial slopes to vegetated debris slopes and alluvial flats. This diversity of landform is repeated in the sub- and low-alpine zones where tussock and shrubland communities dominate. As altitude increases the exposed, rugged, glacially-scoured landscapes of the high mountain ridges, cirques, nivation hollows, rock bluffs, boulderfields and screes are prominent.

e. Robert Creek Catchment including Symmetry Peaks

Only the higher western half of this catchment was surveyed. It encompasses an altitudinal range of c. 500 m to c. 1900 m on Symmetry Peaks. The easternmost, and thus potentially the driest of the catchments within the survey area, only Quadrat Groups 1, 3, 6-8 and 10 were represented here.

Beech forest remnants are present in most of the tributary streams of Robert Creek, with mountain beech dominating silver beech in both the montane and subalpine zones. Above treeline tussock-shrublands with some local flush areas occur with condition and cover generally greater above the retirement fencelines at c. 1100 m. Grazing and trampling was evident, particularly on Ross and Way Spurs, with numerous sheep observed on the main Symmetry Peaks ridge during a return visit in mid February.

Celmisia thomsonii reaches its northern limit on the main crest to the south of Symmetry Peaks while the only populations of Parahebe planopetiolata seen in the District occupy shaded eluffs beneath these peaks, probably here at their eastern limits. The two scree ranunculi, R. haastii ssp. piliferus and the undescribed "Eyre Mountains" species extend northward at least as far as Symmetry Peaks (Fig. 2).

A series of ridges and valleys form the western portion of the Robert Creek catchment with streams often deeply incised into the schistose bedrock. Beech forest frequently occupies these fire-sheltered sites with their margins largely occupying colluvial slopes dominated by various shrubland and tussockland communities. In the low- and high-alpine zones impressive rock bluffs dominate the main ridge crests with a complex pattern of glacial features - moraines, tarns, hanging U-shaped valleys, cirques (some with associated lakes), screes and boulderfields occupying the upper easterly faces of Symmetry Peaks.

4. Fauna

A. Invertebrates

a. Lepidoptera: A total of 90 species of Lepidoptera were recorded from the Eyre Mountains (Appendix Table 2), the vast majority collected as adults or larvae during the four day survey. Of these, 83 (92%) are considered alpine species. The few forest species found are typical of beech forest areas generally and as such are much less distinctive of the Eyre Ecological District. Although the excellent weather encountered had a positive influence on the success of the collecting, it is apparent that the District has a richer moth fauna than mountain ranges of adjacent districts, especially in the high-alpine zone above c. 1700 m and on the numerous steep, dripping rock faces. The many ranges to the east, including the Garvie, Old Man, Remarkable and Umbrella massifs in three separate ecological districts, are relatively rich (Patrick 1985, 1986), whereas those west of the Eyre District, even the adjacent Livingstone District of the same (Mavora) ecological region, are only moderately rich.

Entomologically the Eyre District has been neglected. Only M.O. Pascoe of Queenstown had previously collected any Lepidoptera and this was confined to Cecil Peak for one day each in January and February 1914. Here he discovered Orocrambus cultus Philpott (Philpott 1917). The surrounding mountains are now fairly well known for Lepidoptera after a decade of intensive searching and documentation, so that useful comparisons can now be made. An analysis of the known Lepidoptera from the Eyre District shows the following affinities: 60% of the species occur in all surrounding mountains from Fiordland to Central Otago including the Takitimu Mountains (of these, 5% are typical of Central Otago but also occur locally in eastern Fiordland while 4% are typical of main divide areas but reach their eastern limit just east of the Eyre District boundary, e.g., on Mid Dome); 28% are typical of Central Otago mountains eastwards to the Rock and Pillar-Lammermoor Ranges (for many of these species the Eyre Mountains are the western limit of their distribution); 9% are typical Fiordland species here at their eastern limits;

and 3% of the species (two moths) are apparently endemic to the District (both discovered during this survey, they are distinct from other species of the same genus but are most closely aligned to Central Otago species).

Several important finds were made among the Lepidoptera, including a new species of Tortricidae in the genus Eurythecta. This small, well-marked species was found flying by day in high-alpine herbfield on Symmetry Peaks. Its closest relative would appear to be an undescribed species found recently high up on Double Cone, Remarkables. Another new species is of the handsome alpine genus Ichneutica. A single male was found on wet rock-faces in the Slate Basin area of upper Eyre Creek. The larvae probably feed on Chionochloa plants present near these damp shady faces. The larvae of a rare moth Helastia frigida were discovered for the first time and found to be feeding on Cheesemanina wallii on rock-faces. A female of this finely-marked grey species was successfully reared and is the first seen for this species as it is known only from a single male discovered at Homer Tunnel in the early 1940's. The finding of the brachypterous female of Asaphodes periphaea below steep rock-faces was also significant. This species occurs only in mountains north, west and south of Lake Wakatipu. A surprising find was the tussock butterfly Argyrophenga janitae. It occurs down the eastern South Island to the Blue Mountains from where it extends inland to the Umbrella and Garvie Mountains and now the Eyre Mountains. Being common here is assumed to indicate that Chionochloa, the larval food plant, is in relatively good condition. The high-alpine moth fauna of Symmetry Peaks was significant both in terms of high diversity and abundance of individuals. More than 20 species, mainly fast-flying and attractive geometrids and pyralids, occurred here.

b. Coleoptera: The checklist of Coleoptera collected during the survey is included in the faunal list (Appendix Table 2). Few carabid beetles were collected, probably because of the hot dry weather which accompanied and preceded the study. This also may have affected the activity of some other groups of insects which

tend to seek refuge under such conditions. However, the carabids collected, especially the smaller groups, were of interest. The migadopine, which may be a new species of an undescribed genus (P.M. Johns, pers. comm.), Demetrida sinuata and Actenonyx bembidioides have not been collected by me (B.I.P.B.) elsewhere, despite pitfall trapping on the Garvie and Umbrella Mountains, and hand collecting on Mt Cardrona and the Old Man, Remarkable, Hector, Mt Cardrona and Richardson Mountains. The latter two species have been recorded previously from Otago localities but the exact sites mentioned in the literature have been difficult to ascertain (Staircase and Clippings Bush).

The stag beetle Ceratognathus foveolatus found in Eyre Creek has not been collected by me previously and is apparently found in South Island mountainous areas in beech forest. In Otago it has not been recorded frequently but Mt Earnslaw and the Routeburn area are known localities.

The scarab beetles were represented by Scythrodes squalidus, which is common throughout the Central Otago mountains, plus three species of Pyronota (manuka beetles). A single dead specimen of Sericospilus advena was found near the hut on Way Spur. It is reasonably common in beech forest throughout the South Island.

The byrrhid, Pedilophilus lewisi seems to have a similar distribution to Scythrodes, being typical of Central Otago mountains. Byrrhid sp. 6 is similar to, and may be the same as that found above the Roaring Meg in the Kawarau Gorge but sp. 19 has not been collected by me previously. They are probably species of Epichorius, but the group is so poorly known taxonomically that the significance of a 'new' find is difficult to assess.

The only tenebrionid beetles collected were two individuals (Pheloneis sp. 4) which were found beneath a rock in Slate Basin. This species has been previously collected only from Williamsons Spur above Moke Lake. The longhorn (Cerambycidae)

found on Hebe propinqua on Way Spur is a spectacular beetle which has not yet been identified but which may be a species of Mesolamia.

Three species of Adoxia, a small chrysomelid group found on a wide range of plants especially when flowering, were collected and of these, sp. 7 has not been found previously by me. Adoxia spp. 4 and 6 occur further east on the Umbrella Mountains with sp. 4 also on the Slopedown Range. Allocharis sp. 11 has been collected at 1700 m on The Remarkables and was also found at this altitude on Symmetry Peaks.

Weevils (Curculionidae) were abundant in the surveyed area, especially at higher altitudes in the vicinity of Symmetry Peaks. Anagotus latirostris, another species typical of the Central Otago mountains, was found in the Way Spur-Symmetry Peaks area and was particularly abundant at the summit. Only a single dead specimen of Anagotus lewisi was found. This is the westernmost record obtained for this species in Otago. It is common on Swampy Summit near Dunedin, at Danseys Pass, Blue Mountains, Lammermoor Range and on the Umbrella Mountains where it is associated with tussock species. Its larvae feed in the tiller bases.

One of the most spectacular groups of weevils are species of Lyperobius, the large black and white striped weevils found on species of Aciphylla and Anisotome. Again these were only found in the Way Spur-Symmetry Peaks area where both L. spedenii and L. hudsoni were seen abundantly on the flower heads of Aciphylla simplex, A. spedenii and A. lecomtei. L. hudsoni is common on many Central Otago mountains while L. spedenii has been recorded from The Remarkables and Garvie Mountains but in far less abundance than here.

The broad-nosed weevils were represented by two species of Irenimus, both of which have also been found previously on the Umbrella Mountains. Although these weevils tend to be broad-spectrum feeders as adults, Irenimus sp. 20 seems to be

particularly associated with Hebe and has not been found feeding on any other plant genus. The adults produce small, semicircular notches on the leaves and the larvae of this group are root-feeders.

The Celmisia species in the study area, including the endemic C. philocremna, supported a group of weevil species, especially in the eugnomine and tychine groups, where many are host-specific.

The Way Spur-Symmetry Peaks area would appear to offer the most diversity and abundance of beetle species of all the sites visited in the District, although this may reflect the longer time spent here and the higher altitude reached. However, the condition of the vegetation throughout the 1200-1800 m altitude range appeared to be so good as to suggest a rich associated fauna. Slate Basin in upper Eyre Creek, where Celmisia spp. were well represented, including a large population of C. philocremna, supported a wide range of beetles, especially weevils, many of which may be restricted to plants of this genus. Although it has not been possible to pin-point any particular 'new' finds amongst the Coleoptera collected during this study, it seems that many of the species found are generally a reflection of a relatively unmodified environment. The abundance of Lyperobius weevils, the presence of Anagotus lewisi and other beetles known previously only from more easterly localities, plus the discovery of several species not collected elsewhere by me despite fairly intensive trapping and collecting in nearby areas, indicate that the areas visited within the Eyre District, especially at the higher altitudes, are most worthy of protection.

c. Other Insects and Invertebrates: Mr P.M. Johns of Canterbury University has identified the millipedes, wetas, cockroaches and crane flies collected during the survey. A checklist of these is included in the faunal list (Appendix Table 2). Of particular interest was the weta Pharmacus which is a new species of the alpine scree group. Hemiandrus focalis is a fairly common alpine burrowing weta found throughout most of Otago. The

cockroach Celatoblatta quinque maculata is a widespread Otago subalpine shrubland and scree species. However, Johns notes that the Eyre population seems to be distinctly paler in colour than those from other Districts.

The tipulid Cerezodia aff. pulverulenta is a particularly large species (28-35 mm) with a brachypterous female. The type locality for C. pulverulenta is Invercargill.

Peter Johns has also provided information on insects collected by Graeme Bremner and himself from the Gorge Burn on the western side of Jane Peak. Another rhabdophorid of undetermined genus and species was collected from alpine vegetation at 1100 m. It is thought to have some affinity with a 'suite' of species from lowland forests of Southland and Stewart Island. A large broscine carabid Mecodema chiltoni Broun was found which is also known from the Carrick Range although a recent search recovered no live specimens there, Nevis Saddle, Hectors and The Remarkables. This is a significant find since the distribution of this species seems to be very limited and it could well be placed on the endangered list. Two millipede species, Zelanion sp. and Maoriella sp., both of which could be new, were also collected from the Gorge Burn, as was a female of the tipulid Cerezodia aff. pulverulenta, previously unknown.

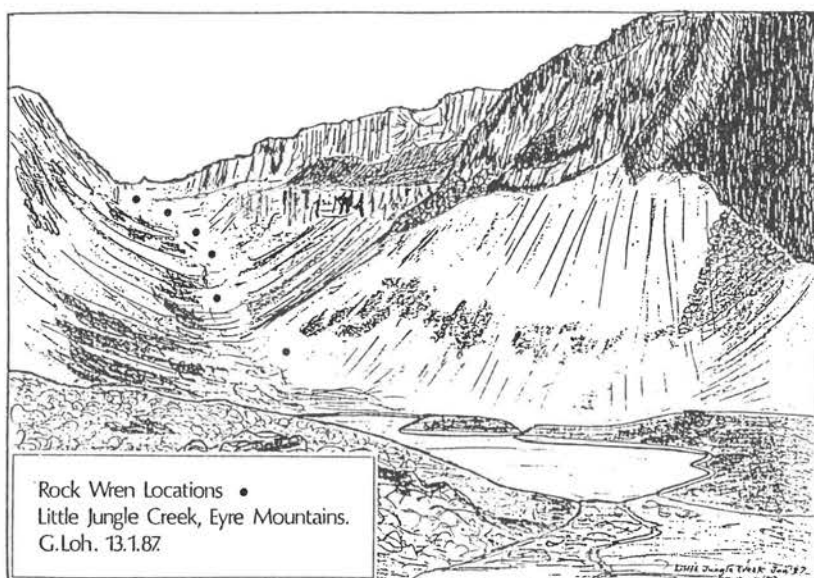
Only one population of the rare snail, Powelliphanta spedeni var. spedeni was found during the survey, locally in mixed snow tussock-shrubland near the beech treeline on the south and north side of the Mt Bee ridge about 3 km to the north of its highest point. Several empty shells lay on the floor of the adjacent beech forest, indicating predation by birds. This protected species is classed as "rare" (Bell 1986).

B. Vertebrates

a. Birds: The bird section of Table 2 (Appendix) includes a summary of all species known from the Eyre District, including their habitats and occurrence therein. Only brief commentary on the significant species and other taxa observed is given. Among

the significant wildlife species several are notable either for their national status or their local significance. The status reference is in accordance with Bell (1986).

Rock Wren. Status: rare. Rock wren were discovered in four areas, Jane Peak, Eyre Peak and Symmetry Peaks (two sites). In the first two places they were found on the shady side of high southeast-facing glaciated valleys. The accompanying sketch shows the locations of wrens in Little Jungle Creek. Here they



ranged in altitude from 1130 m to 1600 m over a distance of 1.5 km. Brian Patrick found them near the north summit of Symmetry Peak at 1840 m while Gerry McSweeney found another population on the upper Ross Spur ridge of Symmetry Peaks. All habitats were dominated by rock with only 20% of the ground vegetated with tussock, shrubs and herbs. All sites were damp, with snow patches nearby. Some were in moraine boulderfields. The wrens' range within the alpine zone appeared to be quite limited and this may explain their being overlooked in the past.

Their habitat is similar to that found on the main divide (Sue Heath, pers. comm.).

These populations of rock wren are unique in their isolation from the known range of the species. There are no other known populations east of the main divide. This new discovery may be an important clue to the birds pre-European distribution.

New Zealand Falcon. Status: threatened. Nine records were gathered by the team in four days in the Eyre, Mataura and Robert catchments. All were found below 1000 m with half being located in the main valley floors below 600 m. One nest site was found opposite the Windley Creek junction and a cake roost was found in the Mataura up from Iron Spur. A "cake roost" is a traditional roosting site where the urea part of the faeces has accumulated to several centimetres. The N.Z. Wildlife Service Fauna Survey in 1982 recorded that falcon were associated with most of the beech habitats. The frequency of sightings indicates that falcon are as common here as anywhere else in their range, although they showed a habitat preference here for lower levels near scrub and water.

Black-fronted tern. Status: threatened. The 1982 survey found that terns will form colonies each spring in Eyre Creek below Scrubby Creek and in the Mataura below Robert Creek but above the highway. Colonies are usually around one hundred birds. They feed well up each river bed through summer.

Banded Dotterel. Status: threatened. Dotterel breed through the same reaches of river as the terns. Numbers are low as each pair requires a 200-500 m stretch of riverbed for a breeding territory. None were seen during the present survey as they leave the rivers after breeding in the spring months.

South Island Robin. The robin has a very patchy distribution. In Southland it has a strong preference for beech forest on damp fertile sites. It was found in the red beech stands of Little Jungle Creek. Elsewhere in the Eyre District it is found in low

numbers in similar forest on alluvial soils. The largest population occurs in Cromel Stream around the old logging site. R. Soulsby (pers. comm. 1984) reports finding them in kanuka scrub on Acton Downs - this scrub has since been cleared. The forest tongue nearest to the Oreti River in the Gorge Burn catchment contains robins. Their populations appear to be very vulnerable within the District.

Yellow-crowned Parakeet. Status: rare (O'Donnell 1986).

Parakeets are widespread, occurring in several of the small forest remnants in the montane valleys. However, their numbers are low except in the Cromel catchment.

Kea. Status: threatened. A small population of keas is present in the Eyre District. They were heard on two occasions on the survey and a flock of four were seen subsequently in the Lochy Valley. The owner of Greenvale Station reports keas harassing sheep in winter. This small population, like others that have been reported as far east as the Umbrella Ecological District (Dickinson 1986), is unusually distant from their stronghold of the main divide. It is unknown whether they breed locally or travel from this latter location.

b. Bats

Status: threatened. Bats (species unknown) have been reported by hunters on the forest edge within Acton Stream catchment. This chance sighting is the only record of bats in the Eyre District. None were seen on the survey despite camping out in suitable places.

c. Lizards

The hot weather during the survey made most lizards elusive. A few common skinks and common geckos were observed in the Eyre, Mataura and Robert Creek catchments. None were species with a vulnerable status.

The Eyre mountains have attracted considerable herpetological interest recently (Mr G. Paterson pers. comm.). The cirque wall

around the lake near the head of in Gorge Burn is known to contain six lizards: the "spotted", "speckled" and "striped" forms of Leiolopisma nigriplantare maccanni; L. chloronoton; and the "maxi" and "mini" forms of Hoplodactylus maculatus - the southernmost record for the "mini" form. (Most authorities accept that all these forms will be described as true species.) This site where the common skink and common gecko forms occur sympatrically is significant.

d. Significant Vertebrate Habitats

Forest Remnants. All the montane beech forest remnants greater than 100 ha were judged to be significant wildlife habitats. Each was given the rank of "moderate" as they provide basic habitat for common forest birds. Collectively they substantially extend the distribution of several species, notably robins and parakeets which favour the small patches of red beech.

Riverbed. Although they are collectively part of the Mataura River habitat, Eyre Creek and the upper Mataura catchment were given separate descriptions to identify their context within the District. Each ranked "moderate" for their small populations of threatened waders and terns. It should be noted that the whole Mataura River has a rank of "high" as it has the country's largest breeding population of the endemic black-billed gull and high numbers of other waterfowl (Appendix Table 2). The reaches upstream of the highway have better water quality and fewer weed problems than downstream sections.

e. Local Extinctions of Vertebrates. The lack of recent records suggests that the following species have become extinct in the Eyre District within the last twenty years: yellowhead, blue duck, red-crowned parakeet, tui and New Zealand pigeon.

f. Further Surveys

Further study of the distribution and status of rock wren, falcon nest sites, robins, keas, bats, yellowheads, blue ducks, bats, lizards and land snails is necessary for the preparation of a fauna conservation plan in the Eyre Mountains.

EXISTING PROTECTED AREAS AND PRIORITY PLACES FOR PROTECTION

a. Existing Protected Natural Areas

Two formally protected areas, Te Kere Haka and Glen Allen Scenic Reserves, totalling 1196 ha, are contained within the Eyre Ecological District (Lands and Survey Department 1984). Both are located near Kingston at the southern end of Lake Wakatipu, close to the District's eastern boundary (Fig. 2). The former (196 ha) contains a small area of silver beech forest with some secondary bracken fernland and fescue tussockland at 500-1000 m elevation. The latter (c. 1000 ha) comprises mountain beech forest (347 ha) and red beech forest (56 ha) surrounded by various fire-induced seral associations plus montane fescue and snow tussocklands at 500-1200 m (Lands and Survey Department 1984). Detailed descriptions of both reserves have been prepared by Dr W.G. Lee, D.S.I.R., (unpublished report 1986).

In addition, the Forest Service has proposed as an ecological area, some 3200 ha centred on West Dome near the southwestern corner of the District (Fig. 2). The ecological area would protect a representative portion of the Dun Mountain Ophiolite Belt with its distinctive vegetation and flora, including the endemic Celmisia spedenii (McIntosh and Lee 1986), plus the upper slopes of the West Dome massif and a corridor on its southwestern side embracing beech forest, shrubland and tussock grassland (Mr Dennys Guild, pers. comm.).

A "background information" paper released by Lands and Survey Department (1982), stated that "several areas of beech forest have been protected by Conservation Covenants under Section 77 of the Reserves Act" on these two Crown land areas.

(b) Priority Places for Protection (PPPs)

The several adjacent catchments identified as having high natural values have been amalgamated into a single PPP (Kelly and Park 1986) of c. 33,000 ha (Fig. 5). This area embraces much of that covered by the present survey. This embraces, within the Cainard Crown land area, much of the upper Mataura catchment beyond its junction with Robert Creek plus all of the slopes to the west of Robert Creek, while within Eyre Creek Crown land area it includes the entire upper catchment beyond Scrubby Creek. A link between these two areas is provided by the block of Unalienated Crown Land (U.C.L.) in the upper Mataura catchment to the east of Eyre Peak. To the south of the Eyre Creek catchment the generally forested contiguous catchments of Irthing and Cromel Streams within the previous Eyre State Forest plus their upper slopes on Helen Peaks (U.C.L.) are also included in the identified area as are the mid and upper reaches of the Gorge Burn catchment, on the western slope of the District, within the area of Mt Nicholas Station destined for retirement.

This PPP is justified on the basis of representative altitudinal sequences of vegetation, flora, fauna and landforms, plus the recorded occurrences of several rare and/or locally endemic plant and animal species or significant local occurrences of more widespread species. These features differ in detail between each of the main catchments (upper Mataura River, Robert Creek, Eyre Creek, Irthing-Cromel Streams, Gorge Burn), as previously described.

In the upper Mataura portion of the identified area the composition and condition of the montane grassland at c. 600-750 m is exceptional. Dominance of the generally palatable blue wheatgrass (Elymus rectisetus), because of the prolonged period of negligible grazing, gives credence to the claims of Petrie (1895) and O'Connor (1986) for the physiognomic dominance of this species in the "true steppe" grasslands of central-eastern South Island. Moreover, it tends to dispel the claims of both A.H. Cockayne (1910) and L. Cockayne (1910) as to the importance

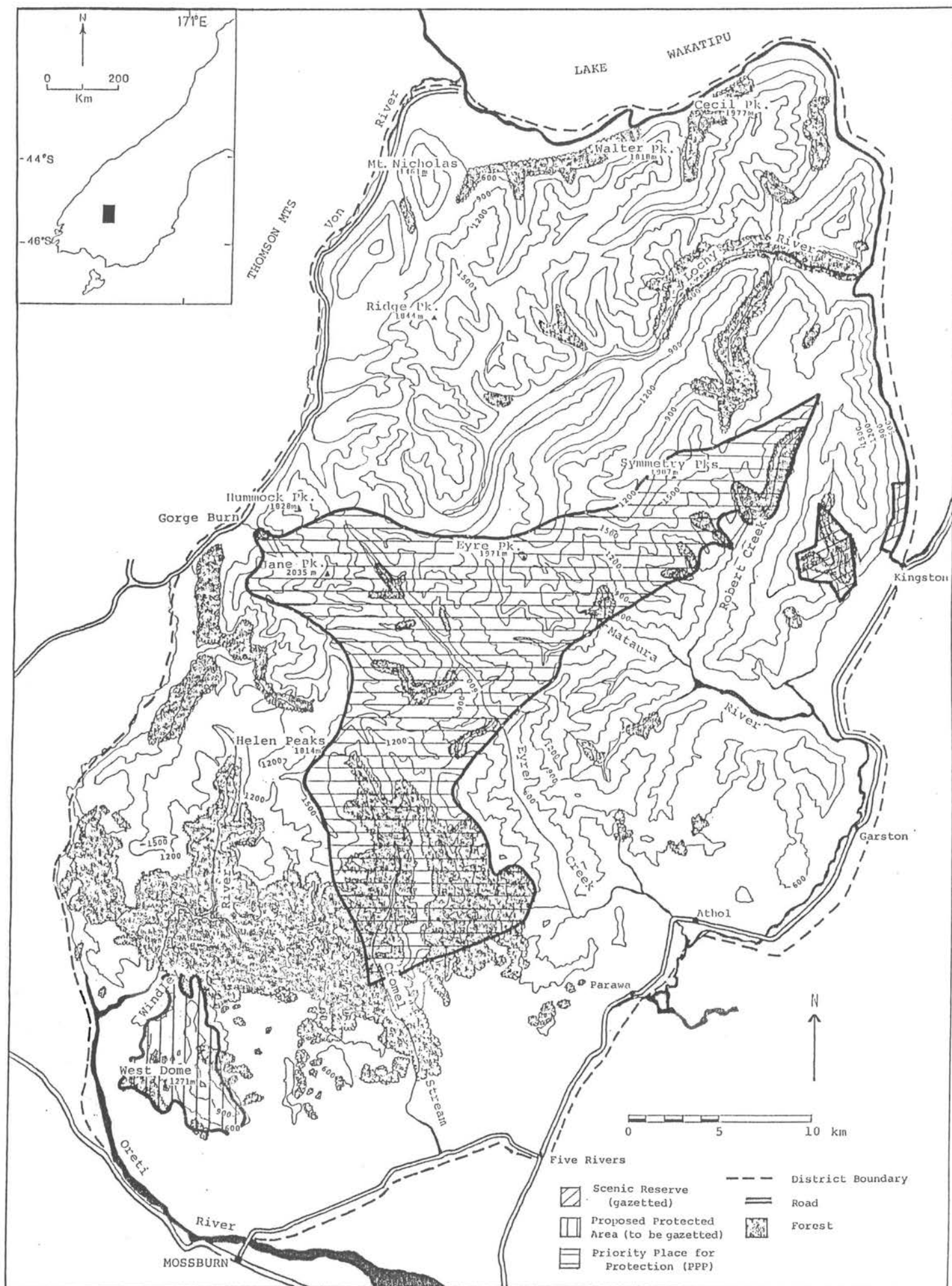


Figure 5. Eyre Ecological District showing its two protected areas (scenic reserves), a reserve proposed by the New Zealand Forest Service plus the Priority Place for Protection identified in relation to the area surveyed.

of Festuca novae-zelandiae in the original montane grasslands (see O'Connor 1986 pp. 27-28). The forest, shrubland, grassland and high-alpine sequences are especially valuable because of their relatively undisturbed condition.

This is also true for the non-forest ecosystems above the retirement fences at c. 1000 m on the slopes to the west of Robert Creek. The extremely localised distribution (c. 10 km²) of the endemic Celmisia thomsonii, with its unique colour forms described previously, justifies formal recognition and also requires special protection against possible exploitation by horticultural enthusiasts. The Symmetry Peaks area, beyond the limits of C. thomsonii has special faunal significance, being two of only four known locations of rock wrens in the District (the only District in which they are known to occur east of the Southern Alps) as well as the only known location for several species of Lepidoptera and Coleoptera, and one of exceptional insect diversity.

The remarkably straight upper Eyre Creek catchment, is geologically significant because of its northwest-southeast fault-controlled orientation which separates greywacke from schist. It apparently experiences a strong moisture gradient as revealed by the vegetation sequences in forest, shrubland and tussock grassland. The beech forests range from mountain beech dominant at the drier eastern end through co-dominant red-mountain beech to mixed red-mountain-silver beech and ultimately pure silver beech at its upper (western) limits. Dry shrubland in the vicinity of Scrubby Creek is characterised by Discaria toumatou (matagouri), several olearias (Olearia hectori, O. virgata var. rugosa, O. odorata, O. lineata), Corokia cotoneaster and Carmichaelia virgata (Quadrat Group J) whereas the mixed subalpine shrubland associated with treelines under moister and cooler conditions are characterised by a dominance of Brachyglottis cassinioides associated with Hoheria glabrata, Hymenanthera alpina, Aristotelia fruticosa, Olearia moschata, Coprosma ciliata, C. rugosa, Podocarpus nivalis, Hebe rakaiensis, H. cockayniana, Aciphylla glaucescens, Clematis marata, and

Pterostylis montana (Quadrat Group K). Unburned and ungrazed for many years, this scrub is generally exceptionally dense and reaches up to 3 m tall in the upper reaches of the valley floors of Eyre Creek and several of its tributaries. Similarly, tussock grasslands grade from mixed fescue tussock - narrow-leaved snow tussockland in the drier lower-altitude sections, through extensive areas dominated by Chionochloa rigida (narrow-leaved snow tussock) to the wetter and higher altitude areas where C. macra (slim snow tussock) predominates. These in turn grade into a mixed slim - curled snow tussockland, and eventually to one dominated by pure C. crassiuscula (curled snow tussock). Not only are the individual snow tussocks exceptionally large and vigorous in this catchment (with prolific flowering at the time of the survey), reflecting their lenient use at least over the past 25 years, but in addition, two species reach unusually high altitudes, C. rigida to 1620 m and C. macra to 1940 m in the upper reaches of this catchment (see Appendix Table 1).

The Eyre catchment is also significant floristically, since almost all of the known populations of the endemic Celmisia philocremna occur near its headwaters in the vicinity of Slate Basin and the Little Jungle Creek confluence, particularly on exposed rock bluffs. In addition, several hybrids between two of the Districts more impressive alpine plants (the white-flowered, wet bluff-inhabiting and generally widespread Ranunculus buechananii with the yellow-flowered endemic scree buttercup, R. haastii ssp. piliferus), were found on the moist, generally shaded scree slopes at c. 1750 m altitude in the upper reaches of the Little Jungle Creek below Jane Peak. Fisher (1965) who noted these hybrids as a unique feature of the Eyre Mountains, recorded such specimens only in the Rough Peaks area on the northern slopes of the Lochy catchment in the northern portion of the District, beyond the area surveyed. The undescribed "Eyre Mountains" Ranunculus species occurs in several parts of the catchment while the few plants of R. crithmifolius seen during the survey were on fine scree in the mid reaches of the Little Jungle tributary, representing a disjunct southernmost population.

A wide range of glacial landforms also feature in the upper Eyre catchment. These include cirques, high rock bluffs, waterfalls and an impressive series of moraines with associated small lakes located in the mid reaches of the Little Jungle catchment at 1100-1200 m.

The Irthing and Cromel catchments on the southern margin of the PPP contain substantial areas of beech forest, dominated by mountain beech with a minor component of silver beech. The natural treeline is intact along much of the Mt Bee ridge which separates both catchments in their mid reaches. The southern slopes of this ridge have been excluded, however, because of various disturbances associated with fire, past logging and local exotic afforestation. The Mt Bee ridge is significant in being the site for the only known population of the generally rare landsnail Powelliphanta spedeni var. spedeni which was locally abundant in mixed snow tussock-shrubland at c. 920 m near treeline on both its north and south aspect slopes c. 3 km to the north of Mt Bee summit. A small population of Celmisia philocremna, remote from its nucleus, occurs on low rock outcrops at the northern end of the Mt Bee ridge at c. 1180 m, while two additional very small populations were located following the survey, to the west of the forest limits in the upper reaches of the Cromel catchment at 1400-1500 m by one of the team members, Ms H. Sandercock. She also located one outlier population of the undescribed "Eyre Mountains" Ranunculus on a north aspect slope at c. 1700 m in the same general vicinity (Fig. 2). A further small outlier population of the species was found beyond the forest limits on a south aspect slope in the upper Irthing catchment at c. 1400 m (Fig. 2). This species is apparently continuous along the high crests as far south as the Helen Peaks area where it is not uncommon on exposed areas of fine scree. Furthermore, moist shaded areas of fine scree plus rock ledges on the main crest near Helen Peaks support a small population of the rare willowherb Epilobium purpuratum while one of only three cushions of the distinctive Raoulia hectori var. mollis seen during the survey, also occurred in this vicinity. The area identified for protection extends to the

south of Helen Peaks, somewhat beyond the area surveyed, since it is likely to contain additional populations of some of these rare species and moreover, is likely to represent their southern limits.

A wide range of landforms is present in the Irthing and Cromel catchments, including alluvial valley floors, which in the Irthing catchment supports a substantial area of red tussock grassland below treeline. This tussockland area also supports the only known populations in the District of Halocarpus bidwillii (bog pine) and the rare shrub Hebe dilatata. Colluvial slopes are widespread at low to moderate altitudes while there are extensive natural and apparently induced screes above treeline that carry large populations of Ranunculus haastii ssp. piliferus, at or close to, its southern limit. A representative range of glacial landforms are increasingly dominant with increasing altitude above c. 1200 m.

On the western slopes of the District only the Gorge Burn catchment was studied because it was already known to contain a range of important natural features. The western slopes of Hummock Peak in the north of the catchment and Smooth Peak to the south have been excluded because of their seriously depleted and highly eroded state. The remainder of the catchment, however, leading to the District's highest point Jane Peak (2035 m) contains several important natural values, which complement those in the eastern catchments of the District, and thus is included in the PPP. Below c. 950 m a substantial area of mountain beech forest occurs within which there are a range of relatively young even-aged, as well as mixed-aged, stands. Adjoining areas of narrow-leaved snow tussockland consist of large and vigorous, if somewhat sparse, tussocks with a relatively diverse associated flora. A distinctive stand of Podocarpus nivalis (snow totara) occupies a few hectares of stabilised rock debris on a north-aspect slope of the catchment at c. 1000 m. Extensive areas of the upper slopes in the low-alpine zone are dominated by curled snow tussock, Chionochoa crassiuscula which is more extensive in this catchment than elsewhere in the area surveyed.

be formally covenanted as earlier claimed by Lands and Survey Department (1982). Moreover, the lower reaches of Eyre Creek and the Mataura River should be protected by a separate management agreement that aims to keep the water clean, the shingle free of weeds and stock away from breeding waders and terns.

DISCUSSION AND CONCLUSIONS

In addition to the two scenic reserves totalling 1196 ha near Kingston and the recently approved reserve of a. 3200 ha on West Dome, a large centrally located representative protected area within the District is justified. This central section of the Eyre Ecological District, particularly that portion centred on the Cainard and Eyre Creek Crown land blocks and embracing the District's two highest peaks (Jane Peak, 2035 m; Eyre Peak, 1971 m) contains a wide range of natural values that justify formal recognition as a protected natural area. None of these values are represented in either of the two existing reserves or the approved reserve occurring within the District. Almost 20,000 ha out of the 33,000 ha identified as a Priority Place for Protection (PPP) is contained within the two Crown properties.

Particular values identified include: (1) sequences of indigenous vegetation embracing forests, shrublands, tussock grasslands, fellfields, snowbanks, screes and bluffs along both altitudinal and moisture gradients; (2) excellent condition of the vegetation throughout most of the area identified. This reflects the freedom from burning and grazing associated with some 25 years of retirement consequent to the Crown resuming the leases of Eyre Creek and Cainard land blocks in 1962-63. The condition of the snow tussocklands is exceptional in terms of tussock size and vigour, including prolific flowering at the time of the survey, and the relatively high upper altitudinal limits reached by all three snow tussock species - C. macra to 1940 m; C. crassiuscula to 1700 m; C. rigida to 1620 m. (3) presence of lower altitude grasslands characterised by Elymus rectisetus (blue wheatgrass) that lend support to them being important, even co-dominant, in the natural grasslands of inland Otago as described in some of the earliest writings (Petrie 1895),

contrary to the views of others (L. Cockayne 1910, A.H. Cockayne 1910). This issue remains unresolved yet is an important question in New Zealand grassland ecology (O'Connor 1986). In the absence of low-altitude inland areas, spelled for extended periods, opportunities have not been available to gain direct insight into this ecological aspect. Deductive reasoning has been the only possible approach (O'Connor op. cit. pp. 27-8). Continued spelling of such areas, that reservation would ensure, therefore is highly desirable. (4) Occurrence of a relatively large number of biota that are significant because they are endemic to the Eyre District, or have a very limited range beyond it, or are at the limits of their distribution in the District. Some of these have been included in the rare and endangered category. Among the vascular flora (Given 1981) there are some notable cases. Indeed Given's "Checklist of plants at risk in New Zealand" contains seven which occur in the Eyre District). Among these are Celmisia philocremna and C. thomsonii, both anomalous species within the genus (Given and Gray 1986) and both with very limited but apparently non-overlapping ranges within the District. Although C. thomsonii has been described for more than 70 years it has been collected only rarely which may explain why a relatively high incidence of plants with pink or mauve coloured capitula has not been reported previously. Both species are highly habitat-specific and, despite being locally common and of considerably greater extent than previously thought, require legal protection throughout most, if not all of their respective ranges. Based on information obtained since Given's (1981) publication, two additional species are recommended to be added to his checklist, the undescribed "Eyre Mountains" Ranunculus species and Celmisia spedenii, both endemic to the District.

The endemic speargrass, Aciphylla spedenii, is widespread and relatively common in fellfield and high-altitude snow tussocklands but is apparently restricted to the Eyre District (there is a single unconfirmed record from Gertrude Saddle, Fiordland - Mark & Adams 1973), while Cheesemanian wallii, which occupies shaded bluffs, recently has been found in two adjoining districts: Old Man (Brumley et al. 1986) and Nokomai (Dickinson unpublished).

Likewise, Ranunculus haastii ssp. piliferus was considered to be confined to the higher scree slopes of the Eyre District (Fisher 1965) but recently it has been discovered on the screes of East Dome in the Nokomai District (Dickinson unpublished). The much less conspicuous, undescribed "Eyre Mountains" Ranunculus species (Mark and Adams 1973) appears to be widespread, but confined to the fine screes of the District. Clearly, the Eyre Mountains are an important area for alpine buttercups, in terms of both presences and absences (Fisher 1965).

Among plant species of very restricted national distributions, new records have been established for the Eyre District, for Epilobium purpuratum (two sites), Raoulia hectori var. mollis (three sites), Hebe dilatata (one site), and Pimelea poppelwellii (relatively widespread). Moreover, the District forms the distribution limits for several plant species, particularly alpenes - Parahebe planopetiolata, Myosotis macrantha, Hebe cockayniana, Chionochoa pallens (eastern limits); Ranunculus crithmifolius, Parahebe birleyi (southern); Abrotanella inconspicua, Parahebe trifida (western).

Among the indigenous fauna, the District is important for both its invertebrates and vertebrates. With the former, only one local occurrence of the rare landsnail Powelliphanta spedeni var. spedeni, here at its western limit, was recorded in the survey. Results of the entomological survey indicate that the Eyre District is highly significant, particularly for alpine Lepidoptera. Two endemic species together with a host of rarely recorded ones, collected over a limited area during a brief period in mid summer, indicates that many other new species likely await discovery in this extensive mountainous area. While the moth fauna of the Eyre District shows definite affinities with other alpine areas around Lake Wakatipu, as well as with Fiordland to the west, it is most closely allied with mountains of the Central Otago region to the east. The strong Central Otago element present in Lepidoptera of the Eyre District is particularly concentrated in the Symmetry Peaks area whereas the Fiordland element is most strongly represented around Jane Peak.

Important entomological sites in the Eyre Mountains that justify formal protection include dry shrublands at 300-600 m in Eyre Creek; low- to mid-altitude wetlands; rock bluffs at all altitudes especially in upper Eyre Creek, Mataura River and Robert Creek catchments; high-alpine fellfields, particularly around Symmetry Peaks; shrublands and herbfields in cirque basins such as the eastern slopes of Jane Peak; screes, especially around Jane Peak and the Slate Basin area of upper Eyre Creek; moss-bogs around alpine tarns as below Symmetry Peaks; and Chionochoa tussocklands at all altitudes.

The Coleoptera collected during the brief entomological survey totalled 50 species which is indicative of a rich fauna and wide species diversity in the District. The species found in greatest abundance share affinities with other mountain ranges around Lake Wakatipu and also Central and eastern Otago ranges. The discovery of Mecodema chiltoni, a large predatory carabid beetle in the Eyre District is significant in that the distribution of the species is limited, and seems to be diminishing. The large weevil, Lyperobius spedeni is another species with a restricted range and this was represented in the Symmetry Peaks area by an apparently thriving population which exceeded in numbers any seen elsewhere.

Among the avian features of the Eyre District rock wren and falcon are outstanding. As long as their habitat is maintained in its current condition they should remain. An important feature of their habitat is the vegetative quality of the montane and subalpine zones associated with the absence of grazing and browsing animals. The District also possesses an assemblage of threatened species on the edge of their distribution. Their low numbers make them vulnerable to further decline. Robin, parakeet, kea, banded dotterel, and black-fronted tern are the most sensitive species. The District will be an important place to monitor these populations of specialised forest and braided river birds in fragments of habitat.

The Eyre District is noted for its actual, and potential, erosion hazard. Almost one quarter of the District's 197,500 ha has been classified as being unable to sustain grazing because of this erosion hazard (Class 8e land) while a further 34% is classified as 7e, indicating very severe limitations for grazing purposes. Largely because of this problem, substantial areas have been retired from such use, either as part of soil and water run conservation plans within individual pastoral leases or through resumption by the Crown, as with the two Crown land blocks (Eyre Creek and Cainard) that were taken over in 1962-63, or have been classified as Unalienated Crown Land. These retired areas consist almost entirely of Class 8e and 7e land. In the case of the Eyre Creek and Cainard Crown land blocks, Class 8e and 7e land constitutes 70.5% and 72.5% respectively, of their total areas. With less than half (41%) of the District being suitable for productive use without serious limitations it should not be surprising that the c. 33,000 ha area identified as a priority place for protection has had its development constrained by intrinsic limitations. The Eyre Creek and Cainard blocks reflect this pattern. With the 20,906 ha Eyre Creek block, the area contained within the PPP covers 89% of the Class 8e and 7e lands on the block. Only 1025 ha of such land remains outside the PPP. With Cainard (13,479 ha) 97.5% of all Class 8e and 7e lands on the block are contained within the PPP and only 815 ha of such land lies beyond the area identified. Similar proportions probably pertain on the balance of the area within the identified PPP which should facilitate implementation of the recommendation.

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Appendix Table 1. Floristic list of vascular plants recorded from the Eyre Ecological District based on the current survey and supplemented with additions based on listing by Dr.C.D.Meurk (pers.comm.) from throughout the district (1); by McIntosh and Lee (1986) from West Dome (2); by Poppelwell (1913) and Simpson and Thomson (1926) from the northern end (3); by Forest Service surveys of forest (Hayward 1969) and indigenous grasslands (Evans 1973) over much of the District (4); and by Dr.W.G.Lee (pers.comm.) and N.C.Simpson (pers. comm.) from the Glen Allen and Te Kere Haka Scenic Reserves near Kingston (5); and from the published floras of Allan (1961) and Moore and Edgar (1970) (6). Exotics are indicated with an asterisk. Altitudinal ranges have been supplemented with values from Meurk (pers.comm.) for the whole District. The number of occurrences of species within the 150 quadrats used in the survey plus the Quadrat Group assigned to those species with more than two occurrences are also shown. Species recorded during the survey but outside the sampled quadrats are denoted by a zero. + denotes voucher specimens held in OTA herbarium.

	No.occ.	Sp.Class	Alt.range(m)
IDOPHYTES			
5 Asplenium bulbiferum ssp. gracillimum	-		
2 A.flabellifolium	-		
A.flaccidum	0		
5 A.hookerianum	-		
A.richardii	1		510-1370
A.terrestre	1		630-870
Blechnum capense	2		750
5 B.chambersii	-		
4 5 B.discolor	-		
B.fluviatile	1		1060
5 B.lanceolatum	-		
B.minus	0		
B.penna-marina	56	D	470-1780
B.procerum	2		670-880
5 B.volcanicum	-		
1 B.sp.("mountain")	-		610-870
Botrychium millefolium	0		
3 Cheilanthes sieberi	-		
5 Cyathea colensoi	-		
Cystopteris tasmanica	0		1100-1600
5 Dicksonia squarrosa	-		
Grammitis billardieri	3	L	710-890
G.givenii +	1		1340-1430
G.patagonica +	0		1300
G.poepiggiana	4	F	900-1970
Histiopteris incisa	1		660
Hymenophyllum multifidum	7	L	710-1100
3 H.revolutum	-		
H.sanguinolentum	1		890-1600
1 H.villosum	-		780-1480
Hypolepis millefolium	13	K	450-1210
5 H.rufobarbata	-		
Lycopodium australianum	23	C	870-1690
L.fastigiatum	56	D	670-1550
L.scariosum	16	K	660-1090

	L.varium	1		630-780	
	L.volubile	1		880	
	Ophioglossum coriaceum	1		970-1010	
2 5	Phymatosorus diversifolius	-			
	Polystichum cystostegia	11	A	1030-1940	
5	P.richardii	-			
	P.vestitum	36	K	490-1380	
	Pteridium esculentum	1		510-720	
5	Pyrrosia serpens	-			
GYMNOSPERMS					
	Halocarpus bidwillii	2		890-1050	
	Phyllocladus aspleniifolius var.				
	alpinus	7	L	840-1250	
	Podocarpus nivalis	23	K	570-1250	
5	Prumnopitys taxifolia	-			
ANGIOSPERMS					
Dicotyledons					
	Abrotonella caespitosa	7	H	1050-1640	
	A.inconspicua	26	B	1000-1780	
	Acaena anserinifolia	0		590-1320	
	A.caesiiglauca	33	G	470-1480	
	A.dumicola	0			
	A.fissistipula	0		1060-1150	
2	A.inermis	-			
	A.microphylla	3	J	470-1380	
	A.novae-zelandiae	+	4	J	470-1240
	A.profundeincisa	+	9	F	720-1470
	A.saccaticupula	7	G	480-1620	
	A.spp.	4	K	550-1600	
	Aciphylla aurea	1		730-1380	
	A.glaucescens	9	K	520-990	
	A.hectori	0			
	A.aff.horrida ("lomondii")	58	D	620-1500	
	A.kirkii	0			
	A.lecomtei	+	15	F	1100-1690
	A.pinnatifida	4	A	1250-1650	
1 4	A.scott-thomsonii	-		1250-1420	
	A.simplex	1		1580-1980	
	A.spedenii	+	11	A	1030-1890
	Alepis flavida	0			
	Anemone tenuicaulis	25	C	700-1340	
	Anisotome aromatica	53	D	720-1830	
	A.aromatica var.flabellifolia	25	C	950-1350	
	A.brevistylis	2		1270-1340	
	A.capillifolia	+	3	E	1100-1830
	A.cauticola	0			
	A.flexuosa	32	B	880-1620	
	A.haastii	3	E	1030-1300	
	A.imbricata var. prostrata	1		1000	
	A.pilifera	0		1100-1600	
	Aristotelia fruticosa	13	K	470-1080	
5	A.serrata	-			
	Brachycome radicata	1		1000-1120	
	B.sinclairii	16	B	550-1780	
	Brachyglottis bellidioides	30	C	700-1640	

		<i>B.buchananii</i>	1		890-1000
		<i>B.cassinoides</i>	11	K	700-1220
3		<i>B.haastii</i>	-		
		<i>B.revoluta</i>	55	C	850-1680
		<i>B.southlandica</i>	17	F	570-1600
		<i>B.revoluta</i> x <i>cassinoides</i>	+	0	1270
1	5	<i>Callitriche petriei</i>	-		480
3	4	<i>Caltha novae-zelandiae</i>	-		
		<i>C.obtusa</i>	13	G	1060-1650
	5	<i>Calystegia turguriorum</i>	-		
		<i>Cardamine bilobata</i>	0		
1		<i>C.sp. ("corymbosa agg.")</i>	-		630
		<i>C.debilis</i>	9	A	510-1650
		<i>C.uniflora</i>	0		1060-1070
		<i>C.spp.</i>	2		520-1130
	5	<i>Carmichaelia grandiflora</i>	-		
		<i>C.virgata</i>	5	J	460-730
1		<i>Carpodetus serratus</i>	-		340-850
		<i>Cassinia vauvilliersii</i>	39	D	340-1380
		<i>Celmisia alpina</i>	4	H	1050-1300
		<i>C.angustifolia</i>	3	F	780-1280
1	3	<i>C.bellidioides</i>	-		700-1050
		<i>C.bonplandii</i>	+	2	1010-1300
		<i>C.brevifolia</i>	8	F	1100-1730
		<i>C.densiflora</i>	52	D	620-1690
		<i>C.du-rietzi</i>	2		1090-1700
		<i>C.glandulosa</i>	5	H	1080-1440
		<i>C.gracilentia</i>	54	D	480-1440
		<i>C.graminifolia</i>	1		850
		<i>C.haastii</i>	0		
		<i>C.hectori</i>	17	A	1100-1890
		<i>C.laricifolia</i>	21	B	1050-1720
		<i>C.lyallii</i>	50	C	890-1780
		<i>C.philocremna</i>	1		700-1500
		<i>C.prorepens</i>	16	B	620-1510
		<i>C.ramulosa</i>	6	F	900-1620
		<i>C.semicordata</i> var. <i>aurigans</i>	0		
		<i>C.semicordata</i> var. <i>stricta</i>	53	C	780-1780
		<i>C.sessiliflora</i>	6	B	1040-1550
2		<i>C.spedenii</i>	-		
		<i>C.thomsonii</i>	0		1380-1780
		<i>C.verbascifolia</i>	41	C	710-1600
		<i>C.viscosa</i>	3	B	1370-1600
		<i>C.walkerii</i>	5	E	950-1300
		<i>C.hectori</i> x <i>ramulosa</i>	+	0	1100-1300
		<i>C.walkerii</i> x <i>ramulosa</i>	0		
		<i>C.semicordata</i> x <i>verbascifolia</i>	2		1010-1280
		<i>C.sessiliflora</i> x <i>semicordata</i> ("linearis")	1		1600
		<i>C.verbascifolia</i> x <i>gracilentia</i>	0		
		<i>C.verbascifolia</i> x <i>lyallii</i>	0		1210
		<i>Centella uniflora</i>	2		1280
*		<i>Cerastium fontanum</i>	19	G	470-1470
1		<i>Cheesemanii fastigiata</i>	-		1570
		<i>C.wallii</i>	+	1	1100-1600
		<i>Chionohebe ciliolata</i>	+	2	1400-1970
		<i>C.ciliolata</i> var. <i>fiordensis</i>	+	0	
		<i>C.densifolia</i>	4	B	1310-1550
		<i>C.thomsonii</i>	3	B	1300-1690
1	5	* <i>Cirsium arvense</i>	-		700-1060
		* <i>C.vulgare</i>	3	J	470-520
5		<i>Clematis foetida</i>	-		

		C.forsteri	1		510-520	
		C.marata	3	K	510-980	
5		C.paniculata	-			
		C.sp.	1		470	
		Colobanthus acicularis	1		1050-1980	
		C.apetalus	1		1650	
		C.buchananii	+	9	B	1210-1970
		C.strictus	3	E	900-1340	
1	5	* Conium maculatum	-		450-470	
	5	Convolvulus verecundis	-			
		Coprosma cheesemanii	46	C	680-1600	
		C.ciliata	22	K	510-1220	
		C.colensoi	1		960	
	5	C.crassifolia	-			
		C.cuneata	2		660	
		C.depressa	2		670-950	
		C.linariifolia	1		630	
		C.microcarpa	0			
		C.parviflora	16	K	570-1300	
		C.aff.parviflora("taylori"sp."P")	12	K	510-1210	
2	3	C.petriei	-			
		C.propinqua	9	J	450-1010	
		C.pseudocuneata	15	L	570-1440	
		C.aff.pseudocuneata				
		("alpina"sp."A")	9	B	900-1690	
		C.pumila	55	C	900-1780	
		C.rhamnoides	1		750-1060	
		C.rigida	2		510-520	
	5	C.rotundifolia	-			
		C.rugosa	8	K	470-1230	
		C.aff.rugosa	+	0	1230	
		C.serrulata	1		850-1300	
		Coriaria angustissima	3	I	450-1190	
		C.plumosa	3	I	620-1120	
		C.sarmentosa	8	I	640-850	
		C.sarmentosa x plumosa	0		900-1000	
		Corokia cotoneaster	8	J	450-800	
	6	Cotula goyenii	-			
		C.pectinata	7	B	1270-1660	
		C.pectinata ssp.wilcoxii	+	1	1200-1730	
		C.pectinata ssp.villosa	2		1210-1490	
		C.squalida	2		1230-1470	
		Craspedia lanata	2		1180-1320	
		C.uniflora	11	F	780-1440	
	1	Crassula sinclairii	-		1060-1070	
	5	* Crataegus monogyna	-			
		* Crepis capillaris	8	J	470-1150	
	2	Cyathodes empetrifolia	-			
	1	5 C.juniperina	-		340-850	
		C.pumila	3	H	1050-1280	
	5	* Cytisus scoparius	-			
	3	Dichondra repens	-			
	5	* Digitalis purpurea	-			
		Discaria toumatou	10	J	450-1060	
		Dolichoglottis lyallii	40	C	800-1780	
		D.scorzoneroideis	1		1520	
		D.lyallii x scorzoneroideis	0			
		Donatia novae-zelandiae	1		1140-1260	
		Dracophyllum longifolium	41	D	510-1250	
		D.muscoides	11	B	1000-1680	
		D.prunum	13	B	620-1690	
		D.prostratum	13	H	1890-1620	

	D.uniflorum	93	D	680-1780
	Drapetes sp. ("bog")	6	A	
	D.dieffenbachii	45	D	680-1550
	D.aff.lyallii	0		1350-1720
	D.sp. ("western cushion")	0		
	D.villosus	14	B	960-1680
	Drosera arcturi	10	H	800-1440
	D.spathulata	1		1050
4	Elaeocarpus hookerianus	-		
	Epilobium alsinoides	53	D	470-1690
	E.brunnescens	7	H	480-1700
	E.brunnescens ssp.minutiflorum	2		990-1490
	E.chlorifolium	+ 22	C	700-1480
*	E.ciliolatum	1		490
	E.glabellum	5	E	1220-1520
1	E.komarovianum	-		480-1070
	E.macropus	1		980-1540
	E.matthewsii	0		
	E.melanocaulon	0		480-490
1	E.microphyllum	-		480-490
5	E.nummularifolium	-		
	E.pedunculare	0		
	E.pernitens	3	A	1060-1750
	E.pictum	2		490
	E.porphyrum	+ 4	E	1070-1780
	E.pubens	2		510-1030
	E.purpuratum	+ 0		1550-1680
	E.pychnostachyum	0		1010-1480
	E.rotundifolium	0		
	E.tasmanicum	5	A	1350-1980
	E.sp.	2		1350-1470
	Euphrasia petriei	10	B	1100-1720
	E.revoluta	4	E	1030-1700
	E.zelandica	16	G	900-1600
	Forstera sedifolia	15	F	780-1600
	F.tenella	7	H	890-1370
3 5	Fuchsia excorticata	-		
1 *	Galium aparine	-		610-620
	G.perpusillum	8	G	550-1380
	G.propinquum	2		510-520
	Gaultheria antipoda	2		700-830
	G.crassa	57	D	680-1780
	G.depressa	1		1210
	G.depressa var.novae-zelandiae	61	D	680-1720
	Gentiana amabilis	2		1000-1300
	G.bellidifolia	72	D	590-1940
2	G.corymbifera	-		
	G.divisa	+ 4	B	1420-1720
	G.montana	8	F	850-1390
	G.patula	0		620
3	G.tenericaulis	-		
	G.sp.	2		1250-1390
	Geranium microphyllum	44	G	470-1640
	G.sessiliflorum	4	I	550-1080
	Geum leiospermum	29	C	900-1520
	G.parviflorum	8	F	780-1780
	G.uniflorum	3	F	1000-1580
	Gingidia decipiens	1		630-1780
	G.montana	0		620-1330
	Gnaphalium audax	1		470-800

5	<i>G. collinum</i>	-			
1	<i>G. lanatum</i>	-			1140-1150
5	<i>G. limosum</i>	-			
3	<i>G. luteo-album</i>	-			
	<i>G. mackayi</i>	19	G		550-1640
3	<i>G. paludosum</i>	-			
5	<i>G. sphaericum</i>	-			
3	<i>G. traversii</i>	-			
3	<i>G. trinerve</i>	-			
	<i>G. sp.</i>	1			550
	<i>Gonocarpus aggregatus</i>	7	I		480-800
	<i>G. micranthus</i>	6	G		700-1210
	<i>Griselinia littoralis</i>	2			340-850
	<i>Gunnera monoica</i>	1			450-1010
	<i>Haastia sinclairii</i>	+	3	B	1410-1940
6	<i>Hebe biggarii</i>		0		
	<i>H. buechananii</i>		11	B	850-1780
	<i>H. cockayneana</i>	+	4	K	750-1100
→	<i>H. dilatata</i>	+	0		1320
	<i>H. epacridea</i>		0		1420-1620
	<i>H. hectori</i>	+	42	C	780-1680
	<i>H. odora</i>		53	D	450-1490
	<i>H. aff. odora</i>		7	G	720-1350
	<i>H. pauciramosa</i>		14	H	930-1440
	<i>H. petriei</i>	+	3	A	1100-1780
	<i>H. pinguifolia</i>	+	3	F	720-1370
	<i>H. propinqua</i>		19	D	620-1600
	<i>H. rakaiensis</i>	+	11	K	510-1050
	<i>H. salicifolia</i>		2		510-900
4	<i>H. subalpina</i>		-		
	<i>H. propinqua x hectori</i>		1		1050
	<i>H. sp.</i>		1		960-1050
	<i>Hectorella caespitosa</i>		7	B	1300-1780
5	<i>Helichrysum aggregatum</i>		-		
	<i>H. bellidioides</i>		74	D	480-1780
	<i>H. filicaule</i>		31	I	470-1120
	<i>H. selago</i>		0		900-1300
	<i>H. selago var. intermedium</i>		0		
*	<i>Hieracium pilosella</i>		1		550-670
	<i>Hoheria glabrata</i>		8	K	510-1050
5	<i>H. lyallii</i>		-		
5	<i>Hydrocotyle americana</i>		-		
	<i>H. heteromeria</i>		1		990
5	<i>H. moschata</i>		-		
	<i>H. novae-zelandiae</i>		15	G	470-1380
	<i>H. novae-zelandiae var. montana</i>		0		640-720
	<i>H. sulcata</i>		0		
	<i>Hymenanthera alpina</i>		19	K	470-1780
*	<i>Hypochoeris radicata</i>		70	D	470-1600
5	<i>Ileostylis macrantha</i>		-		
3	<i>Ischnocarpus novae-zelandiae</i>		-		
	<i>Kirkianella novae-zelandiae</i>		1		680
	<i>Lagenifera cuneata</i>		17	G	680-1500
	<i>L. petiolata</i>		0		480
3	<i>L. pumila</i>		-		
	<i>L. strangulata</i>		10	L	570-1060
1 2 4 5	<i>Leptospermum scoparium</i>		-		340-780
	<i>Leucogenes grandiceps</i>		16	F	700-1780
	<i>Leucopogon colensoi</i>		2		340-1220

	L.fraseri	18	I	470-1380
5 *	Leycesteria formosa	-		
5	Lilaeopsis sp.	-		
*	Linum catharticum	14	I	470-950
	Lobelia linnaeoides	14	F	900-1410
*	Lotus pedunculatus	6	G	480-1210
1 *	Matricaria matricarioides	-		450-470
	Mazus radicans	1		480-730
5	Melicope simplex	-		
5	Melicytis lanceolatus	-		
5	M.ramiflorus	-		
	Mentha cunninghamii	4	G	550-1120
5	Metrosideros umbellata	-		
	Microseris scapigera	2		900-1780
*	Mimulus moschatus	1		480
	Montia australasica	2		1060-1700
5	Muehlenbeckia australis	-		
	M.axillaris	19	F	470-1420
	M.complexa	5	K	480-1300
	Mycelis muralis <i>Myosotis ? cheesemanii</i>	2		570-1100
1 *	Myosotis discolor	-		480
	M.elderi <i>= Melaleuca / yellow of R. A. G. W.</i>	0		1470-1690
	M.macrantha	0		1050-1600
	M.pulvinaris	0		1420-1780
	M.pygmaea var.drucei	4	K	1210-1450
	M.pygmaea var.minutiflora	0		1080
1 *	M.tenericaulis	-		1150-1160
5	Myrsine australis	-		
	M.divaricata	1		
5	M.nummularia	32	C	710-1680
4	Neomyrtus pedunculata	-		
	Nertera balfouriana	1		1110
	N.ciliata	1		1060
2	N.depressa	-		
4	N.dichondraefolia	-		
	Nothofagus fusca	1		670-900
	N.menziesii	11	L	570-1100
	N.solandri var.cliffortioides	11	L	630-1100
	N.fusca x solandri var. cliffortioides	1		710
	Olearia arborescens	1		770-930
3	O.avicenniaefolia	-		
	O.hectori	0		
	O.ilicifolia	0		780
	O.moschata	7	K	870-1320
	O.nummularifolia	1		780-1060
	O.nummularifolia var.cymbifolia	8	K	680-1230
	O.odorata	1		930
	O.virgata var.lineata	2		330-750
	O.virgata var.rugosa	0		700-780
4	Oreomyrrhis andicola	-		
	O.colensoi	7	G	550-1270
	O.ramosa	19	K	510-1350
2	O.rigida	-		
3	Oreostylidium subulatum	-		
	Ourisia caespitosa	16	F	700-1600
	O.confertifolia	0		
	O.glandulosa	3	F	1050-1500
	O.sessilifolia	30	C	900-1800
	O.spathulata	16	B	1260-1720

	O.sessilifolia x glandulosa	+	0			
	Oxalis exilis		2			990-1210
	O.magellanica		5	G		730-1370
	Pachycladon novae-zelandiae		0			1430-1970
	Parahebe birleyi		0			1770-1980
	P.decora		0			630-670
	P.linifolia		0			1050
	P.lyallii		0			
	P.plano-petiolata	+	0			
6	P.trifida		-			
*	Parentucellia viscosa		1			480
5	Parsonsia capsularis		-			
5	P.heterophylla		-			
5	Pennantia corymbosa		-			
	Pentachondra pumila		13	H		720-1550
	Peraxilla colensoi		0			670
	P.tetrapetala		1			640
	Pernettya alpina		16	B		700-1680
1 2	P.macrostigma		-			340-780
	P.nana		1			1000
	Phyllachne colensoi		32	B		1000-1720
	Pimelea oreophila		30	D		550-1620
	P.poppelwellii		6	H		1030-1260
2	P.prostrata		-			
	P.pseudolyallii		21	B		680-1690
5	Pittosporum eugenoides		-			
	P.tenuifolium		3	L		340-690
1 *	Plantago lanceolata		-			480-490
	P.lanigera		5	F		1270-1510
1 *	P.major		-			450-470
	P.novae-zelandiae		13	G		800-1650
	P.triandra	+	3	H		1060-1150
	P.uniflora		13	G		950-1650
1 *	Polygonum aviculare		-			460
5 *	Populus sp.		-			
	Pratia angulata		17	G		720-1220
	P.macrodon		0			1420-1780
	* Prunella vulgaris		2			480-620
	Pseudopanax colensoi		9	L		510-1060
4 5	P.crassifolius		-			
	P.simplex		4	L		670-890
2 4 5	Pseudowintera colorata		-			
	Ranunculus buchananii	+	3	A		1130-1890
	R.cheesemanii		1			1060-1650
	R.crithmifolius		0			
	R.foliosus		2			990-1450
	R.glabrifolius		2	K		480-1590
	R.gracilipes		17	G		950-1440
	R.haastii ssp.piliferus	+	4	E		1080-1660
	R.lappaceus		14	G		480-1520
2	R.multiscapus		-			
	R.reflexus		6			490-1100
5 *	R.repens		-			
	R.sp.("Eyre Mountains")		0			1100-1900
	R.haastii ssp.piliferus x buchananii		1			1260
	Raoulia australis		0			720
	R.buchananii		18	B		900-1780
	R.glabra		10	I		550-1480
	R.grandiflora		23	B		1150-1780
1	R.haastii		-			480-490

	R.hectori	+	4	E	1210-1600
	R.hectori var.mollis		0		1500-1600
2	R.hookeri		-		
	R.parkii		1		1450
	R.subsericea		44	D	480-1600
	R.subulata		2		1540-1700
	R.tenuicaulis		1		470-1590
	R.youngii		0		1580
5	* Ribes grossularia		-		
	* Rosa rubiginosa		1		470-780
3	Rubus australis		-		
	R.cissoides		1		340-890
5	* R.fruticosus		-		
	R.schmidelioides		2		450-520
	* Rumex acetosella		23	G	470-1480
	* R.crispus		2		480
	R.flexuosus		1		480
1	* Sagina procumbens		-		480
5	* Salix fragilis		-		
5	* Sambucus nigra		-		
5	Scandia geniculata		-		
	Schizeilema haastii		6	E	900-1780
	S.haastii var.cyanopetalum		4	F	940-1680
	S.trifoliolatum		1		510-520
	Scleranthus biflorus		0		
1 2	S.brockiei		-		680-690
	S.uniflorus		9	G	550-1600
5	Senecio glomeratus		-		
2	S.quadridentatus		-		
	S.wairauensis		9	K	750-1130
5	Sophora microphylla		-		
	* Stellaria alsine		2		480-1070
	S.gracilentia		1		940
5	* S.media		-		
	S.parviflora		3	K	510-1080
	S.roughii	+	0		980-1520
	Taraxacum magellanicum		11	A	1030-1650
	* Trifolium dubium		3	J	480-490
5	* T.pratense		-		
	* T.repens		13	J	470-1210
5	* Ulex europaeus		-		
3 5	Urtica incisa		-		
	Utricularia monanthos		0		
1	* Verbascum thapsus		-		450-470
1	* V.virgatum		-		450-470
1	* Veronica serpyllifolia		-		1060-1070
	Viola cunninghamii		69	D	630-1600
	V.filicaulis		3	K	510-1060
2	Vittadinia australis		-		
	Wahlenbergia albomarginata		83	D	470-1600
3	W.gracilis		-		

Monocotyledons

	* Agrostis capillaris		25	I	450-1030
	A.muscosa		1		1150-1380

4	A.parviflora	-		
	A.subulata	17	B	900-1980
	A.sp.	2		1160-1340
1 5	* Aira caryophyllea	-		480-490
	* Anthoxanthum odoratum	54	D	450-1390
	Aporostylis bifolia	11	K	780-1150
5	Astelia fragrans	-		
	A.linearis	2		1160-1260
	A.nervosa	17	L	700-1480
	A.nivicola	15	C	1160-1490
	Bulbinella angustifolia	32	D	450-1380
	Carex acicularis	+	0	1420-1520
2	C.berggrenii	-		
2	C.breviculmis	-		
5	C.buchananii	-		
	C.coriacea	8	H	480-1150
	C.diandra	1		480
	C.dissita	+	1	1150
	C.echinata	+	3	H 930-1110
2	C.flaviformis	-		
5	C.forsteri	-		
	C.gaudichaudiana	3	H	1000-1750
	* C.ovalis	1		470-480
	C.pyrenaica var.cephalotes	7	A	12580-1800
	C.secta	1		470-480
	C.sinclairii	2		950-1120
	C.wakatipu	9	G	620-1600
	C.sp.	2		1350-1470
	Carpha alpina	9	H	1050-1440
	Chiloglottis cornuta	4	F	630-1050
	Chionochloa conspicua	1		570
	C.crassiuscula	31	C	950-1700
	C.macra	52	C	700-1940
	C.? pallens	+	0	1450
	C.rigida	96	D	510-1620
	C.rubra	6	H	680-1150
1	C.teretifolia	-		870-880
	C.macra x rigida	1		1470
	C.rigida x rubra	2		1110
3 5	Cordyline australis	-		
	Cortaderia richardii	0		360-470
5	Corybas macranthus	-		
2	C.orbiculatus	-		
	C.trilobus	5	L	660-890
	* Cynosurus cristatus	2		480
	* Dactylis glomerata	4	J	490-750
	Deschampsia novae-zelandiae	1		950-1070
	Deyeuxia avenoides	21	G	510-1690
	Dichelachne crinita	4	I	640-720
	Eleocharis acuta	1		470-480
	Elymus rectisetus	11	I	450-930
	Empodisma minus	1		890-1260
	Erythranthera pumila	0		1070-1380
	Festuca matthewsii	40	D	450-1380
1	F.multinodis	-		1270
	F.novae-zelandiae	10	I	550-1220
	F.rubra	7	J	470-1340
2	F.tenuifolia	-		

5	Gahnia procera	-		
2	Herpolirion novae-zelandiae	-		
	Hierochloe equisetata	+	5	F 1010-1450
	H.recurvata	+	29	C 870-1640
4	H.redolens	-		
	H.novae-zelandica	+	1	1150
*	Holcus lanatus		21	I 470-1150
	Isolepis aucklandica		2	930-1520
1	I.habra	-		470
	I.setacea		0	480
	Juncus antarcticus		1	460-1050
*	J.articulatus		2	470-480
1	* J.bufonius	-		450-470
*	J.effusus		2	470-480
1	J.gregiflorus	-		480
1 5	* J.novae-zelandiae	-		750-1000
5	J.sarophus	-		
	Koeleria cheesemanii		1	1410
	K.novo-zelandica		6	F 880-1600
	Lachnagrostis forsteri		3	F 1020-1220
	L.lyallii		3	D 900-1110
	L.sp.		1	480-1260
5	Libertia ixioides	-		
1	* Lolium perenne	-		450-470
	Luzula banksiana		3	F 870-1600
	L.colensoi		1	1450
	L.crinita var.petriana		26	B 900-1780
	L.leptophylla		1	480-950
5	L.migrata	-		
	L.picta var.limosa		1	1060
	L.pumila		13	L 1000-1830
	L.rufa		71	D 470-1690
	L.traversii		0	940-1300
	L.sp.		2	870-1240
	Marsippospermum gracile		12	A 1100-1700
4	Microlaena avenacea	-		
	M.colensoi		4	A 1100-1780
	Microtis unifolia		3	G 470-1140
	Oreobolus impar		4	B 1280-1680
	O.pectinatus		19	H 800-1380
	O.strictus		5	H 890-1470
*	Phleum pratense		2	470-480
	Phormium cookianum		11	K 700-1250
1	P.tenax	-		360-830
1	* Poa annua	-		450-470
	P.breviglumis		4	F 510-1470
	P.cita		1	470-490
	P.colensoi		124	D 510-1980
	P.incrassata		1	1060-1650
	P.kirkii	+	7	F 940-1600
	P.lindsayi		0	
5	P.matthewsii	-		
	P.novae-zelandiae		2	1380-1990

1	*	<i>P.pratensis</i>	-		610-620
		<i>P.subvestita</i>	0		1240-1300
	*	<i>P.trivialis</i>	1		470-480
		<i>P.sp.</i>	1		1470
		<i>Prasophyllum colensoi</i>	17	I	480-1320
		<i>Pterostylis areolata</i>	+	0	1050
5		<i>P.australis</i>	-		
		<i>P.banksii</i>	1		510-520
		<i>P.montana</i>	5	K	570-990
		<i>Rytidosperma buechananii</i>	+	1	620
		<i>R.gracile</i>	+	14	I 550-1010
		<i>R.setifolia</i>		30	D 470-1780
		<i>R.sp.</i>		1	630
4		<i>R.unarede</i>	-		
		<i>Schoenus pauciflorus</i>		46	C 730-1620
		<i>Thelymitra hatchii</i>		1	970
		<i>T.? pauciflora</i>		1	980
		<i>T.? pulchella</i>		0	
1		<i>T.longifolia</i>	-		620-960
		<i>T.sp.</i>		9	I 680-1110
2	3	<i>Trisetum antarcticum</i>	-		
1		<i>T.spicatum</i>	-		1620-1640
4		<i>T.youngii</i>	-		
		<i>Uncinia angustifolia</i>	+	1	1050
		<i>U.caespitosa</i>		16	F 1080-1510
		<i>U.clavata</i>	+	3	L 630-1150
		<i>U.divaricata</i>	+	8	F 950-1490
		<i>U.drucei</i>		0	
		<i>U.filiformis</i>		1	890
		<i>U.fuscovaginata</i>	+	24	C 980-1750
		<i>U.gracilentia</i>		0	630
		<i>U.purpurata</i>		2	730-1340
		<i>U.rubra</i>	+	3	H 470-1110
		<i>U.uncinata</i>		8	L 570-850
		<i>U.viridis</i>	+	5	H 890-1620
		<i>U.sp.</i>		3	F 1050-1480

APPENDIX

Table 2. Annotated Checklist of Fauna Recorded from the Eyre Ecological District. Note all records are for the period of the survey unless indicated otherwise.

1. Invertebrates

a. Lepidoptera

Hepialidae:

Aoraia sp. Jane Peak, 1500m (March)

This large species (wing span 7cm.) is known from forest and alpine grassland. Female brachypterous and unable to fly.

A new genus and species is known from moss-bogs on the southwestern boundary of the Eyre District. The orange adults emerge in April and are known from many areas of Southland and Otago.

Mnesarchaeoidae:

Mnesarchaea paracosma Meyrick Jane Peak, 1000m
One tiny adult in beech forest. Widespread. Larvae on liverworts.

Nepticulidae:

Stigmella oriastra Meyrick Slate Basin and Symmetry Peaks, 1600-1650m
A tiny grey species with larvae mining Celmisia leaves. Widespread.

Stigmella sp. Eyre Creek, 600m
Tiny species with larvae here mining Oleari hectori leaves. Widespread.

Psychidae:

Orophora unicolor (Butler) Way Spur, 1400m
A casemoth species that is found in many alpine areas. Female apterous.

Reductoderces sp. Slate Basin and Jane Peak, 1160-1250m
Case-larvae found on damp rock faces where the larvae feed on algae. The long green algae-covered cases are known from many alpine areas in Central Otago and coastal areas just north of Dunedin.

Glyphipterigidae:

Circia oxymachaera (Meyrick) Jane Peak and Slate Basin, 1100-1300m
An attractive diurnal species typical of alpine grasslands.

Choreutidae:

Asterivora barbigera (Meyrick) Symmetry Peaks and Slate Basin, 1200-1500m
Larvae feed under the tomentum of Celmisia leaves. Widespread.
Asterivora symbolaea (Meyrick) Way Spur, 1300m
Larvae feed on Celmisia densiflora leaves. Widespread diurnal species.

Elachistidae:

Elachista thallophora Meyrick Slate Basin, 1300m
Widespread small species, especially of wet grassland and bogs.

Yponomeutidae:

- Plutella sp. Slate Basin and Jane Peak, 1250-1300m
Westernmost record of an alpine Central Otago species. Larvae here bred from Cardamine uniflora.
- Protosynaema sp. Eyre Creek, 600m
Larvae found on Olearia hectori. Unique adult bred from O. odorata in Central Otago.

Tortricidae:

- Ascerodes prochlora Meyrick Slate Basin, 1000-1850m
A common Fiordland species of alpine herbfield, here reaching its eastern limit in northern Southland.
- Ericodesma melanosperma (Meyrick) Slate Basin, 800m
Widespread silver-coloured species of shrublands. Larvae feed on Dracophyllum longifolium.
- Eurythecta phaeoxyla Meyrick Jane Peak, 1250m
Bred from larvae found on Senecio wairauensis under damp rock-face. Widespread in low alpine areas.
- Epichorista hemionana (Meyrick) Jane Peak, 1200m
Typical of damp alpine grasslands.
- Epichorista siriana Meyrick Symmetry Peaks, 1500m
Widespread in alpine grasslands.
- Eurythecta curva Philpott Jane Peak, 1250m
Bred from Craspedia, Ourisia and Dolichoglottis. This is the easternmost record of a common Fiordland species. The female is brachypterous.
- Eurythecta sp. Symmetry Peaks, 1850m
A distinctive new species for high-alpine herbfield. Related species on The Remarkables.
- Gelophaula sp. Symmetry Peaks and Slate Basin, 1250-1600m
Inadequate material of this alpine genus to comment on its relationships. Larvae bore in Celmisia rosettes.
- Harmologa sanguinea (Philpott) Symmetry Peaks and Slate Basin, 1300-1500m
Widespread in alpine zone in Otago-Southland, with larvae on Hebe.

A new genus and species is known from moss-bogs on the south-western boundary of the Eyre District. The striped-winged adults are found in April and are locally common with brachypterous females. This is the only known locality for the species and is close to the Oreti River.

Oecophoridae:

- Hierodoris sp. Symmetry Peaks, 1550m
Attractive black and white species known from eastern Fiordland to alpine eastern Otago. Diurnal species.
- Proteodes carnifex (Butler) Jane Peak 650m
Common in beech forest and typical of this habitat.

Satyridae:

- Argyrophenga antipodum (Doubleday) Slate Basin, 1300m
Tussock butterfly is not common in alpine areas.
- Argyrophenga janitae Craw Slate Basin, Symmetry Peaks, Jane Peak and Way Spur, 1000-1500m. An uncommon tussock butterfly species, not found in Central Otago but mainly eastern South Island. Important new record.
- Pernodaimon merula (Hewitson) Slate Basin, Jane Peak and Symmetry Peaks, 1200-1860m
Black butterfly is common over scree and rocky areas.

Lycaenidae:

- Lycaena boldenarum White Way Spur and Slate Basin, to 1450m
Boulder copper butterfly occurs with its food plant Muehlenbeckia axillaris, into alpine areas.
- Lycaena salustius (Fabricius) Slate Basin, Jane Peak and Way Spur, to 1200m
Common copper butterfly frequents areas of Muehlenbeckia, the larval food plant.

Arctiidae:

- Metaerias huttoni (Butler) Slate Basin and Symmetry Peaks, 1500-1860m
This tiger moth species is common in alpine areas of the eastern and central South Island. The conspicuous hairy larvae are polyphagous. The fluffy buff-coloured females are brachypterous.

Noctuidae:

- Aletia cuneata Philpott Way Spur, 1500m
Attractive and widespread alpine species of herbfield areas.
- Aletia longstaffii (Howes) Way Spur, 1300m (March)
Adults bred from reddish larvae on Dracophyllum. Abundant alpine species in Otago alpine areas.
- Aletia virescens (Butler) Way Spur and Symmetry Peaks, 1500m
Large blue-grey species of lowland and alpine areas. Larvae have been bred from Blechnum.
- Graphania agorastis (Meyrick) Mt. Bee area
Widespread. Lowland to upland species of wetlands.
- Graphania mutans (Walker) Slate Basin, 1300m
Ubiquitous lowland species.
- Graphania nullifera (Walker) Jane Peak, to 1250m
Large dull-brown moth with larvae boring into root-stock of Aciphylla.
Widespread.
- Ichneutica cana Howes Way Spur and Slate Basin. 1300-1500m
Fine grey species that is found throughout Otago alpine areas and in Nelson Lakes area.
- Ichneutica ceraunias Meyrick Way Spur, 1500m
Another fine species, this one more widespread. Larvae on Chionochoa.
- Ichneutica n.sp. Slate Basin, 1300m
A distinct new species that fits neatly into the genus. The brachypterous female has recently been found on Mt. Tennyson to the east.

Geometridae:

- Aponotoreas anthracias (Meyrick) Slate Basin, Jane Peak, Way Spur and Symmetry Peaks, 1300-1500m
Diurnal grey and white species common in alpine areas with larvae feeding on Dracophyllum.
- Aponotoreas orphnaea (Meyrick) Slate Basin and Symmetry Peaks, 1500-1550m
This large sooty-black coloured species is found in alpine areas of Otago and Southland and is dayflying.
- Asaphodes declarata (Prout) Jane Peak, 1250m
A Central Otago species that is commonest around Lake Wakatipu.
- Asaphodes omichlias (Meyrick) Jane Peak, 1250m
Common down the main divide in alpine areas, occurring east to the Garvie Mountains. Diurnal around shady rock faces.

- saphodes periphaea (Meyrick) Slate Basin and Jane Peak, 1250-1300m
A rare species that occurs only in the alpine areas north and south of Lake Wakatipu. The dull brown males can be locally common, as they were here, usually around shady bluffs. The female was found for the first time and has extremely abbreviated wings, quite unable to fly.
- saphodes sericodes (Meyrick) Symmetry Peaks, 1160m
This pale species is common around wetland areas in many low-alpine areas of Otago.
- ustrocidaria cedrinodes (Meyrick) Slate Basin, 1300m
Widespread in lowland to upland areas with larvae feeding on Coprosma.
- chloroclystis nereis (Meyrick) Slate Basin, Jane Peak and Symmetry Peaks, 1100-1500m
Diurnal grey-green species with larvae feeding in Celmisia flower heads. Widespread.
- leclana glacialis Hudson Slate Basin, 1100m
This pretty orange species is swift-flying and typical of western-alpine shrublands. Larvae on Dracophyllum.
- asyuris anceps (Butler) Slate Basin, Jane Peak, Way Spur and Symmetry Peaks, 1300-1550m. This is a genus of attractive strong flyers that fly by day and have larvae on Aciphylla or Anisotome. This species is common and widespread.
- asyuris austrina Philpott Slate Basin, Jane Peak and Symmetry Peaks, 1200-1860m
A widespread alpine species that often rests on warm rock surfaces and takes off rapidly.
- asyuris hectori (Butler) Symmetry Peaks, 1650-1860m
A magnificent black and white moth that occurs down the main divide and east in this area to the Remarkables.
- asyuris partheniata Guenee Symmetry Peaks, 1500-1550m
This impressive orange species is widespread from lowland to alpine habitats but is replaced by another species down the main divide to Fiordland.
- elastia frigida (Howes) Slate Basin, 1250m
This is the only female of the species and only the second of the species. Bred from larvae on Cheesemania wallii on rock face. Type found at Homer Tunnel in 1940 s.
- elastia semifissata (Walker) Symmetry Peaks, 1200m
Widespread lowland species that occurs as an alpine insect in Fiordland and here. Larvae feed on Cardamine.
- Hydriomena hemizona (Meyrick) Jane Peak, 1250m
Found in beech forest, more common in eastern areas.
- lotoreas chioneres Prout Symmetry Peaks, 1550-1860m
Pretty yellow and black diurnal species that is typical of Central Otago alpine areas. Larvae on Drapetes.
- lotoreas isomoera Prout Slate Basin and Symmetry Peaks, 1500-1550m
An attractive striped orange and dark brown species that is widespread in alpine areas of Otago and Southland except most of Fiordland. Larvae feed on Drapetes species. Diurnal.
- lotoreas ortholeuca Hudson Symmetry Peaks, 1600-1870m
A small diurnal black and white moth with larvae feeding on cushion Drapetes species. Occurs from the Lake Wakatipu mountains eastwards.
- aranotoreas brephosata (Walker) Way Spur and Symmetry Peaks, 1350-1550m
Widespread Orange Under-wing moth, larvae feed on Epilobium.
- aranotoreas zopyra (Meyrick) Slate Basin and Jane Peak, 800-1100m
A montane to low alpine Orange Under-wing moth, also widespread. Larvae feed on Helichrysum bellidioides.
- asiphila humilis (Philpott) Way Spur, 1300m
A widespread but uncommon species of southern New Zealand. Larvae feed on Dracophyllum flowers.
- asiphila magnimaculata (Philpott) Jane Peak, 1250m
An attractive species of southern upland areas.

- Pasiphila rubella (Philpott) Mt. Bee area.
Widespread in Otago with larvae on Ilebe spp.
- Sestra flexata (Walker) Jane Peak, 1250m
Widespread lowland species that has been found in some western alpine areas.
Occurred under shady bluffs where the larvae feed on fern species.

Pyrallidae:

- Eudonia cyptastis (Meyrick) Slate Basin, 1300m
Common southern alpine species.
- Eudonia paltomacha (Meyrick) Slate Basin and Way Spur, 1300-1450m
Common southern wetland species.
- Eudonia psammitis (Meyrick) Jane Peak and Slate Basin, 1400-1450m
Ubiquitous species, lowland open areas to alpine snowbanks.
- Eudonia trivirgata (Felder & Rogenhofer) Way Spur, 1300m
Common species from lowland to alpine open areas.
- Glaucobaris epiphaea (Meyrick) Way Spur, 1300m
This species is typical of wet banks.
- Glaucobaris helioctypa Meyrick Symmetry Peaks, 1200m
Common diurnal species of wetlands.
- Mnesictena flavidalis (Doubleday) Jane Peak, 1000-1100m
Ubiquitous species of lowland forest margins.
- Musotina nitidalis (Walker) Jane Peak and Slate Basin, 1400-1450m
Mainly lowland species of forest glades.
- Orocrambus catacaustus (Meyrick) Symmetry Peaks and Jane Peak, 1160-1200m
A neatly marked and widespread species of Oreobolus cushion-bogs.
- Orocrambus cultus Philpott Symmetry Peaks, Slate Basin and Jane Peak, 1500-1860m
Distinctive diurnal high alpine species discovered on Cecil Peak,
rediscovered recently on Old Man Range and Garvie Mountains.
- Orocrambus dicrenellus (Meyrick) Symmetry Peaks, 1450-1800m
Large widespread species of alpine Chionochoila slopes.
- Orocrambus melampetrus Purdie Slate Basin and Symmetry Peaks, 1500-1860m
Black, fast-flying high-alpine species common in bare rocky areas of the
South Island. Diurnal.
- Orocrambus paraxenus (Meyrick) Symmetry Peaks, 1600m
Widespread in alpine grassland around Lake Wakatipu.
- Orocrambus philpottii Gaskin Symmetry Peaks, 1160m
Wet grassland species, common in eastern alpine areas of the South Island.
- Scoparia claranota Howes Slate Basin and Symmetry Peaks, 1000-1550m
Neatly marked alpine species found on many southern mountains.
- Scoparia clavata Philpott Jane Peak, 1250m
This species is found only in Fiordland, Longwood Range, Mt. Anglem (Stewart Island)
and here. Attractive nocturnal species of alpine shrubland.
- Scoparia ergatis Meyrick Slate Basin, 1200m
Widespread diurnal species.
- Scoparia nomeutis (Meyrick) Slate Basin and Symmetry Peaks, 1300-1600m
Common alpine diurnal species.
- Scoparia siderapsis Meyrick Slate Basin and Symmetry Peaks, 1300-1860m
Attractive diurnal species, widespread in scree or bare alpine areas.
- Scoparia subita (Philpott) Jane Peak, 1150m
Easternmost record in Otago which is common in Fiordland in damp grassland areas.
- Scoparia sp. Symmetry Peaks, 1550m
An undescribed but known species found on many alpine areas from the
Takitimus through to Central Otago.
- Scoparia sp. Symmetry Peaks, 1700-1860m
Westernmost record of a high-alpine Central Otago snow-bank species.

Tauroscopa gorgopis Meyrick Symmetry Peaks, 1600m
This sooty-black species delights to fly in the sunshine over bare rocky alpine areas. Common from Central Otago to Northwest Nelson.

Tauroscopa trapezitidis Meyrick Symmetry Peaks and Slate Basin, 1400-1860m
Similar to the last species but much less widely distributed.

Tawhitia glaucophanes (Meyrick) Symmetry Peaks, 1600m
A diurnal, blue-grey and widespread alpine species.

b. Hemiptera

Cicadidae:

Maoricicada nigra frigida Dugdale & Fleming Slate Basin, Jane Peak and Symmetry Peaks, 1300-1750m

A high-alpine species of western Central Otago.

Maoricicada otagoensis otagoensis Dugdale & Fleming Slate Basin, Symmetry Peaks, Hummock Peak and Jane Peak, 1200-1680

Alpine black species of central and western Otago. Some Symmetry Peaks examples closely approach subspecies maceweni from the Takitimus.

c. Orthoptera

Acrididae:

Alpinacris tumidicauda Bigelow Slate Basin, Jane Peak and Symmetry Peaks, 1180-1500m
A Central Otago species that occurs west to eastern Fiordland. Low to high-alpine snowbanks.

Paprides dugdali Bigelow
Will be present in valley floor wetland areas and montane grassland as occurs on Snowdon Peak and in Dunton bog to the west. Mainly a southeastern species.

Phaulacridium marginale (Walker)
Will be present in a range of lowland ecosystems as it occurs near Lake Mavora to the west and is widespread to the east, south and north.

Sigaüs australis (Hutton) Symmetry Peaks, 1830m
Widespread species, not common here.

Sigaüs campestris (Hutton) Jane Peak and Symmetry Peaks, 1160-1480
Widespread southern species except in western areas. Generally low-alpine.

Sigaüs obelisci Bigelow Jane Peak, Slate Basin and Symmetry Peaks, 1300-1850m
Circum alpine Lake Wakatipu species that occurs west to eastern Fiordland. Adults covered with short pale hairs. Usually high-alpine rocky areas.

d. Coleoptera (Identified by B.I.P. Barratt)

Altitude (m) Remarks

Eyre Creek:

Lucanidae:

Ceratognathus foveolatus Broun 640 near shrubs on boulderslide

Little Jungle-Jane Peak:

Carabidae:

<u>Actenonyx bembidioides</u> White	1200-1350	lake edge cushion
<u>Neocicindela parryi</u> (White)	1200-1350	scree
<u>Notagonum feredayi</u> (Bates)	1200-1350	gravel at tarn edge

Dytiscidae:

<u>Liodessus deflectus</u> Ordish	1200-1350	in tarn
<u>Rhantus pulverosus</u> (Stevens)	1200-1350	in tarn

Byrrhidae: Byrrhid sp. 6	1200-1350	scree herbfield
Elateridae: <u>Elatichrosis castanea</u> (Broun)	1200-1350	tussock herbfield
Languriidae: Languriid sp. 1	1200-1350	beaten from <u>Brachyglottis bellidioides</u>
Coccinellidae: <u>Coccinella punctata</u> L.	1200-1350	tussock herbfield
Oedemeridae: <u>Selenopalpus aciphyllae</u> Broun	1200-1350	tussock herbfield
Chrysomelidae: <u>Adoxia</u> sp. 6	1200-1350	beaten from <u>Brachyglottis cassinioides</u>
Curculionidae: <u>Irenimus</u> sp. 20 <u>Liparogetus</u> sp. 1	1200-1350 1600	beaten from <u>Hebe odora</u> herbfield herbfield
Slate Basin (Eyre Creek): Carabidae: <u>Scopodes prasinus</u> Bates <u>Demetrida sinuata</u> Broun	1350-1500 1350-1500	herbfield herbfield
Scarabaeidae: <u>Pyronota punctata</u> Given <u>Pyronota festiva</u> (F.)	1350-1500 1350-1500	herbfield herbfield
Melyridae: <u>Acantharthrus</u> sp. nr. <u>planifrons</u> (Broun)	1350-1500	on <u>Celmisia verbascifolia</u>
Tenebrionidae: <u>Pheloneis</u> sp. 4	1350-1500	herbfield
Chrysomelidae: <u>Adoxia</u> sp. 7 <u>Eugnomis dispar</u> (Broun) <u>Rhopalomerus</u> sp. 5 <u>Peristoreus</u> sp. 9 <u>Liparogetus sulcatissimus</u> Broun <u>Liparogetus</u> sp. 1	1350-1500 1350-1500 1350-1500 1350-1500 1350-1500 1350-1500	on <u>Celmisia philocremna</u> on <u>Celmisia verbascifolia</u> and <u>C. semicordata</u> on <u>Celmisia verbascifolia</u> and <u>C. semicordata</u> on <u>Celmisia verbascifolia</u> and <u>C. semicordata</u> herbfield on <u>Celmisia verbascifolia</u>
Symmetry Peaks: Carabidae: <u>Migadopine</u> sp. 6 <u>Mecodema ?lucidum</u> Cast.	1600 1600	herbfield herbfield

Scarabaeidae:		
<u>Scythrodes squalidus</u> Broun	1750-1860	scree herbfield
<u>Pyronota festiva</u> (F.)	1750-1860	scree herbfield
<u>Pyronota ?laeta</u> (F.)	1700	scree herbfield
Byrrhidae:		
<u>Pedilophorus lewisi</u> Broun	1700-1860	herbfield
Byrrhid sp. 19	1600	herbfield
Chrysomelidae:		
<u>Allocharis</u> sp. 11	1600-1860	scree herbfield
Curculionidae:		
<u>Anagotus latirostris</u> (Broun)	1750-1860	herbfield
<u>Liparogetus sulcatissimus</u> (Broun)	1600	herbfield
<u>Irenimus</u> sp. 16	1750-1860	herbfield
? <u>Ancistropterus</u> sp. 1	1750-1860	on <u>Hebe odora</u>
<u>Lyperobius spedenii</u> Broun	1750-1860	on <u>Aciphylla lecomtei</u> , <u>A. spedenii</u> and <u>A. simplex</u>
<u>Lyperobius hudsoni</u> Broun	1750-1860	on <u>Aciphylla spedenii</u> and <u>A. simplex</u>
Way Spur:		
Carabidae:		
<u>Neoferonia ?procerula</u> (Broun)	1250-1350	tussock herbfield
Staphylinidae:		
<u>Aleocharine</u> sp. 16	1400	on <u>Hebe buechanani</u>
Scarabaeidae:		
<u>Pyronota punctata</u> Given	1250-1400	tussock herbfield
<u>Sericospilus advena</u> Sharp	650	dead outside hut; near beech forest
<u>Scythrodes squalidus</u> Broun	1250-1350	tussock herbfield
Elateridae:		
<u>Elatichrosis castanea</u> (Broun)	1150	on <u>Oreobolus</u> flush
Oedemeridae:		
<u>Selenopalpus aciphyllae</u> Broun	1400	on <u>Hebe buechananii</u>
Inopeplidae:		
<u>Diagrypnodes wakefieldi</u> Waterhouse	650	in hut
Cerambycidae:		
? <u>Mesolamia</u> sp. 1	1250-1350	on <u>Hebe propinqua</u>
Chrysomelidae:		
<u>Adoxia</u> sp. 7	1400	on <u>Aciphylla lecomtei</u>
<u>Adoxia</u> sp. 4	1250-1350	tussock herbfield
Curculionidae:		
<u>Anagotis latirostris</u> (Broun)	1250-1350	tussock herbfield
<u>Anagotis lewisi</u> (gp.) (Broun)	1400	dead in tussock herbfield
? <u>Ancistropterus</u> sp. 1	1400	on <u>Hebe odora</u>

<u>Eugnomine</u> sp. 6	1400	on <u>Brachyglottis revoluta</u>
<u>Eugnomis dispar</u> (Broun)	1400-1500	on <u>Celmisia verbascifolia</u> , <u>Hebe odora</u> , <u>Aciphylla lecomtei</u>
<u>Liparogetus</u> sp. 1	1250-1400	on <u>Phyllachne colensoi</u> , <u>Hebe odora</u> and <u>Aciphylla lecomtei</u>
<u>Lyperobius spedenii</u> Broun	1400	on <u>Aciphylla lecomtei</u>
<u>Peristorius</u> sp. 9	1500	on <u>Celmisia verbascifolia</u>
<u>Rhopalomerus</u> sp. 5	1400	on <u>Hebe odora</u>

Checklist of other insects and invertebrates (identified by P.M.Johns)

	Altitude (m)	Location
Diplopoda		
Cambalidae:		
<u>Eumastigonus</u> ?n. sp.	1400	Way Spur
Sphaerotheriidae:		
<u>Procyliosoma leiosomum</u> (Hutton)	1350-1500	Slate Basin
Blattodea		
Blattidae (cockroaches):		
<u>Celatoblatta quinque maculata</u>	1400	Way Spur
Orthoptera		
Rhaphidophoridae (cave/scree wetas):		
<u>Pharmacus</u> n. sp. A	1400	Way Spur
Stenopelmatidae (burrowing wetas):		
<u>Hemiandrus focalis</u>	1400	Way Spur
	1350-1500	Slate Basin
Diptera (flies)		
Tipulidae (crane flies):		
<u>Cerezodia</u> sp. aff. <u>pulverulenta</u>	1400	Way Spur
	1350-1500	Slate Basin
<u>Leptotarsus</u> (<u>Macromastix</u>) sp. aff. <u>montana</u>	1400	Way Spur

APPENDIX:

TABLE 2 (Continued)

Bird List.									
In systematic order (after Bull et al. 1985)									
Species.	Occurrence	Habitat.	Catchments.*						
Black Shag	common	riverbed	Rob	Mat	Eyre	Crom	Gorg	PPP	
White-faced Heron	common	riverbed pasture	Rob	Mat	Eyre			PPP	
Paradise Shelduck	common	forest riverbed pasture	Rob	Mat	Eyre		Gorg	PPP	
Grey Duck	rare	riverbed	Rob	Mat				PPP	
Mallard	some	riverbed	Rob	Mat				PPP	
Harrier	common	riverbed pasture tussock	Rob	Mat	Eyre	Crom	Gorg	PPP	
N.Z. Falcon	common	forest scrub tussock	Rob	Mat	Eyre	Crom	Gorg	PPP	
Pukeko	rare	riverbed		Mat					
S.I. Pied -									
Oystercatcher	common	riverbed pasture	Rob	Mat	Eyre				
Spur winged -									
Plover	common	riverbed pasture	Rob	Mat	Eyre				
Banded Dotterel	some	riverbed		Mat	Eyre				
Pied Stilt	some	riverbed		Mat	Eyre				
Black-billed Gull	common	riverbed pasture	Rob	Mat	Eyre				
Black-backed Gull	common	riverbed pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Black-fronted Tern	common	riverbed pasture	Rob	Mat	Eyre				
Feral Pigeon	some	riverbed pasture		Mat	Eyre				
Kea	rare	forest scrub tussock	alpine	Mat				PPP	
Parakeet	rare	forest scrub			Eyre	Crom	Gorg	PPP	
L.T. Cuckoo	common	forest	Rob	Mat	Eyre	Crom	Gorg	PPP	
Shining Cuckoo	rare	forest			Eyre				
Morepork	some	forest		Mat	Eyre			PPP	
Rifleman	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Rock Wren	rare	alpine	Rob	Mat	Eyre			PPP	
Skylark	common	pasture tussock	Rob	Mat	Eyre		Gorg	PPP	
Swallow	rare	riverbed		Mat	Eyre				
Fantail	some	riverbed scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Y.B. Tit	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Robin	rare	forest scrub			Eyre	Crom	Gorg	PPP	
Brown Creeper	some	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Grey Warbler	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Thrush	common	forest scrub pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Blackbird	common	forest scrub pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Dunnoek	common	forest scrub pasture tussock	Rob	Mat	Eyre	Crom	Gorg	PPP	
Pipit	some	riverbed alpine	Rob	Mat	Eyre	Crom	Gorg	PPP	
Bellbird	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Silvereye	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Greenfinch	common	pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Goldfinch	common	pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Redpoll	common	forest scrub pasture tussock	Rob	Mat	Eyre	Crom	Gorg	PPP	
Chaffinch	common	forest scrub	Rob	Mat	Eyre	Crom	Gorg	PPP	
Yellowhammer	common	scrub pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Sparrow	some	pasture		Mat	Eyre				
Starling	common	riverbed pasture	Rob	Mat	Eyre	Crom	Gorg	PPP	
Magpie	some	pasture		Mat	Eyre				

*The full names of the abbreviations in order are:
 Robert Ck; Mataura R; Eyre Ck; Cromel Stm; Gorge Burn.
 PPP means that the species is in the Priority Place for Protection.

Bull et al. (1985) covered only the peripheral squares. The following additional species were recorded on this survey; shining cuckoo, grey duck, kea, magpie, morepork, parakeet, feral pigeon, swallow, and rock wren. Most additions reflect the greater time spent in the more remote areas. However the magpie, feral pigeon and swallow are new arrivals that have spread recently.

