

# ECOLOGICAL REGIONS AND DISTRICTS OF NEW ZEALAND

THIRD REVISED EDITION IN FOUR 1:500 000 MAPS

Booklet to accompany SHEET 3:  
descriptions of Districts in central  
New Zealand, from Eastern Wairarapa  
to Akaroa; also Chathams, not shown  
on map.

Editor W. Mary McEwen  
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ABSTRACT

New Zealand's 268 ecological districts in 85 ecological regions are listed and an introduction describes the concept, definitions, the districts shown on each of the four map sheets, the format and content of the prescriptions (printed on the maps), descriptions of each district and acknowledgements to the large number of contributors of scientific information. A glossary defines certain words and abbreviations used in the text and lists common plant and animal names used, together with their scientific names. Ecological descriptions of the districts shown on each map sheet are given in the booklet accompanying that sheet.

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Eastern Hawkes Bay -- Part 3. Booklet to accompany sheet 3  
descriptions of districts in central New Zealand, from Eastern  
Wairarapa to Akaroa, also Chathams not shown on map -- Part 4.  
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LIST OF ECOLOGICAL REGIONS AND DISTRICTS OF NEW ZEALAND  
AND THEIR CODE NUMBERS  
DECEMBER 1986

<u>Region</u>	<u>District</u>	<u>Code</u>
KERMADEC	Kermadec	01.01
THREE KINGS	Three Kings	02.01
TE PAKI	Te Paki	03.01
AUPOURI	Aupouri	04.01
WESTERN NORTHLAND	Maungataniwha	05.01
	Hokianga	05.02
	Tutamoe	05.03
	Tangihua	05.04
EASTERN NORTHLAND	Eastern Northland and Islands	06.01
	Taranga	06.02
POOR KNIGHTS	Poor Knights	07.01
KAIPARA	Kaipara	08.01
AUCKLAND	Rodney	09.01
	Waitakere	09.02
	Tamaki	09.03
	Rangitoto	09.04
	Inner Gulf Islands	09.05
	Awhitu	09.06
	Manukau	09.07
	Hunua	09.08
COROMANDEL	Little Barrier	10.01
	Great Barrier	10.02
	Colville	10.03
	Mercury Islands	10.04
	Thames	10.05
	Tairua	10.06
	Waihi	10.07
	Te Aroha	10.08
	Mayor	10.09
WAIKATO	Meremere	11.01
	Hapuakohe	11.02
	Hauraki	11.03
	Hamilton	11.04
	Hinuera	11.05
	Maungatautari	11.06
	Waipa	11.07
TAINUI	Raglan	12.01
	Kawhia	12.02
	Herangi	12.03

NORTHERN VOLCANIC PLATEAU	Motiti	13.01
	Tauranga	13.02
	Otanewainuku	13.03
	Rotorua	13.04
	White Island	13.05
WHAKATANE	Te Teko	14.01
	Taneatua	14.02
	Opotiki	14.03
WESTERN VOLCANIC PLATEAU	Ranginui	15.01
	Pureora	15.02
	Tokoroa	15.03
CENTRAL VOLCANIC PLATEAU	Atiamuri	16.01
	Taupo	16.02
EASTERN VOLCANIC PLATEAU	Kaingaroa	17.01
	Whirinaki	17.02
TONGARIRO	Tongariro	18.01
RAUKUMARA	Waioeke	19.01
	Motu	19.02
EAST CAPE	Pukeamaru	20.01
	Waiapu	20.02
	Turanga	20.03
UREWERA	Waimana	21.01
	Ikawhenua	21.02
	Waikaremoana	21.03
WAIROA	Tiniroto	22.01
	Mahia	22.02
	Waihua	22.03
KING COUNTRY	Waitomo	23.01
	Taumarunui	23.02
TARANAKI	North Taranaki	24.01
	Matemateaonga	24.02
EGMONT	Egmont	25.01
MOAWHANGO	Moawhango	26.01
KAIMANAWA	Kaimanawa	27.01
RUAHINE	Ruahine	28.01
HAWKES BAY	Maungaharuru	29.01
	Heretaunga	29.02
RANGITIKEI	Rangitikei	30.01
MANAWATU	Manawatu Plains	31.01
	Foxton	31.02

MANAWATU GORGE	Manawatu Gorge North	32.01
	Manawatu Gorge South	32.02
PAHIATUA	Woodville	33.01
	Puketoi	33.02
EASTERN HAWKES BAY	Eastern Hawkes Bay	34.01
EASTERN WAIRARAPA	Eastern Wairarapa	35.01
WAIRARAPA PLAINS	Wairarapa Plains	36.01
AORANGI	Aorangi	37.01
TARARUA	Tararua	38.01
SOUNDS-WELLINGTON	Wellington	39.01
	Cook Strait	39.02
	Sounds	39.03
	D'Urville	39.04
RICHMOND	Pelorus	40.01
	Para	40.02
	Fishtail	40.03
WAIRAU	Blenheim	41.01
	Wither Hills	41.02
	Grassmere	41.03
	Flaxbourne	41.04
	Hillersden	41.05
INLAND MARLBOROUGH	Waihopai	42.01
	Medway	42.02
	Bounds	42.03
	George	42.04
MOLESWORTH	Sedgemere	43.01
	Balaclava	43.02
	Miromiro	43.03
CLARENCE	Tapuaenuku	44.01
	Dillon	44.02
	Manakau	44.03
KAIKOURA	Kekerengu	45.01
	Aniseed	45.02
	Kowhai	45.03

NORTH-WEST NELSON	West Whanganui	46.01
	Wakamarama	46.02
	Golden Bay	46.03
	Totaranui	46.04
	Heaphy	46.05
	Wangapeka	46.06
	Arthur	46.07
	Karamea	46.08
	Matiri	46.09
NELSON	Motueka	47.01
	Moutere	47.02
	Bryant	47.03
	Red Hills	47.04
NORTH WESTLAND	Ngakawau	48.01
	Foulwind	48.02
	Buller	48.03
	Reefton	48.04
	Punakaiki	48.05
	Maimai	48.06
	Totara Flat	48.07
	Blackball	48.08
	Hochstetter	48.09
	Greymouth	48.10
	Brunner	48.11
SPENSER	Rotoroa	49.01
	Travers	49.02
	Ella	49.03
	Lewis	49.04
	Hope	49.05
WHATAROA	Hokitika	50.01
	Whitcombe	50.02
	Harihari	50.03
	Wilberg	50.04
	Waiho	50.05
	Glaciers	50.06
	Karangarua	50.07
	Mahitahi	50.08
ASPIRING	Paringa	51.01
	Mataketake	51.02
	Landsborough	51.03
	Haast	51.04
	Okuru	51.05
	Arawata	51.06
	Dart	51.07
LOWRY	Hundalee	52.01
	Leslie	52.02
	Culverden	52.03
	Waiau	52.04
	Cheviot	52.05
	Motunau	52.06
	Waikari	52.07

HAWDON	Minchin	53.01
	Arthur's Pass	53.02
PUKETERAKI	Sumner	54.01
	Poulter	54.02
	Cass	54.03
	Torlesse	54.04
	Craigieburn	54.05
	Coleridge	54.06
CANTERBURY FOOTHILLS	Ashley	55.01
	Oxford	55.02
	Whitecliffs	55.03
CANTERBURY PLAINS	High Plains	56.01
	Low Plains	56.02
	Ellesmere	56.03
BANKS	Port Hills	57.01
	Herbert	57.02
	Akaroa	57.03
D'ARCHIAC	Browning	58.01
	Armoury	58.02
	Mt Cook	58.03
HERON	Mathias	59.01
	Mt Mutt	59.02
	Arrowsmith	59.03
	Hakatere	59.04
	Two Thumb	59.05
TASMAN	Godley	60.01
	Dobson	60.02
PAREORA	Orari	61.01
	Fairlie	61.02
	Geraldine	61.03
	Hunters	61.04
	Waimate	61.05
	Hakataramea	61.06
WAINONO	Makikihi	62.01
	Glenavy	62.02
	Oamaru	62.03
MACKENZIE	Tekapo	63.01
	Pukaki	63.02
	Ben Ohau	63.03
	Grampians	63.04
	Ahuriri	63.05
	Omarama	63.06
	Benmore	63.07
WAITAKI	Kirkliston	64.01
	St Mary	64.02
	Hawkdun	64.03
	St Bathans	64.04

KAKANUI	Duntroon	65.01
	Dansey	65.02
	Waianakarua	65.03
LAKES	Huxley	66.01
	Wanaka	66.02
	Richardson	66.03
	Shotover	66.04
	Remarkables	66.05
CENTRAL OTAGO	Lindis	67.01
	Pisa	67.02
	Dunstan	67.03
	Maniototo	67.04
	Old Man	67.05
	Manorburn	67.06
	Rock and Pillar	67.07
LAMMERLAW	Macraes	68.01
	Waipori	68.02
	Tapanui	68.03
	Lawrence	68.04
OTAGO COAST	Waikouaiti	69.01
	Dunedin	69.02
	Tokomairiro	69.03
	Balclutha	69.04
CATLINS	Waipahi	70.01
	Tahakopa	70.02
OLIVINE	Cascade	71.01
	Pyke	71.02
FIORD	Darran	72.01
	Doubtful	72.02
	Te Anau	72.03
	Preservation	72.04
MAVORA	Livingstone	73.01
	Eyre	73.02
	Upukerora	73.03
WAIKAIA	Nokomai	74.01
	Umbrella	74.02
GORE	Gore	75.01
SOUTHLAND HILLS	Takitimu	76.01
	Taringatura	76.02
	Hokonui	76.03
TE WAE WAE	Waitutu	77.01
	Tuatapere	77.02
	Longwood	77.03
MAKAREWA	Southland Plains	78.01
	Waituna	78.02

RAKIURA	Foveaux	79.01
	Anglem	79.02
	Freshwater	79.03
	Mt Allen	79.04
	Solanders	79.05
	Snares	79.06
CHATHAMS	Chathams	80.01
BOUNTY	Bounty	81.01
ANTIPODES	Antipodes	82.01
AUCKLAND ISLANDS	Auckland Islands	83.01
CAMPBELL	Campbell	84.01
MACQUARIE	Macquarie	85.01

## INTRODUCTION

"A sense of identity or place develops where an individual grows up within a particular province and learns to recognise its flora and fauna, to respond to its climatic regime, to become familiar with its limits. Many serious land use blunders could have been avoided if people had not tried to transplant land-use practices developed within one biotic province to the differing ecological conditions of another."

Raymond Dasmann, 1976, Biogeographical Provinces, Understanding Whole Systems; the Co Evolution Quarterly.

### Background

New Zealand's physical environment is extremely diverse and this diversity is reflected in the indigenous plant and animal communities (ecosystems). The concept of dividing New Zealand into a series of Ecological Regions and Districts evolved because of the need for the establishment of a representative system of reserves which would encompass this ecological diversity. One purpose of the Reserves Act 1977, is to ensure the

"preservation of representative samples of all classes of natural ecosystems and landscapes which in the aggregate originally gave New Zealand its own recognisable character."

(Section 3(1) (b))

Before this could be done a framework on which to define representativeness was necessary. In the late 1970s Mr John Nicholls, then forest ecologist with the New Zealand Forest Research Institute, Rotorua, pioneered the idea of ecological districts grouped within an ecological region. He proposed the division of a large area in North Westland (defined as the NORTH WESTLAND Ecological Region) into eleven smaller parts (Ecological Districts) as a framework for the selection of forest reserves (Ecological Areas) by the Scientific Co-ordinating Committee. Each ecological district is a unique unit with its own distinctive general pattern of ecosystems and special features. Together they form an ecological region with its own broad ecological character, differing in many ways from those of its neighbouring regions.

### Definitions

Ecological District:

The definition of an ecological district depends on a thorough consideration of the topography, geology, climate, soils, vegetation and man-induced modifications of the area (Nicholls, 1979). Thus an ecological district is a local part of New Zealand where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities (Park et al., 1983).

Ecological Region:

An aggregation of adjacent ecological districts with very closely related characteristics together form an ecological region. In some cases, a single very distinctive ecological district is given the status of ecological region to emphasise its uniqueness (Park et al., 1983).

## The Biological Resources Centre and the Ecological Regions and Districts Project

The concept of ecological regions and districts was embraced by the New Zealand Biological Resources Centre which co-ordinated the mapping of the country into over 260 districts in 1982. Many different scientists were involved in this exercise, with DSIR Botany Division scientists, Dr Ian Atkinson and Dr Brian Molloy, overall convenors for the North and South Island respectively.

First edition maps of ecological regions and districts were produced and circulated widely, together with a publication describing the concept and calling for submissions (Simpson, 1982). Many of the suggested changes were incorporated into second edition maps which were produced as an overlay series (Biological Resources Centre, 1983). Since then further refinements have been made to the region and district boundaries, particularly as a result of surveys made under the Protected Natural Areas Programme, and these are shown in the present edition.

## Other Uses of the Ecological Region and District Framework

Ecological regions and districts are refinements at a national scale of the concept of the "biogeographic province". This concept has been widely promoted by the International Union for the Conservation of Nature and Natural Resources (IUCN) as a valuable scientific tool for nature conservation planning.

The ecological regions and districts system is already in use, for example, in the Register of Protected Natural Areas (Department of Lands and Survey, 1984), and in the Protected Natural Areas Programme (under the auspices of the National Parks and Reserves Authority). However the ecological regions and districts framework has potential values which go well beyond its original purpose as a basis for designing a representative system of protected natural areas throughout New Zealand. For example the concept helps to make people aware of the natural areas that make their own district unique and can help to promote the feeling of local identity (a sense of place), the awareness of landscape and the stewardship of local and national heritage values. It can also be used in many practical ways to organise, record and retrieve biological and other resource information; to aid in land use planning; and as an educational tool.

## THE MAPS

There are four maps at 1:500,000 scale. The ecological region and district boundaries have been printed on Department of Lands and Survey NZMS 242 topographic maps.

- Sheet 1      The northern North Island including ecological descriptions and prescriptions of 29 ecological districts: from Kermadec E.D. and Three Kings E.D. in the north (not shown on map) to Mayor E.D. in the south.
- Sheet 2      The central North Island including ecological descriptions and prescriptions of 55 ecological districts: from Meremere E.D. in the north to Eastern Hawkes Bay E.D. in the south.
- Sheet 3      Central New Zealand including ecological descriptions and prescriptions of 84 ecological districts: from Eastern Wairarapa E.D. in the north to Akaroa E.D. in the south; also includes Chathams E.D. (not shown on map).
- Sheet 4      The southern South Island including ecological descriptions and prescriptions of 100 ecological districts (plus parts of CANTERBURY Low Plains and High Plains): from Browning E.D. in the north to Snares E.D. in the south; also includes Bounty, Antipodes, Auckland Islands, Campbell and Macquarie E.D.'s (not shown on map).

## Prescriptions

Brief prescriptions, summarising the ecological character of each of the ecological districts, are printed on the map surface of each map.

## Descriptions

Ecological descriptions of each district on Sheet 1 are included in this booklet. They have been compiled giving a broad picture of the district in terms of topography, geology, climate, soils, vegetation and modifications; information about flora and fauna with special conservation or scientific value is included where this is known. Descriptions vary in length depending on the district's size and complexity and the amount of information which has been compiled. The descriptions are compiled under a series of headings as follows:

**Criteria:** a statement at the beginning of each description lists the criteria on which the district has been defined, in the order of importance where it is possible to determine this. Criteria consist of one or more of the features of the district which distinguish it from neighbouring districts.

**GEOLOGY:** the descriptions of geology were compiled using New Zealand Geological Survey (DSIR) geological maps (scale 1:250,000), and edited by regional geologists from the New Zealand Geological Survey.

**CLIMATE:** for most districts the climate description is based on the New Zealand Meteorological Service map "New Zealand Climate Regions (scale 1:2,000,000)"; temperatures (cool, warm etc.) generally refer to the lowlands in districts which include a wide altitudinal range. The rainfall ranges are from the New Zealand Meteorological Service "Mean Annual Rainfall (1941-70)" maps (scale 1:500,000). Other climate information was included when provided by ecologists with local knowledge.

**SOILS:** descriptions of soils for most districts (apart from some island districts), were written by Mr Des Cowie, formerly of the New Zealand Soil Bureau; they have been shortened for inclusion here. The descriptions deliberately avoid the use of descriptive soil names (e.g. yellow-brown earth) and instead attempt to describe the soils in ecological terms.

**TOPOGRAPHY/VEGETATION:** most of the information in these sections was provided by a large number of plant ecologists. In the north of the North Island the main contributors were Mr John Nicholls (formerly F.R.I., NZ Forest Service) and Dr Bruce Clarkson (DSIR Botany Division, (BD)). Dr Ian Atkinson (BD) was responsible for the south of the North Island as well as the outlying and offshore islands off the North Island. Dr Brian Molloy (BD) was responsible for the north of the South Island with other contributors including Dr Peter Williams (BD), Dr Philip Simpson (Commission for the Environment, now Department of Conservation), Dr Geoff Park (Biological Resources Centre, now DOC), and Dr Peter Wardle (BD). Dr Peter Johnson (BD) was responsible for the south of the South Island with other contributors including Dr Ralph Allen (BD), Dr Collin Meurk (BD), and Professor Alan Mark (Otago University). Other contributors include Mr Geoff Kelly (BD), Mr Hugh Wilson, Mr Chris Jenkins (NZ Forest Service), Mr Rowly Taylor (DSIR Ecology Division), Mr Henk Stengs (NZ Forest Service), Dr Colin Burrows (Canterbury University), Mr Colin Ogle (NZ Wildlife Service), Mr Willie Shaw (Forest Research Institute), Mr Mike Page (MOWD), Dr Niel Mitchell (Auckland University), Mr Geoff Rogers (Victoria University), Mr Ash Cunningham (NZ Forest Service), Mr Geoff Walls (BD), Mr Warren Burke, Dr John Wardle (FRI), Ms Cathy Brumley, Dr Kathy Dickenson, Ms Maggie Bayfield, Mrs Margaret Bulfin (BD) and Mr Pat Burstall (Wildlife Service).

MODIFICATIONS: include changes to indigenous ecosystems caused by farming, forestry, urban and other developments and by introduced plants and animals. Land uses were taken from "The New Zealand Atlas" (Government Printer, 1976) and checked by local ecologists. Introduced mammals such as rodents, rabbits, mustelids, possums, and deer are widespread and not always mentioned; their absence may be a more notable ecological feature than their presence. In some cases modifications are described together with the vegetation section.

FLORA: where contributors mentioned any special elements of the flora of a district these were included. In some cases flora is combined with the vegetation section.

FAUNA: most animal information is restricted to species considered to be important in terms of nature conservation. Information about indigenous animals has come from a wide variety of sources.

MAMMALS: only bats and marine mammals are included. The short-tailed bat belongs to an endemic family *Mystacinidae*, and is classified as vulnerable in "The Red Data Book of New Zealand" (Nature Conservation Council, 1981 ); It is mentioned where it has been positively identified in recent years. The long-tailed bat is an endemic species of a southern hemisphere family and is widespread in suitable habitats; it is only mentioned in districts where the population is isolated. Dr Mike Daniel (DSIR Ecology Division) provided bat information (Daniel, M.J. and Williams, G.R. 1984 "A Survey of the Distribution, Seasonal Activity and Roost Site of New Zealand Bats," *New Zealand Journal of Ecology* 7:9-25)

Marine mammals are mentioned if they breed in the district or are present in large numbers. Much of the information was provided by Mr Rowly Taylor (DSIR Ecology Division). Breeding localities of New Zealand fur seals were obtained from Crawley, M.C. and Wilson G.J., 1976 "The Natural History and Behaviour of the New Zealand Fur Seal ( *Arctocephalus forsteri* )," *Tuatara* 22:1.29.

Introduced mammals are mentioned in the MODIFICATIONS section.

BIRDS: only certain groups of birds are mentioned, including kiwi, sea bird colonies, endemic ducks, falcon, crakes, large congregations of waders, kaka, parakeets, kea, Rock Wren, Yellowhead and Fernbird; other birds are mentioned where they occur close to the limits of their range, or show other peculiarities of distribution. Mr Sandy Bartle (National Museum) contributed much of the bird information, especially about the North Island and north of the South Island and Mr Tony Whitaker added bird information for the rest of the country. Bird distributions were obtained from the Ornithological Society of New Zealand's "Atlas of Bird Distributions in New Zealand", the "New Guide to the Birds of New Zealand" (Collins), the "Complete book of New Zealand Birds" (Readers Digest), *Notornis*, 1976-86 and a variety of papers and reports. Additional bird information was received from Mr Paul Sagar and Mr Wynston Cooper (both Ornithological Society of New Zealand) and Mr John Atkinson (Lands and Survey).

REPTILES AND FROGS: Mr Whitaker also provided information about indigenous reptiles and frogs. Reptiles considered to be widespread and common are only mentioned where they occur at the limits of their range, show other peculiarities of distribution or are distinctive or peculiar in other ways. Information was obtained from the NZ Wildlife Service's amphibian and reptile distribution mapping scheme, a variety of papers (see Reptiles in Glossary) and some personal observations by Mr Whitaker. Dr Ben Bell (Victoria Univeristy) provided additional frog information.

FISH: information about fresh-water fish was obtained from Dr Bob McDowell (MAF, Fisheries Research Division). Only indigenous fish listed in "The Red Data Book of New Zealand" (Nature Conservation Council, 1981) are included.

INVERTEBRATES: information was compiled by Ms Jojette Drost (while employed by the National Museum) from a large number of sources; further information was added by Ms Cath Walker (NZ Wildlife Service), Mr Frank Climo (National Museum) and Mr Graeme Ramsay (DSIR Entomology Division).

#### Acknowledgements

The Biological Resources Centre acknowledges the help of all these contributors and also others whose names may have been omitted inadvertently. Without the assistance of so many experts the task of compiling the descriptions of the 268 Ecological Districts would have taken many years. Special thanks are due to Mrs Karen Lewis who typed most of the extensive manuscript and made the numerous corrections and alterations with unending patience.

#### Future Amendments

In such a large project there are certain to be errors both of omission and of fact or interpretation. If you know any corrections or additional information which could be used to improve this work, please forward them to the Biological Resources Centre for inclusion in future editions of this map series.

It is expected that further refinements to ecological region and district boundaries will be made in future, especially in the course of surveys made under the Protected Natural Areas Programme.

## GLOSSARY AND EXPLANATION OF TERMS

### General

Certain words have been used in the text to mean specific things:

"Original" refers to conditions prior to the arrival of Polynesian man in New Zealand; original conditions are only included when they are well known.

"Former" refers to conditions at the time of European settlement, about 1840.

"Treeline" refers to the "timberline" of other authors, indicating the upper altitudinal limit of tree growth.

"Remnant" refers to vegetation or animal populations which are diminished from their former size because of the influence of man.

"Scattered patches" refers to vegetation types which were once extensive but are now reduced to small areas because of natural change, e.g. climate change.

"Offshore islands" are within 50 km from the New Zealand mainland.

"Outlying islands" are further than 50 km from the New Zealand mainland.

"Pakihi" refers to dense low cover of sedges, umbrella fern, rushes and low growing shrubs and herbs on level water-logged country.

"Endemic" refers to plants and animals which are restricted to a certain area; in this case usually one or several Ecological Districts.

"Indigenous" means native.

"Exotic" means introduced, as opposed to indigenous, usually referring to pine plantations.

### Abbreviations

a.s.l.	above sea level
E.A.	Ecological Area
E.D.	Ecological District
E.R.	Ecological Region
L.	Lake
N, S, E and W etc.	North, South, East and West etc.
p.a.	per annum
R.	River
S.F.	State Forest
Stm	Stream

Plant Names Used (in alphabetical order)

<u>Maori or Common Name</u>	<u>Scientific Name</u>
agropyron	<u>Agropyron scabrum</u>
akeake	<u>Dodonea viscosa</u>
akepiro	<u>Olearia furfuracea</u>
akiraho	<u>Olearia paniculata</u>
alpine fescue tussock	<u>Festuca matthewsii</u>
beech	<u>Nothofagus</u> spp.
black maire	<u>Gymnelaea cunninghamii</u> ( <u>Nestegis cunninghamii</u> )
black beech	<u>Northofagus solandri</u> var. <u>solandri</u>
blue tussock	<u>Poa colensoi</u>
bog pine	<u>Dacrydium bidwillii</u> ( <u>Halocarpus</u> <u>bidwillii</u> )
boxthorn	<u>Lycium ferrocissimum</u>
bracken	<u>Pteridium esculentum</u>
broadleaf	<u>Griselinia littoralis</u>
broom	<u>Cytisus scoparius</u>
browntop	<u>Agrostis tenuis</u>
bull kelp	<u>Durvillaea antarctica</u>
cabbage tree	<u>Cordyline</u> spp.
celmisias	<u>Celmisia</u> spp.
clover	<u>Trifolium</u> spp.
cocksfoot	<u>Dactylis glomerata</u>
composites	Family Compositae
coprosma	<u>Coprosma</u> spp.
corokia	<u>Corokia</u> spp.
crack willow	<u>Salix fragilis</u>
cyperus	<u>Cyperus</u> spp.
Douglas fir	<u>Pseudotsuga menziesii</u>
dracophyllum	<u>Dracophyllum</u> spp.
fescue tussock	<u>Festuca novae-zelandiae</u>
fivefinger	<u>Pseudopanax arboreus</u>
flax	<u>Phormium</u> spp.
fuchsia	<u>Fuchsia excorticata</u>
golden spaniard	<u>Aciphylla aurea</u>
gorse	<u>Ulex europeus</u>
Hall's totara	<u>Podocarpus totara</u>
hangehange	<u>Geniostoma ligustrifolium</u>
hard beech	<u>Nothofagus truncata</u>
hard tussock	<u>Festuca novae zelandiae</u>
hawkweed	<u>Hieracium pilosella</u> <u>H.pracaltum</u> , <u>H.aurantiacum</u> , <u>H.lachenalii</u>
hebes	<u>Hebe</u> spp.
heketara	<u>Olearia rani</u>
Himalayan honeysuckle	<u>Leycesteria formosa</u>
hinau	<u>Elaeocarpus dentatus</u>
hohere	<u>Hoheria</u> spp.
inaka	<u>Dracophyllum longifolium</u>
inanga	<u>Dracophyllum longifolium</u>

kahikatea	<u>Podocarpus dacrydioides</u> ( <u>Dacrycarpus dacrydioides</u> )
kaikawaka	<u>Libocedrus bidwillii</u>
kaikomako	<u>Pennantia corymbosa</u>
kamahi	<u>Weinmannia racemosa</u>
kanuka	<u>Leptospermum ericoides</u> ( <u>Kunzea ericoides</u> )
karaka	<u>Corynocarpus laevigatus</u>
karamu	<u>Coprosma australis</u>
karo	<u>Pittosporum crassifolium</u>
kauri	<u>Agathis australis</u>
karaka	<u>Libocedrus plumosa</u>
kawakawa	<u>Macropiper exelsum</u>
Kermandec pohutukawa	<u>Metrosideros kermandecensis</u>
kiekie	<u>Freycinetia banksii</u>
kohekohe	<u>Dysoxylum spectabile</u>
kohuhu	<u>Pittosporum tenuifolium</u>
koromiko	<u>Hebe</u> spp.
kowhai	<u>Sophora</u> spp.
lacebark	<u>Hoheria populnea</u>
lancewood	<u>Pseudopanax crassifolius</u>
larch	<u>Larix decidua</u>
leatherwood	<u>Olearia</u> spp.
lemonwood	<u>Pittosporum eugenioides</u>
mahoe	<u>Meliccytus ramiflorus</u>
maire	<u>Gymnelaea</u> spp. ( <u>Nestegis</u> spp.)
mamaku	<u>Cyathea medullaris</u>
mangeao	<u>Litsea calicaris</u>
mangroves	<u>Avecinnia resinifera</u>
manuka	<u>Leptospermum scoparium</u>
mapau	<u>Myrsine australis</u>
marbleleaf	<u>Carpodetus serratus</u>
marram	<u>Ammophila arenaria</u>
matagouri	<u>Discaria toumatou</u>
matai	<u>Podocarpus spicatus</u>
microlaena	<u>Microlaena</u> spp.
mingimingi	<u>Coprosma propinqua</u>
miro	<u>Podocarpus ferrugineus</u>
mistletoe	Family Loranthaceae
mountain beech	<u>Nothofagus solandri</u> var. <u>solandri</u>
mountain flax	<u>Phormium cookianum</u>
mountain lacebark	<u>Hoheria glabrata</u>
mountain toatoa	<u>Phyllocladus alpinus</u>
narrow-leaved lacebark	<u>Hoheria angustifolia</u>
narrow-leaved snow tussock	<u>Chionochoa rigida</u>
native broom	<u>Carmichaelia</u> spp.
ngaio	<u>Myoporum laetum</u>
nikau	<u>Rhopalostylis sapida</u>
niggerhead	<u>Carex secta</u>
northern rata	<u>Metrosideros robusta</u>
pate	<u>Schefflera digitata</u>
pampas grass	<u>Cortaderia</u> spp.
pine	<u>Pinus</u> spp.
pigeonwood	<u>Hedycarya arborea</u>
pigmy pine	<u>Dacrydium laxifolium</u> ( <u>Lepidothamnus laxifolius</u> )
pingao	<u>Desmoschoenus spiralis</u>
pink pine	<u>Dacrydium biforme</u>

	<u>(Halocarpus biformis)</u>
prairie grass	<u>Bromus carthaticus</u>
pohuehue	<u>Meuhlenbeckia complexa</u>
pohutukawa	<u>Metrosideros excelsa</u>
pokaka	<u>Elaeocarpus hookerianus</u>
ponga	<u>Cyathea dealbata</u>
Poor Knights ngaio	<u>Myoporum laetum</u> var. <u>decumbens</u>
pukatea	<u>Laurelia novae-zelandiae</u>
puriri	<u>Vitex lucens</u>
putaputaweta	<u>Carpodetus serratus</u>
quintinia	<u>Quintinia</u> spp.
rarekau	<u>Coprosma australis</u>
rata	<u>Metrosideros</u> spp.
raupo	<u>Typha orientalis</u>
red beech	<u>Nothofagus fusca</u>
red tussock	<u>Chionochloa rubra</u>
restiad	Family <u>Restionaceae</u>
rewarewa	<u>Knightea excelsa</u>
ribbonwood	<u>Hoheria glabrata</u> or <u>Plagianthus betulinus</u>
rimu	<u>Dacrydium cupressinum</u>
rush	Family <u>Juncaceae</u>
ryegrass	<u>Lolium</u> spp.
scabweed	<u>Raoulia</u> spp.
sedge	Family <u>Cyperaceae</u>
silver beech	<u>Nothofagus menziesii</u>
silver fern	<u>Cyathea dealbata</u>
silver pine	<u>Dacrydium colensoi</u> <u>(Lagarostrobos colensoi)</u>
silver tussock	<u>Poa laevis</u>
slim snow tussock	<u>Chionochloa macra</u>
sorrel	<u>Rumex</u> spp.
southern rata	<u>Metrosideros umbrellata</u>
snow totara	<u>Podocarpus nivalis</u>
snow tussock	<u>Chionochloa</u> spp.
spaniard	<u>Aciphylla</u> spp.
supplejack	<u>Ripogonum scandens</u>
swamp maire	<u>Eugenia maire</u> <u>(Syzygium maire)</u>
sweet brier	<u>Rosa rubiginosa</u>
sweet vernal	<u>Anthoxanthum odoratum</u>
tanekaha	<u>Phyllocladus trichomanoides</u>
taraire	<u>Beilschmiedia tarairi</u>
tarata	<u>Pittosporum eugenioides</u>
tawa	<u>Beilschmiedia tawa</u>
tawari	<u>Ixerba brexioides</u>
tauhinu	<u>Cassinia leptophylla</u>
taupata	<u>Coprosma repens</u>
tawapou	<u>Planchonella novo-zelandica</u>
tawaroa	<u>Beilschmiedia tawaroa</u>
	(ref. Wright 1984, NZ J.Bot.22(1))
thyme	<u>Thymus</u> spp.
titoki	<u>Alectryon excelsus</u>
toatoa	<u>Phyllocladus glaucus</u>
toetoe	<u>Cortaderia</u> spp.

toro	<u>Myrsine salicina</u>
totara	<u>Podocarpus totara</u>
towai	<u>Weinmannia silvicola</u>
tree lupin	<u>Lupinus arboreus</u>
tree mallow	<u>Lavatera arboria</u>
tutu	<u>Coriaria</u> spp.
umbrella fern	<u>Gleichenia</u> spp.
whau	<u>Entelia arborescens</u>
white maire	<u>Gymnelaea lanceolata</u> ( <u>Nestegis lanceolata</u> )
wineberry	<u>Aristotelia serrata</u>
wire rush	<u>Empodism minus</u>
yellow silver pine	<u>Dacrydium intermedium</u> ( <u>Lepidothamnus intermedius</u> )

Mammal Names Used (in alphabetical order)

<u>Common Name</u>	<u>Scientific Name</u>
bats	<u>Chalinobus tuberculatus</u> or <u>Mystacina tuberculata</u>
black rat	<u>Rattus rattus</u>
bush wallabies	<u>Macropus rufogriseus</u>
cattle	<u>Bos taurus</u>
cats	<u>Felis catus</u>
chamois	<u>Rupicapra rupicapra</u>
deer	<u>Cervus</u> spp. etc.
dolphins	Family <u>Delphinidae</u>
elephant seal	<u>Mirounga leonina</u>
fallow deer	<u>Dama dama</u>
ferret	<u>Mustela putorius</u>
fur seal	<u>Arctocephalus forsteri</u>
goats	<u>Capra hircus</u>
hares	<u>Lepus europaeus</u>
Hooker's sealion	<u>Phocarctos hookeri</u>
horses	<u>Equus caballus</u>
leopard seal	<u>Hydrurga leptonyx</u>
lesser short-tailed bat	<u>Mystacina tuberculata</u> <u>tuberculata</u>
long-tailed bat	<u>Chalinobus tuberculatus</u>
mice	<u>Mus musculus</u>
mustelids	<u>Mustela</u> spp.
New Zealand fur seal	<u>Arctocephalus forsteri</u>
Norway rat	<u>Rattus norvegicus</u>
pigs	<u>Sus scrofa</u>
Polynesian rat	<u>Rattus exulans</u>
possums	<u>Trichosurus vulpecula</u>
rabbits	<u>Oryctolagus cuniculus</u>
rats	<u>Rattus</u> spp.
red deer	<u>Cervus elaphus</u>
sea leopard	<u>Hydrurga leptonyx</u>
short-tailed bat	<u>Mystacina tuberculata</u>
stoats	<u>Mustela ermina</u>
tahr	<u>Hemitragus jemlahicus</u>
wallabies	<u>Macropus</u> spp.
wapiti	<u>Cervus canadensis</u>
whales	<u>Cetaceans</u>
whitetail deer	<u>Odocoileus virginianus</u>

## Birds

Only common names have been used for birds. Scientific names can be found in the "Annotated Checklist of the Birds of New Zealand" by the Checklist Committee (F.C. Kinsky, Convenor), Ornithological Society of N Z Inc. A.H. and A.W. Reed, 1970. Capital letters are used for full common names, e.g. Red-crowned Parakeet; small letters are used for generalised common names, e.g. parakeets. Some commonly used abbreviations are followed e.g. SIPO for South Island Pied Oystercatcher.

## Reptiles

Both common and scientific names have been used in the text. Nomenclature follows several authorities:

- Hardy, G.S. 1977: The New Zealand Scincidae (Reptilia:Lacertilia); a taxonomic and zoogeographic study. New Zealand Journal of Zoology 4:221-325
- McCann, C. 1955: The lizards of New Zealand. Gekkonidae and Scincidae. Dominion Museum Bulletin No 17. 127p.
- Robb, J. 1980: Three species of gekkonid lizards, genera Hoplodactylus Fitzinger and Heteropholis Fischer, from New Zealand. National Museum of New Zealand records 1:305-310
- Robb, J.; Rowlands, R.P.V. 1977: Reinstatement of Hoplodactylus maculatus (Boulenger) with redescription of H. pacificus (Gray) (Reptilia:Squamata:Gekkonidae). Records of the Auckland Institute and Museum 14:133-142
- Robb, J.; Hitchmough, R.A. 1980: Review of the genus Naultinus Gray (Reptilia:Gekkonidae). Records of the Auckland Institute and Museum 16:189-200
- Thomas, B.W. 1981: Hoplodactylus rakiurae n.sp. (Reptilia:Gekkonidae) from Stewart Island, New Zealand, and comments on the taxonomic status of Heteropholis nebulosus McCann. New Zealand Journal of Zoology 8:33-47
- Whitaker, A.H. 1984: Hoplodactylus kahutarae n.sp. (Reptilia:Gekkonidae) from the Seaward Kaikoura Range, Marlborough, New Zealand. New Zealand Journal of Zoology 11:259-270

## Frogs

Both common and scientific names are given in the text.

## Fish

Both common and scientific names are given in the text.

## Invertebrates

Information about invertebrates is very varied. Mainly large conspicuous species are included; in particular large wetas, cicadas, beetles and land snails. Scientific names (where known) are given in the text.

N.B. Snails: refers to land snails only.

## ECOLOGICAL DISTRICT DESCRIPTIONS

On the following pages are ecological descriptions of the 84 ecological districts from Eastern Wairarapa (35.01) to Akaroa (57.03) and also Chathams (80.01)

The southern 6 districts of WHATAROA Region, Harihari (50.03) to Mahitahi (50.08) and those of ASPIRING Region appear on Sheet 4

## EASTERN WAIRARAPA ECOLOGICAL DISTRICT 35.01

Criteria: topography (steep conical taipo landforms with low gentler slopes of low fertility), climate (relatively dry), vegetation (absence of tawa).

TOPOGRAPHY: hill country including characteristic steep-sided hills of sharp relief (the Taipos); highest point 578m a.s.l.; drainage to the E; long coastline includes several rocky points and cliffs, extensive coastal reefs, sandy beaches.

GEOLOGY: diverse, with Cenozoic and Mesozoic sediments: early Cretaceous sandstones (Taipos), mudstone, alternating sandstone and mudstone, minor igneous rocks and breccia; late Cretaceous sandstone, mudstone, conglomerate and breccia; Tertiary mudstone, sandstone and limestone; Quaternary alluvium and coastal sands; and minor igneous rocks.

CLIMATE: very warm summers; day temperatures occasionally exceed 32<sup>o</sup> with dry foehn NW winds; droughts may occur in spring and summer; moderate winters; rainfall 1000-1400mm p.a.

SOILS: mainly hill and steepland soils from wide range of parent materials: soils on Tertiary mudstones moderately deep; those on more indurated sandstones, argillites and limestones, shallower and more droughty; in higher rainfall areas with a slight summer dry season soils fertile but moderate to severe soil erosion occurs; in higher rainfall areas soils more leached, generally less fertile. Small areas of soils from loess with compact subsoils and impeded drainage occur on rolling lands along western border of district.

VEGETATION: many small areas of indigenous vegetation remain: black beech widespread; hard beech very local, known only from Mt Rewa, Castle Point; small areas of podocarp forest; extensive areas of secondary forest without podocarps, beech species or taws. Kamahi and tawa dominated forests are notably absent.

FLORA: The Taipos are floristically varied and provide a reservoir for non-forest species; many occur here that are absent from Eastern Hawke's Bay: e.g. Brachyglottis greyi, B monroi var. (endemic at Castle Point), and B. perdicioides var. (endemic at Mt Percy.) The forest and shrub remnants of the Mt Percy area are the most varied and important of the coastal area.

BIRDS: sub-fossil moa bones at Castle Point, Mataikona and at coastal sites elsewhere sometimes associated with early Polynesian camp sites; important sub-fossil cave deposits of birds at Ruakakopotuna showing that present bird fauna is greatly reduced from that of the past, as at L. Poukawa in Heretaunga E.D. Marsh Crake occur at Castle Point.

REPTILES: spotted skink (Leiolopisma lineocellatum) known from several coastal sites.

MODIFICATIONS: much of district farmed (semi-extensive sheep and cattle); areas of exotic forest.

## WAIRARAPA PLAINS ECOLOGICAL DISTRICT 36.01

Criteria: geology, climate, topography.

TOPOGRAPHY/GEOLOGY: low lying Pleistocene and Holocene alluvial terraces and plains with a large lake (L. Wairarapa) at the southern end.

CLIMATE: dry, rainfall 800-1200mm p.a.; very warm summers, day temperatures occasionally rise above 32°C with dry foehn NW winds; moderate winter temperatures with most rain in winter.

SOILS: on eastern fans mainly stony and shallow droughty soils; on terraces and rolling land in eastern, drier parts soils have compact heavy textured subsoils; winter drainage poor but soils droughty in summer. In the W and NW with higher rainfalls, subsoils siltier and more friable with more even moisture. Soils on limited areas of hilly land from Tertiary rocks show similar range; on river flats fertile alluvial soils occur ranging from stony, sandy and silty well drained soils bordering rivers to poorly drained heavier textured soils in backswamps and around Lake Wairarapa; limited areas of sandy soils on dunes border this lake.

VEGETATION: few remaining areas of indigenous forest e.g. small remnants of kahikatea forest; quite large areas of scrub; extensive wetlands remain around L. Wairarapa.

FLORA: important wetland plants include: in the turfs surrounding lake, Cotula maniototo, C. dispersa, elsewhere only found in South Island; Carex cirrhosa, C. buchananii, Eleocharis pusilla, Pilularia novae-zelandiae all with very localised distributions; in deeper water, endemic Myriophyllum triphyllum, and profuse populations of Potamogeton pectinatus, Ruppia polycarpa, Scirpus lacustris; amongst introduced willows, rare species of Crassula (= Tillaea acutifolia) only found elsewhere at Carters Bush, Urtica linearifolia, Viola lyallii.

BIRDS: major waterfowl breeding areas (especially Black Swan, Grey and Mallard Duck, N.Z. Shoveler, Grey Teal, Paradise Shelduck); feeding areas for waterfowl and both Arctic breeding and N.Z. waders; N.Z. Dabchick breeding near L. Wairarapa are southernmost in N.Z. (the species no longer in South Island). Ruamahanga River bed important for breeding Banded and Black-fronted Dotterel. Bittern abundant. Spotless Crake S of L. Wairarapa; Marsh Crake also recorded near L. Wairarapa.

REPTILES: ornate skink (Cyclodina ornata) present in bush remnants N of Masterton; copper skink (C. aenea) in localised populations on the plains and along the Tararua foothills (both C. ornata and C. aenea are uncommon and localised S of line Taranaki-Gisborne). Speckled skink (Leiopisma infrapunctatum) at Mikimiki N of Masterton and near Carterton (only other North I. populations in Hamilton, Kaiangaroa and Eastern Hawkes Bay E.Ds.). Spotted skink (Leiopisma lineocellatum) at Dyerville and reported near Martinborough; these are the only inland sites in the North I.

FISH: include giant kokopu (Galaxias argenteus), short jawed kokopu (G. postvectis) and brown mudfish (Neochanna apoda).

MODIFICATIONS: most of district farmed (semi-extensive sheep and cattle grazing in the W and S; intensive sheep farming, cropping elsewhere).

## AORANGI ECOLOGICAL DISTRICT 37.01

Criteria: topography, geology and climate.

TOPOGRAPHY: steeply dissected range: highest peak (Mt Ross), only 983m a.s.l., but terrain has mountainous appearance; higher parts in the N and S divided by lower central section; streams from the NE section of range flow into Ruamahanga River, remaining streams flow directly to the sea, major rivers have small river flats; most rivers follow fault lines and shatter zones and have V-shaped, steep walled valleys.

GEOLOGY: mostly very hard greywacke and argillite (with minor igneous rocks) of Jurassic-?Cretaceous age; minor less indurated sandstone and conglomerate of Cretaceous age; small areas of softer sandstone, mudstone, conglomerate of late Tertiary age, and a strip of high level Quaternary gravel deposits around the SE coast; several large NE-trending faults cut the range resulting in zones of shattered rock, particularly along major valleys.

CLIMATE: much of region affected by strong winds which cause exposed vegetation to be stunted and windswept: strong dry northwesterlies prevail but southerlies bringing gale force winds, torrential rain and salt-laden air are common; rainfall 1200-2400mm p.a.; snow and fog relatively rare. SOILS: mainly steepland soils from greywacke and Plio-Pleistocene sandstones and conglomerates; those from greywacke shallow and stony, showing a leaching sequence with increasing altitude and rainfall; soils at lower elevations moderately leached, those at higher elevations strongly to very strongly leached and infertile; soils from sandstone and conglomerate somewhat deeper but more susceptible to slipping and gullyng. VEGETATION: in the S low altitude forest is exposed to salt-laden winds and dominated by mahoe, hinau, rewarewa with scattered rimu, matai and miro emergents; areas of pure silver beech at higher altitudes; flax-manuka-Cassinia scrub and grassland occur on seaward faces. In the N podocarp-hardwood forest similar to that in the S, occurs on valley floors with an altitudinal sequence through black beech, red beech and silver beech with occasional podocarps on the slopes and a cap of silver beech on high ridgetops. Some areas have pockets of pure black beech and fire-induced kanuka. An area of induced subalpine scrubland occurs on Mt Barton, dominated by Dracophyllum filifolium, Cyathodes fasciculata, Coprosma parviflora, manuka and Chionochloa cheesemanii.

FLORA: southern North Island endemic plants include Brachyglottis greyi, Chionochloa beddiei; South Island species which are very uncommon in North Island include Cotula perpusilla, Clematis afoziata, Muehlenbeckia ephedroides. Flora in some respects similar to Rimitaka Range but mountain plants (those normally found above 450m a.s.l.) poorly represented here; possibly the relatively dry climate is a limiting factor.

BIRDS: mostly forested and therefore, despite its isolation, important for the breeding of native forest birds in the southern North Island. N.Z. Falcon and kaka present.

REPTILES: southernmost populations of common green gecko (Naultinus elegans punctatus) in Haurangi SF.

MODIFICATIONS: some areas modified by fire, some logging has occurred in Turanganui catchment, some revegetation planting in Tauanui and Dry River catchments; introduced mammals include red deer, goats, pigs, feral sheep and cattle, possums, rabbits, hares.

## TARARUA ECOLOGICAL DISTRICT 38.01

Criteria: topography, climate, vegetation (the northern boundary lies at the northern extent of beech in Tararuas).

TOPOGRAPHY: steep, high, dissected hills and mountains of Tararua and Rimutaka Ranges, rising to 1571m in the central Tararua Range (Mitre Peak), heavily faulted and broken by major rivers with steep hill slopes dropping to small river flats; severe erosion especially in the S of the Rimutaka Range, leading to large slump areas, raw erosion pavement and gravel filled river beds; many rivers gorged near the foothills; some valleys in central Tararuas may be of glacial origin; southern coastline includes the uplifted beaches of Turakirae Head.

GEOLOGY: Triassic-Jurassic greywacke, argillite and bedded, alternating greywacke and argillite (0.01-1m thick beds).

CLIMATE: westerly winds predominate, gale force common; low cloud covers ranges for prolonged periods; high rainfall, ranging from 1600mm p.a. at lower altitudes to 8000mm and occasionally as high as 10,000mm in the central Tararua Range; some high intensity rainfalls of 370mm/day, leading to flash flooding; snow lies on much of the alpine areas of Tararuas during winter, small snowfalls recorded for all months at high altitudes on both ranges.

SOILS: steepland soils from greywacke mainly shallow, stony and strongly leached to podzolised with low natural fertility; mainly in forest or induced scrub and gorse; small areas of shallow stony alpine soils on mountain tops; less leached and more fertile farmed steepland soils in lower altitude foothills with lower rainfalls; hill soils from greywacke range from moderately leached with yellowish brown, well-structured silty subsoils developed under hardwood forest to strongly leached soils with compact, pale coloured impermeable clayey subsoils formed under beech; deep silty, well drained soils from Pleistocene drift or loess under moderate rainfalls. With increasing altitude and rainfall soils more strongly leached with poorer drainage and peaty topsoils.

VEGETATION: altitudinal zonation down slope from alpine herbfield, tussockland (Chionochloa pallens etc.), to leatherwood scrub above treeline; extensive forests: in the Tararua Range silver beech dominant in montane and subalpine forests; red beech/kamahahi forest; rata/kamahahi forest dominant in western Tararua foothills; rimu, Hall's totara and miro found throughout; hard beech also occurs. In the Rimutaka Range extensive stands of silver beech occur, also hard beech, black beech and some red beech (eg Pukuratahi catchment); lowland hardwood forests of Rimutaka Range are complex mosaic of hardwood species with isolated podocarps (Hall's totara and rimu); rata/kamahahi forest and scrub dominant at lower altitudes. Near the coast rata/kamahahi forest replaced by manuka, flax and Cassinia.

FLORA: alpine herbfields of Tararua Range rich and varied; along the coast in the S southern species which have crossed Cook Strait include Muehlenbeckia astonii, Carex appressa; Cook Strait endemics include Aciphylla squarrosa subspecies, Raoulia sp. (c.f. R. hookeri). Mangaroa swamp includes Gahnia rigida.

MAMMALS: the vulnerable lesser short-tailed bat has been found on the eastern side of the Tararua Range.

BIRDS: include Yellow-crowned Parakeet, Red-crowned Parakeet, southernmost distribution of Whitehead, N.Z. Falcon (widespread), kaka.

REPTILES: Pacific gecko (Hoplodactylus pacificus) is rare in the southern half of the North I. and reaches its southernmost limit in the eastern Hutt Hills. Scattered populations of ornate skink (Cyclodina ornata) in the western foothills of the Tararua Range, and copper skink C. aenea) occurs in the eastern Hutt Hills, the Orongorongo Valley and at Turakirae Head (both species are uncommon and localised S of line Taranaki-Gisborne). Spotted skink (Leiolopisma lineocellatum) on the coast between Port Nicholson and Palliser Bay.

INSECTS: include an endemic cicada (Maoricicada myersi) on Orongoronga coastal hills; the cicada Amphipsalta strepitans an eastern South Island species) occurs at Turakirae and Fitzroy Bay.

SNAILS: Wainuia (Rhytida) snails found throughout.

MODIFICATIONS: large areas of northern Rimutaka Range gorse covered following fires which spread from land clearing; some areas of lowland grassland in Rimutaka Range; most result from land clearing and wildfires; small areas of exotic forest; introduced mammals include red deer, goats, pigs and possums, sheep, rabbits, hares.

## WELLINGTON ECOLOGICAL DISTRICT 39.01

Criteria: topography, soils (younger and more fertile than Tararua soils), vegetation (very little beech).

TOPOGRAPHY/GEOLOGY: steep, strongly faulted hills and ranges; two harbours, one with several small islands, a large estuary (Pauatahanui) and a large river valley (Hutt). Almost entirely Triassic-Jurassic alternating argillite and greywacke.

CLIMATE: windy: W to NW winds prevail with high wind-run and frequent gales; warm summers, mild winters, rainfall 900-1400mm p.a., evenly distributed.

SOILS: includes range of soils from greywacke and Pleistocene drift material and loess, with alluvial, peaty and stony soils in valleys. Soils on steep slopes moderately leached stony and shallow steepland soils; moderately fertile with only slight scree erosion, mainly used for pastoral farming, some areas reverting to scrub. Soils on hilly, rolling and flattish slopes have variable thickness of loess or drift material over greywacke, generally moderately deep to deep; in lower rainfall areas near coast, subsoils pale coloured, firm to compact, but in more inland higher rainfall areas subsoils browner, more friable and better structured. Soils in valleys range from sandy and silty well drained soils on levees, through poorly drained heavier textured soils in backswamps and fans to peaty soils in swamps. Shallow, stony soils occur on low terraces; minor areas of salty soils in estuarine areas and sandy soils on coastal dunes.

VEGETATION: indigenous vegetation includes salt marsh communities around Pauatahanui Inlet and remnants of originally widespread forests: podocarp forests (kahikatea, totara, matai) on hills; rimu-rata/kohekohe forest nearer coast; miro-rimu/tawa forest at higher levels; all these species present in remnant forests though podocarps have been logged out of many remnants; (very little beech: black beech and hard beech occurs in ridge stands between Haywards and Moonshine).

FLORA: important plants include some Cook Strait endemics in Ohiro Bay-Island Bay area, and in some cases in inner harbour e.g. Hymenanchera obovata variety (low-growing, hermaphrodite shrub), Aciphylla squarrosa subspecies, Raoulia sp. (c.f. R. hookeri), Craspedia uniflora ssp. maritima; South Island species which just reach S of North Island e.g. Coriaria sarmentosa, Pellaea sp. (unnamed dryland species); rare Northland species more common in South Island still present on Seatoun-Miramar peninsula, e.g. matagouri, Carex diandra, Hypsela rivalis.

BIRDS: Pauatahanui is a significant shore bird habitat and Wellington Harbour an important feeding ground for large numbers of sea-birds in winter. Soames I.: breeding Reef Heron, Spotted Shag, Blue Penguin, major roost for Black-backed and Red-billed Gull and Starling.

REPTILES: southernmost records of ornate skink (Cyclodina ornata) are in Wellington city (uncommon and localised S of line Taranaki-Gisborne). Spotted skink (Leiopisma lineocellatum) on islands in Port Nicholson. Eastern limit of brown skink (Leiopisma zelandicum) is Wellington city.

FISH: include giant kokopu (Galaxias argenteus) and short jawed kokopu (G. postvectis).

MODIFICATIONS: much of district farmed (semi-extensive sheep and cattle); areas of gorse common, barberry increasing; large urban areas (Wellington city).

## COOK STRAIT ECOLOGICAL DISTRICT 39.02

Criteria: exposure to severe gales, topography, vegetation.

TOPOGRAPHY etc: the boundaries recognise ecological and floristic affinities between the very exposed, steep coastal escarpments, terraces, headlands and islands on either side of Cook Strait. However, the district also represents a major biogeographic barrier to a large number of organisms.

GEOLOGY: complex: Wellington coast and Mana Island Triassic and Jurassic alternating greywacke and argillite, and Holocene alluvium; Kapiti, the Chetwode Is, Titi Island, the Trios, the Brothers and part of Arapawa Island Permian brecciated greywacke and argillite; Renunder Point, Cape Jackson, Cape Lambert and Alligator Head Paleozoic chlorite schists; Rangitoto Island Permian argillite and igneous conglomerate; Stephens Island and Cape Stephens Permian green sandstone, igneous conglomerate and limestone lenses; and eastern Cape Stephens Permian ultramafic rocks.

CLIMATE: maritime, characterised by high wind-run and frequent gales; rainfall approx. 1200mm p.a.

SOILS: mainly shallow and stony steepland soils from greywacke with skeletal soils and areas of bare rock and scree on coastal cliffs; minor areas of shallow and gravelly soils on old beach ridges.

VEGETATION/MODIFICATIONS: forest included karaka, kohekohe and ngaio, also tawa, titoki, occasional podocarps and northern rata; steepest hill slopes and cliffs probably originally in mixed low forest and scrub dominated by akiraho, mahoe, kiekie, Phormium cookianum and manuka; this now largely replaced, as a result of fire and grazing, by shrublands and grasslands in which tauhinu, akiraho, mahoe, manuka, Coprosma propinqua, Muehlenbeckia complexa, Phormium cookianum and silver tussock are important as well as many introduced plants including cocksfoot, prairie grass, veldt grass (Ehrharta erecta) and tree mallow. The Trios, Brothers, Outer Chetwode, Titi and Stephens Islands are noteworthy for having no introduced mammals; Inner Chetwode and Te Kiore Islands to the W, have kiore only. Mana Island and most of Kapiti were formerly farmed. Sheep were removed from Mana I. in the 1970s and cattle removed in 1986.

FLORA: notable plant species include Melicope ternata, Craspedia uniflora var maritima, Aciphylla squarrosa subspecies, Hebe elliptica var crassifolia (on slopes of Titahi Bay and Kapiti only) and Hymenanthera obovata.

BIRDS etc: in relation to various parts of the district: Kapiti: vegetation mostly modified by Polynesians; goats shot out in the 1920s, wekas and possums remain a problem but are being controlled, Norway rats and Kiore are present, cats are absent. The present day bird fauna of the island is the only substantial remnant of the former coastal forest bird fauna of Cook Strait. Several species, e.g. kaka, Whitehead, N.I. Robin, are at much higher densities than on the mainland. Little Spotted Kiwi and Saddleback have been introduced. For sea birds Kapiti is of only moderate importance; Sooty Shearwater on main and adjacent islands.

Mana Island, although more conspicuously modified than Kapiti, may have comparable biological importance in that the only introduced wild mammals now present are mice.

The North Island coast of this district is so modified that very few significant wildlife and vegetation values remain; possibly the most diverse and interesting site from point of view of birds and vegetation is

Pipinui Point where Sooty Shearwater still breed.

Of national importance are the Cook Strait Islands adjacent to the Marlborough Sounds; Stephens I., Trios I., Chetwode Islands, White Rocks, The Brothers.

Stephens I: although the original vegetation has been destroyed, most of the island is still heavily grazed (sheep) and cats (since removed) and early collectors destroyed former bird fauna, this island remains very important for breeding sea birds (Fairy Prion, major central N.Z. colony; Sooty Shearwater; Fluttering Shearwater; Diving Petrel) and other wildlife.

Trio Islands: the least modified Cook Strait islands; weka were removed in 1950s. Very important for breeding sea birds with Sooty Shearwater, Fluttering Shearwater (very abundant), Flesh-footed Shearwater, Fairy Prion (very abundant), Diving Petrel (very abundant), King Shag (North Trio).

Chetwode Islands: consist of two main islands and five stacks (including Ninepins and Sentinel Rock), more modified - pigs and rabbits no longer present; Outer Chetwode (Te Kakako I.) formerly grazed; has dense populations of Yellow-crowned Parakeet and robin. Kiore on Inner Chetwode; lower populations of sea birds than other islands in this category, only Fluttering Shearwater really abundant. Sentinel Rock of special importance as a breeding site for rare King Shag and only Cook Strait breeding locality for White-faced Storm Petrel.

The Brothers: most important for their large sea bird colonies; islands greatly modified, grazed and original vegetation burnt, but no introduced mammals. Fairy Prion are the most abundant and important species of sea birds; Sooty Shearwater, Fluttering Shearwater, Diving Petrel also present in large numbers.

White Rocks: nationally important as world's main breeding site for King Shag (endemic subspecies). Virtually no vegetation and soil (therefore no breeding petrels).

In secondary category of importance is Titi Island (Motungarara) from which rats were removed in the 1970's; it has important sea bird populations: Flesh-footed, Sooty and Fluttering Shearwaters.

Rangitoto Islands: vegetation much modified (grazed and burnt); Norway rat and kiore are present but the islands are stoat free.

Arapawa I., more than 9000 ha, is the largest island in Marlborough Sounds and sixth largest in N.Z. group; the most important part of the island biologically is that which is included in this district - boundary is drawn to exclude the red beech and black beech forest on axial ridge (Sounds E.D.) but to include distinctive coastal forest on lower slopes. These coastal forests are finest remaining examples of those which originally clad the shores of Cook Strait. The Arapawa I. examples show great complexity in terms of structure and species richness in the canopy. About half of the section of this island in this district is covered with forest unmodified by fires in European times. Possums absent; however rats and mustelids present; goats and pigs a major problem. The very local population of Arapawa I. feral sheep near Perano Head are probably the most ancient feral population in Australasia apart from Pitt Island (CHATHAMS).

Only land bird species of note Brown Creeper. A small population of Fluttering Shearwater may persist.

REPTILES: very high reptile diversity with tuatara (Sphenodon punctatus) and 15 lizards (11 on the N side of the strait, 8 on the S). Tuatara are abundant on Stephens I., all three islands in the Trios group, and on the northernmost of The Brothers. Stephens I. has the largest remaining population of tuatara, probably exceeding 50,000 animals. The Cook Strait populations of tuatara are the southernmost although sub-fossil remains are known from scattered sites throughout the South Island. Stephens Island gecko (Hoplodactylus stephensi) is endemic to Stephens I.

Southernmost limit for the skink genus Cyclodina is the northern side of the strait, and of C. whitakeri at Pukerua Bay known elsewhere only from Castle Rock (Tairua E.D.) and Middle I. (Mercury Islands E.D.), C. magregori on Mana I. (known elsewhere only from Sail Rock (Taranaga E.D.) and the Cavalli Islands (Eastern Northland E.D.)), and copper skink (C. aenea). Ornate skink (Cyclodina ornata) present on Kapiti I. Southernmost limit of the gecko genus Naultinus and of common green gecko (N. elegans punctatus) is the northern side of the strait.

Southernmost limit of goldstrip gecko (Hoplodactylus chrysosireticus) on Mana I. (elsewhere known only in Egmont, North Taranaki, Matemateaonga and Manawatu Plains E.D.) and of Duvauvcel's gecko (H. duvauceli) on The Brothers. Hoplodactylus duvauceli is common on Trios Islands, Sentinel Rock and The Brothers but is now believed extinct on Stephens I. Large populations of Marlborough green gecko (Heteropholis manukanus) on Stephens I. (northern limit). Speckled skink (Leiolopisma infrapunctatum) common on Stephens I.; spotted skink (L. lineocellatum) known from Titahi Bay and Plimmerton on the N side of the strait and most of the islands in the outer Sounds; brown skink (L. zelandicum) common on the Wellington coast and on the islands in the outer Sounds.

FROGS: Hamilton's frog (Leiopelma hamiltoni) occurs in very low numbers near the summit of Stephens I. Elsewhere known only from Maud I. in the adjacent Sounds E.D.

INSECTS: include the Cook Strait giant weta (Deinacrida rugosa) on Mana and Stephens Islands; the eastern South island chirping cicada, Amphipsalta strepitans, has been recorded N of the strait on Red Rocks coast, and from Karori Stm to Terawhiti, its northernmost location; the click beetle, Amychus granulatus (Brown) is abundant on Stephens I. and also occurs on Brothers; the speargrass weevil, Lyperobius huttoni Pascoe, occurs on the Wellington south coast (food plant Aciphylla spp.); found elsewhere from Marlborough to Canterbury.

SNAILS: include the land snail, Rhytida greenwoodi stephensis, endemic on Stephens I. and Wainuia urnula urnula on Kapiti and adjacent mainland. Powelliphanta hochstetteri bicolor occurs on Arapawa I.

## SOUNDS ECOLOGICAL DISTRICT 39.03

Criteria: topography (the catchments of drowned river valleys), climate (maritime).

TOPOGRAPHY: complex system of drowned valleys, separated by ridges and hills; highest point Mt Stokes, 1204m a.s.l.

GEOLOGY: Carboniferous Marlborough schist in the E; Carboniferous greywacke and argillite in the central part; Permian argillite and igneous conglomerate with some serpentine, dunite and gabbro etc. conglomerate on D'Urville I. in the W.

CLIMATE: W to NW winds prevail with relatively frequent gales; rainfall 1200-2000mm p.a., reliable and evenly distributed throughout year; maritime influence in outer sounds especially; minimal coastal influence on vegetation above the littoral zone in inner sounds; warm summers, mild winters.

SOILS: mainly moderate to very strongly leached and podzolised stony steepland soils from indurated sandstone, argillite and subschist and derived slope deposits, with minor areas from basic and ultrabasic rocks: stony and deep to shallow soils with clayey subsoils; in lower rainfall areas under former mainly coastal hardwood-podocarp forest, leaching moderate to strong; with increasing altitude and rainfall and beech forest dominance soils grade through strongly leached to very strongly leached podzolised soils and podzols with bleached surface horizons and iron-humus pans. Soils from ultrabasic rocks, browner in colour and have severe nutrient imbalances because of very high magnesium which often reaches toxic levels for plants. Soil fertility generally low to very low throughout.

VEGETATION: originally forested throughout; beech forests occur widely above 250m a.s.l.: mostly hard beech with black beech at low altitudes and silver beech with very little red beech on upper slopes except on Arapawa I. In outer sounds coastal hardwood forests (kohekohe) with some podocarps are predominant, with beech species mainly restricted to ridges and spurs. In inner sounds a littoral fringe of low coastal vegetation; hard beech forest originally predominated on most slopes with black beech on headlands and spurs and hardwood forest, usually kohekohe-taws forest with pukatea and hinau in valleys and minor podocarp element (rimu, some miro), elsewhere.

FLORA: kohekohe reaches its southern limit here. The 2.2 ha of alpine vegetation above the bushline and surrounding forest on Mt Stokes contain 154 species of vascular plants; endemic species on Mt Stokes include Celmisia mcmahonii var mcmahonii, C. hieracifolia var oblonga, Anisotome haastii n.var.; type locality Celmisia rutlandii and Stellaria minuta; the snow tussocks are related to North I. rather than South I. populations.

FAUNA: important populations of threatened species occur on some islands - see below.

BIRDS: the land bird fauna is mostly influenced by the distribution of unmodified forest. Special features include the isolated population of Yellowhead on Mt Stokes; also present are kaka, N.Z. Falcon, Reef Heron (all uncommon), Brown Creeper (central forested areas and Arapawa I., not on small islands). Forests around inner Sounds provide habitat for robins which occur naturally on some mainland areas and some islands and have been introduced to others, e.g. Motuara I., Allports I. Pelorus R. mouth is the only estuary in Sounds and thus important for e.g. Spotless Crane, Marsh Crane.

Sea birds: breed on islands in district and King Shag (unknown outside this district and closely adjacent sea areas) and Pied Shag feed in sheltered waters; large populations of Red-billed Gull (moulting) and Fluttering Shearwater are present especially in winter.

Maud I. is rodent free; species of endangered N.Z. endemic bird genera were introduced but some removed when stoats reached the island; stoats have since been trapped out and robin and Takahe persist. Duffers Reef (Pelorus Sound) is main breeding place of King Shag after White Rocks. Sooty Shearwater and Fluttering Shearwater nest in small numbers on several islands in Sounds including Duffers Reef, Motuara, Motungarara, Amerikawhati, Kokomohua. Spotted Shag breed at Admiralty Bay.

REPTILES: good populations of brown skink (Leiolopisma zelandicum) and spotted skink (L. lineocellatum) on islands in the district, and of Marlborough green gecko (Heteropholis manukanus) on the mainland.

FROGS: the largest Hamilton's frog (Leiopelma hamiltoni) population is in the forest remnant on Maud I.; known elsewhere only from Stephens I. in the adjacent Cook Strait E.D.

INSECTS: include the giant weta, Deinacrida rugosa which was transferred to Maud I. (from Stephens I.) before 1980 (also occurs on Mans, I. in Cook Strait District). The Anthribid beetle, Cacephatus huttoni (Sharp) occurs at its southernmost (recorded) limit at Picton on a wide range of indigenous trees and shrubs. The ground beetle, Megadroma sp, is found at Picton and Port Underwood Saddle, Arapawa I. only. At least three species of this genus occur in this area: M. compessus, M. rectangulus and an unnamed species - distributions, abundance and conservation status inadequately known.

SNAILS: include Powelliphanta hochstetteri bicolor, abundant on Blumine I., Arapawa I. and Mt Stokes; P. h. obscura also occurs in the district; Wainuia urnula occurs in the high beech forests on Arapawa I. There is an endemic species of punctid snail, N. gen. spiralis (Suter).

MODIFICATIONS: some Polynesian clearance mainly in the E; much farm clearance: podocarp-hardwood forest now largely eliminated and restricted to gullies, alluvial terraces and fans; throughout the district a great variety of scrub and secondary forest has followed burning, dominated by tauhinau, manuka, bracken in the early stages, Spanish heath common in the E; no beech occurs in secondary forests. Some farming continues (semi-extensive sheep and cattle); exotic forest area increasing. The only introduced mammals on Long and Motuara Islands are kiore. Stoats are capable of reaching all islands except Bird, Allports, Long and Motuara; they visit Maud from time to time and will visit any other islands less than 1 km from shore. Rat free islands are Maud, Awaiti and possibly Karaka. Allports I. has mice.

## D'URVILLE ECOLOGICAL DISTRICT 39.04

Criteria: topography, geology.

TOPOGRAPHY: coastal steeplands of eastern Tasman Bay: steep hills, gullies and confined coastal flats and inlets distinguish this district from the gentler, smoother topography of Bryant district; maximum altitude 729m a.s.l.

GEOLOGY: mostly Permian argillite and igneous conglomerate; extensive areas of ultramafic rocks: serpentinite, dunite, gabbro etc. and conglomerate and spilite, also Brook Street and Patuki Volcanics; D'Urville I. only separated from rest of Marlborough since last glacial.

CLIMATE: W to NW winds prevail with relatively frequent gales; rainfall 1250-2000mm p.a., reliable and evenly distributed throughout year; warm summers, mild winters.

SOILS: steepland soils from indurated sandstone, argillite and schist and solifluvial debris from these rocks with smaller areas of basaltic and ultramafic rocks; soils stony, moderately deep to shallow with clayey subsoils; in lower rainfall areas leaching moderate, soils fertile; with increasing altitude and rainfall soils grade through strongly leached and podzolised to infertile podzols with bleached subsurface horizons and iron-humus pans.

VEGETATION/MODIFICATIONS: originally forested; Polynesian and European clearance; large areas of indigenous vegetation remain: coastal vegetation has greater affinities with Sounds district than with Bryant or Motueka. Predominant vegetation on most slopes is hard beech - kamahi forest with some rimu; kohekohe, karaka, titoki and tawa dominate on higher fertility sites, black beech on spurs and exposed ridges, red beech and silver beech in damper sites at higher altitudes. Scrub-akiraho and Phormium cookianum dominate coastal cliffs and escarpments; manuka-kanuka scrub with regenerating forest hardwoods covers extensive areas where forest has been burnt. Vegetation on ultramafic rocks probably originally dominated by low forest and scrub of southern rata, mountain beech, kamahi and inaka; most ultramafic areas have been burnt; now dominated by a tight scrub of manuka, inaka, tauhinu, kamahi, southern rata. There are some wetlands.

FLORA: D'Urville I. has abundance of mistletoe species (6 of the 8 extant mistletoe species recorded); Gahnia lacera and Lepidosperma laterale present (their only South Island location). The SW corner of the district (as well as D'Urville Island itself) contains several coastal tree species (kohekohe, karaka, tawa, wharangi (Melicope ternata), whau, nikau and pukatea) which are either very restricted in, or do not extend into, Bryant E.D. Plants of the ultramafic areas include Hebe urvilleana and H. rigidula form.

BIRDS: on D'Urville Island notable birds include Little Spotted Kiwi (possibly no longer present), S.I. Robin, Brown Creeper, Rifleman, kaka, N.Z. falcon, Brown Teal (introduced), Reef Heron. Delaware Bay and Croisilles Harbour provide significant wader habitats; Banded Rail abundant; breeding colonies of Pied, Black and Little Shags. Pepin I. in Delaware Bay has Red-crowned Parakeet.

REPTILES: scattered populations of brown skink (Leiolopisma zelandicum) (as far S as Cable Bay), spotted skink (L. lineocellatum), and Marlborough green gecko (Heteropholis manukanus).

SNAILS: include Powelliphanta hochstetteri hochstetteri fa. obscura.

MODIFICATIONS: parts of district are farmed; exotic forest area increasing; possums, hares, Norway and ship rats absent from the island; kiore, mice, stoats, and cats present. No introduced mammals occur on Motuanauru, Moukirikiri and Otuhaereroa Islands.

Criteria: topography, climate, vegetation.

TOPOGRAPHY: inland hill country and mountains of the Pelorus River catchment draining N to Marlborough Sounds; highest point Mt Richmond, 1762m a.s.l.

GEOLOGY: includes Carboniferous chlorite schist in the SE, Permian greywacke and argillite in the Richmond Range and Permian argillite and igneous conglomerate of serpentine, dunite and gabbro etc. in the Bryant Range, notably in the vicinity of Dun Mountain.

CLIMATE: relatively warm summers and mild winters in hill country; rainfall 1600-2000mm p.a., reliable and evenly distributed throughout the year; W to NW winds prevail. Lowland valleys locally wet and cool, with strong influence of a diurnal ponding of cold air (with valley fogs in winter). The hill country has a milder climate.

SOILS: strongly leached to podzolised stony steepland soils and podzols from indurated greywacke, argillite, schist and associated solifluvial debris; small areas of soils from Pleistocene gravels; minor areas of alluvial soils in valleys; apart from latter, fertility low, generally not farmed.

VEGETATION/MODIFICATIONS: originally forested, few remnants; typically montane species such as silver beech occur in cooler sites in the Rai and Ronga valleys with ribbonwood (Plagianthus betulinus), kahikatea, matai and totara on more riverine sites; some farmland (semi-extensive sheep and cattle). Hill country forest predominantly hard beech-rimu dominated at low altitude, with red beech and silver beech at higher altitudes; kamahi is a major sub-dominant throughout. Alpine grasslands mainly dominated by snowgrass, Chionochloa pallens, with carpet grass, C. australis, in some areas. A Phyllacne-Oreobolus herbfield occurs between Mt Richmond and Johnson Peak.

FLORA: rare species occurring in the alpine grasslands of Mt Richmond include Celmisia macmahonii var hadfieldii, C. sinclairii, C. cordatifolia, Hebe gibbsii.

MAMMALS: long-tailed bats occur in Pelorus R. catchment (only location in Marlborough).

BIRDS: a wide variety of forest birds, perhaps reflecting diversity of food sources and tree species: Blue Duck, kaka, Yellow-crowned Parakeet in upper Pelorus R., N.Z. Falcon (rare), kea near Mt Richmond, Yellowheads at Whangamoia Saddle.

REPTILES: Marlborough green gecko (Heteropholis manukanus) in the N and E; Nelson green gecko (Heteropholis stellatus) in the Bryant Range.

INSECTS: include giant weta Deinacrida connectans, found locally.

## PARA ECOLOGICAL DISTRICT 40.02

Criteria: topography (hill blocks and broad flat valleys) and climate (rapid reduction of rainfall from north to south).

TOPOGRAPHY/GEOLOGY: steep, finely dissected Paleozoic schist hills to 1310m a.s.l., penetrated by long, broad valleys with deep alluvium.

CLIMATE: generally moist: rainfall 800-1600mm p.a.; mild with valley fog in winter.

SOILS: strongly leached to podzolised stony steepland soils from subschist and associated solifluvial debris; small areas of strongly leached to podzolised soils from Pleistocene gravels; minor areas of alluvial soils on river flats and fans along southern boundary; apart from latter natural fertility low; alluvial soils fertile but generally stony and droughty.

VEGETATION/MODIFICATIONS: upper slopes in beech-kamahi-rata forest: silver beech dominant on upper slopes, red beech prominent mid-slope, black beech and hard beech lower slopes; kamahi main understorey tree; lower slopes and valleys mostly pasture and exotic forest, occasional wetlands and remnant podocarps and species-rich hardwood forests.

BIRDS: include Spotless Crake and Marsh Crake.

REPTILES: Marlborough green gecko (Heteropholis manukanus) present in forested areas.

## FISHTAIL ECOLOGICAL DISTRICT 40.03

Criteria: topography (a backbone of high peaks with steep south-facing valleys, imparting a characteristic climate and distinctive high altitude flora).

TOPOGRAPHY/GEOLOGY: upper Paleozoic low grade schist and greywacke, non glaciated mountains to 1655m a.s.l., Mt Patriarch, with a discontinuous series of high peaks along the Richmond Range; steep streams descending southwards to the Wairau River; western portion distinctive, with extensive fluvio-glacial outwash and moraine deposits, a complex geological pattern and locally severe erosion.

CLIMATE: cool moderately wet mountain climate; rainfall 1000-1600mm p.a.

SOILS: mainly strongly acid, stony, strongly leached and podzolised steepland soils from greywacke and subschist; minor areas of moderately to strongly leached and podzolised soils from morainic and outwash gravels; alluvial soils on river flats and fans; apart from latter fertility is low; alluvial soils fertile but stony and droughty.

VEGETATION/MODIFICATIONS/FLORA: mainly forested (red beech, silver beech and mountain beech) with distinctive flora above treeline including wet mountain shrubland, grassland (with both southern and northern affinity) and endemic species of Hebe and Celmisia. Lower slopes farmed; increasing areas of exotic forest.

BIRDS: Yellowhead near L. Chalice; Blue Duck in Goulter R.

REPTILES: Marlborough green gecko (Heteropholis manukanus) in scattered populations throughout; those toward the S with prominent raised scales over much of the body. These are the southernmost animals that are regarded as rough gecko (H. rudis) although the geographical and morphological boundary between these two species is unclear.

## BLENHEIM ECOLOGICAL DISTRICT 41.01

Criteria: geology, topography and climate

TOPOGRAPHY/GEOLOGY: low-lying Quaternary outwash plain formed by Wairau, Waihopai and Opawa Rivers with Holocene marine gravel adjacent to the prograding coastline; coastal lagoons; all below 200m a.s.l.

CLIMATE.: low rainfall, 700-800mm p.a., with very high summer-autumn sunshine hours.

SOILS: well to poorly drained alluvial soils on river flats range from gravelly sands to clays; natural fertility high but drainage ranges from excessive to poor so some areas are droughty in summer while others are waterlogged in winter and require drainage. Stony and shallow soils on terraces very droughty in summer.

VEGETATION: formerly a mosaic of hardwood-podocarp forest (mainly kahikatea), flax and raupo wetland, shrubland and short-tussockland. Now the main natural habitats are streams, rivers and wetlands including Wairau lagoons and remnant freshwater wetlands (very important).

BIRDS: estuary of Wairau R. and Wairau lagoons extremely important waterfowl and shore bird habitat, e.g. N.Z. Shoveler, Grey Teal, Spotless Crane.

REPTILES: spotted skink (Leiopisma lineocellatum) occurs along the shore of Cloudy Bay.

FISH: include giant kokopu (Galaxias argenteus).

MODIFICATIONS: now almost completely pastoral with increasing areas of intensive horticulture; urban areas.

## WITHER HILLS ECOLOGICAL DISTRICT 41.02

Criteria: climate, topography and soils.

TOPOGRAPHY/GEOLOGY: a variable block of steep dissected hill country, composed of weakly consolidated Tertiary rocks in the E and rising to low mountains of Mesozoic greywacke in the W; maximum altitude 1234m a.s.l; coated with deep loess on the N.

CLIMATE: low rainfall, 780-1000mm p.a., with extreme summer desiccation; NW winds.

SOILS: weakly to moderately leached steepland soils from greywacke on steeper hill country; weakly leached soils from loess with compact, pale-coloured, mottled subsoils on hilly and rolling land; stony, shallow soils on terraces; most soils fertile but droughty in summer; those from loess on hill slopes subject to tunnel-gully erosion.

VEGETATION: believed to have formerly included xeric shrubland (Sophora prostrata, matagouri, Hymenanchera crassifolia, Muehlenbeckia complexa), gully forests (kowhai, mahoe, five finger, Olearia paniculata), silver tussock and "danthonia" grassland; possibly also matai and totara.

REPTILES: eastern limit of forest gecko (Hoplodactylus granulatus) in northern South Island is at Dumgree.

MODIFICATIONS: now a mosaic of vegetation types, mostly secondary (bracken, kanuka), dominated by mixed native and introduced pasture grasses.

## GRASSMERE ECOLOGICAL DISTRICT 41.03

Criteria: landform, climate and vegetation.

TOPOGRAPHY/GEOLOGY: rising from highly saline Lake Grassmere at sea level to low foothills of Tertiary rocks in the S; maximum altitude 293m a.s.l.; includes high terraces of Awatere River, coastal cliffs, sand-dunes and wetlands; drained mainly by Awatere River, also by many small streams flowing to Lake Grassmere or the coast (e.g. Blind River).

CLIMATE: very warm summers with dry foehn winds; moderate winter temperatures; rainfall less than 700mm p.a., spring-summer dry.

SOILS: weakly leached soils with pale-coloured compact subsoils from loess on terrace, rolling and hilly land, fertile but droughty; saline soils around Lake Grassmere; fertile, well drained alluvial soils on river flats.

VEGETATION/MODIFICATIONS: formerly small areas of matai-hinai-mahoe forest, but mostly mahoe-titoki-ngaio coastal hardwood forest, Leptospermum scrub and fescue-silver tussock grassland; now mostly farmland, riverbeds and patches of Leptospermum forest and scrub with other hardwoods in places; marram grasslands on sand-dunes; wetland vegetation.

BIRDS: L. Grassmere important for waterfowl and shore birds; species include Grey Teal, N.Z. Shoveler; also adjacent is large colony of Red-billed Gull.

## FLAXBOVRNE ECOLOGICAL DISTRICT 41.04

Criteria: landform, climate, geology and vegetation.

TOPOGRAPHY/GEOLOGY: hilly land of Tertiary sediments in the N rising to higher hills of Mesozoic greywacke in the S; maximum altitude 838m a.s.l.; finely dissected drainage patterns, mainly drained to the E via Flaxbourne River.

CLIMATE: very dry springs and summers with dry foehn winds; rainfall 700-1000mm p.a.; moderate winter temperatures.

SOILS: on terrace, rolling and hilly lands from loess with compact, pale-coloured subsoils, moderate to high natural fertility but droughty in summer; soils on hilly land from argillites and conglomerates, moderately deep, moderate to low fertility, slips and gullies common; soils on steep slopes from greywacke in slightly higher rainfall areas, shallow and stony with browner, more friable subsoils.

VEGETATION/MODIFICATIONS: originally small areas of matai-totara-hinaumahoe forest, extensive mahoe-fivefinger-mapou forest and Leptospermum forest and some black beech forest in the S. Now predominantly farmland with pockets of hardwood forest including black beech and Leptospermum scrub.

FLORA: this area is the habitat of the strikingly red-stemmed Pachystegia 'D'.

BIRDS: L. Elterwater significant for waterfowl including Grey Teal, N.Z. Shoveler, N.Z. Scaup; Southern Crested Grebe have bred on lake; weka, N.Z. Falcon present; Rifleman, Brown Creeper in forest remnants.

## HILLERSDEN ECOLOGICAL DISTRICT 41.05

Criteria: topography (landform, altitude and aspect) and climate.

TOPOGRAPHY: lower slopes of Bounds and Raglan Ranges (reaching 1415m a.s.l. in the W), including terraces along the true right bank of the Wairau River and its tributaries.

GEOLOGY: Mesozoic greywackes and argillites with Tertiary mudstone and sandstone conglomerates in the NE.

CLIMATE: mostly north-facing with dry summers and cool winters; rainfall 800-1400mm p.a.

SOILS: mainly moderately fertile shallow and stony steep-land soils from greywacke, conglomerates and mudstones; in lower rainfall areas in NE subsoils pale-coloured and compact, droughty in summer; in higher rainfall areas in SW, subsoils browner and more friable with more even moisture conditions; stony and shallow droughty soils on terraces of Wairau River.

VEGETATION/MODIFICATIONS: formerly probably a diverse mosaic of forest (podocarp, beech and hardwood), shrubland (kanuka, manuka, Sophora, matagouri) and tussockland (silver tussock). Now almost entirely farmed, with scattered kanuka forest and occasional forest remnants, including red beech, black beech, matai and lowland hardwoods such as kowhai, lacebark and tarata.

INSECTS: include weta, Deinacrida connectens in Wairau Valley.

## WAIHOPAI ECOLOGICAL DISTRICT 42.01

Criteria: topography (between alpine and lower hill country), climate, vegetation: the diversity of vegetation types (including induced vegetation) reflects the range of altitude and climate which relates to the location of the district between alpine areas to the W and S, and drier lower hill country to the N and E.

TOPOGRAPHY/GEOLOGY: steep Mesozoic greywacke mountains reaching 2050m a.s.l. in the SW; drained principally to the NE by the Waihopai and Awatere River systems; evidence of former glaciation rare.

CLIMATE: relatively low rainfall, 800-1800mm p.a.; hot summers, cold winters.

SOILS: shallow, stony steepland soils from greywacke and associated slope deposits, at low altitudes and rainfall soils are moderately fertile but droughty in summer; with increasing altitude and rainfall gradation through moderately leached, slightly less fertile soils to strongly leached, low fertility soils in upland areas; latter have severe sheet, slip and frost erosion; small areas of stony soils on terraces.

VEGETATION/MODIFICATIONS: originally mostly forested; now predominantly extensive pastoral farming, but a diverse range of vegetation types remain, particularly beech (red beech and mountain beech) and kanuka forest, shrubland and fellfield.

FLORA: some lowland forest species are significant (Notospartium, Pittosporum tenuifolium, Griselinia littoralis); formerly Chordospartium - now extinct.

BIRDS: the most northern district where the undescribed large eastern race of N.Z. Falcon becomes common; Brown Creeper present.

REPTILES: spotted skink (Leiolopisma lineocellatum) known from Awatere Valley.

INSECTS: include weta, Deinacrida connectens in Black Birch Stream catchment.

## MEDWAY ECOLOGICAL DISTRICT 42.02

Criteria: climate, vegetation and landform.

TOPOGRAPHY: steep hilly land with many gorges; maximum altitude 1426m a.s.l.

GEOLOGY: lower Tertiary deposits in the Waima catchment draining to the E; mainly Mesozoic greywacke in the Medway catchment draining north-eastwards to the Awatere River.

CLIMATE: very warm summers with dry foehn winds; spring-summer dry, rainfall 1000-1200mm p.a.; cooler winter temperatures.

SOILS: mainly stony steepland and hill soils from greywacke, argillites, calcareous sandstones and limestones and related slope deposits formed under a wide range of altitude and rainfall; at lower altitudes and rainfall soils have compact, pale-coloured, heavy textured subsoils; with increasing altitude and rainfall soils grade from those with yellowish-brown firm silty subsoils to high country soils with friable loamy subsoils; most soils are farmed but dry out in summer, erosion serious in some areas especially the high country.

VEGETATION: originally black beech forest in the W, Hall's totara-broadleaf or matai-totara-hinau-mahoe forests and broadleaf-fuchsia or mahoe-fivefinger-mapou forests in the E; small areas of fescue-silver tussockland at high altitudes and in the Awatere.

MODIFICATIONS: now mainly farmland with pockets of forest and Leptospermum scrub.

## BOUNDS ECOLOGICAL DISTRICT 42.03

Criteria: climate, vegetation, soils and geology.

TOPOGRAPHY: alternating series of partially glaciated SW-NE trending mountain ranges and narrow valleys, mostly between 1000 and 2000m a.s.l.; extremely steep, numerous rock outcrops; some perched basins (former cirques), narrow alluvial fans, outwash terraces; debris avalanches important.

GEOLOGY: Triassic greywacke and argillite, scattered volcanic dykes, local limestone.

CLIMATE: cold winters, intermittent shallow snow; hot, dry summers, strong NW wind; rainfall varies from 1600mm in the NE to 2000mm in the SW, spring and autumn maxima.

SOILS: shallow, stony high country steepland soils from greywacke and related slope deposits with alpine soils, bare rock and scree at higher altitudes; more fertile lowland soils with firmer subsoils at lower altitudes; soils dry out in summer, prone to scree erosion.

VEGETATION: extensive mountain beech forest with limited hardwood species and podocarps (Hall's totara); high treeline (1500m); limited subalpine shrubland and tall tussock grassland; extensive fellfield and bluff communities. Induced vegetation extensive at lower altitudes, dominated by short tussockland, with tauhinu and spaniard, and kanuka forest.

FLORA: dominated by eastern South I. high country species with strong NE South I. endemic element on bluffs, fellfield and scree. Notospartium occurs in far NE, otherwise Marlborough riparian endemics absent; bluff and fellfield species include e.g. Helichrysum coralloides, Ewartia sinclairii, Haastia pulvinaris, Leucogenes leontopodium. Northern outliers of southern species include Senecio cassiniodes, Ranunculus crithmifolius, Pittosporum patulum.

BIRDS: include Bellbird, Brown Creeper in beech forest; N.Z. Falcon common; otherwise district highly modified and bird fauna depauperate.

REPTILES: northernmost limit of animals referred to Heteropholis rudis - rough gecko.

INSECTS: include a scree weta. This district is the southernmost part of the range of the alpine cicada Maoricicada tenuis Dugdale and Fleming.

SLUGS: include the giant slug (Pseudoneitea sp.).

MODIFICATIONS: extensively modified by Polynesian fires, pastoral farming, exotic forest (as erosion control revegetation); introduced mammals including deer, chamois, goat, hare, rabbit, possum. Widespread accelerated erosion.

## GEORGE ECOLOGICAL DISTRICT 42.04

Criteria: landform, geology, vegetation and climate.

TOPOGRAPHY: steep, dissected hill country; maximum altitude 1523m a.s.l.

GEOLOGY: Tertiary deposits, extensive areas of limestone are exposed on inland side of major faults in the N of the district; Mesozoic greywacke in the S; bisected by gorge of Clarence River which drains most of district.

CLIMATE: very warm dry summers in the N and E; cooler, wetter hill climates inland and to the south; rainfall 1000-1400mm p.a.

SOILS: mainly stony and shallow steepland soils from greywacke, limestone and calcareous sandstone and related slope deposits; those from greywacke range from moderately leached and fertile soils at lower altitudes to less fertile strongly leached and podzolised soils at higher altitudes and rainfall; soils from limestone are clayey textured, with moderate natural fertility.

VEGETATION/MODIFICATIONS: originally mostly forested: forest types include podocarp-hardwood forests with Hall's totara/broadleaf forest at higher altitudes and matai-totara-hinau-mahoe forests at lower altitudes; hardwood forests with broadleaf-fuchsia forest at higher altitudes and mahoe-fivefinger-mapou forest at lower altitudes; and beech forests, black beech-mountain beech and red beech forests. All forests reduced to remnants amongst extensive Leptospermum and mixed hardwood scrub, silver tussockland and farmland; a 10-15 ha matai remnant on river meander occurs at Matai Flat, Clarence R.

FLORA: main populations of tree broom (Chordospartium stevensonii)

occur on N end of Seaward Kaikoura Range; many other Marlborough endemics, e.g. Pachystegia spp., Carmichaelia astonii, Notospartium glabrescens; rare species, Myosotis arnoldii (also in N.W. Nelson) on spectacular limestone topography.

BIRDS: include N.Z. Falcon, robin.

## SEDGEMERE ECOLOGICAL DISTRICT 43.01

Criterion: topography.

TOPOGRAPHY/GEOLOGY: inland basin with numerous tarns formed in Quaternary glacial outwash and associated tectonic landforms, surrounding an isolated block of dry, rounded Mesozoic greywacke and argillite mountains (Mt Alma, 1617m a.s.l.).

CLIMATE: low rainfall, about 800mm p.a.; hot summers and cold winters.

SOILS: predominantly stony, shallow droughty steep-land soils from greywacke, argillite and related slope deposits; stony soils on glacial outwash material with patches of poorly drained soils with peaty topsoils in hollows; serious scree and slip erosion.

VEGETATION/MODIFICATIONS: predominantly short tussockland and wetland vegetation; grazed (Sedgemere is surrounded on three sides by Balaclava and is bordered by the dry mountains of Dillon on the E).

FLORA: diverse turf flora including Isoetes and Pilularia; northern most area of glacial till and outwash wetlands.

## BALACLAVA ECOLOGICAL DISTRICT 43.02

Criteria: topography, climate and vegetation

TOPOGRAPHY: mountains to 2000m a.s.l. isolated by broad valleys, constituting part of the headwaters of the Wairau, Waiau and Clarence Rivers.

GEOLOGY: mainly non-glaciated Mesozoic greywacke, generally eroding to produce rounded slopes, often scree-covered.

CLIMATE: relatively dry, continental; hot summers and cold winters; rainfall 1000-2400mm p.a.

SOILS: mainly stony, shallow stepland soils from greywacke and related slope deposits showing increasing leaching with increasing rainfall and altitude; on easier slopes under higher rainfall very strongly leached podzols with bleached subsurface horizon; soils dry out in summer, scree and slip erosion common.

VEGETATION/MODIFICATIONS: scattered remnants of mountain beech forest in the W, mainly tall and short tussockland elsewhere, with cattle grazing. BIRDS: exceptional situation in Rainbow Valley where despite absence of forest there is a relatively rich forest bird fauna including rifleman in the restricted areas of shrubs; N.Z. Falcon present; otherwise district highly modified, bird fauna depauperate.

REPTILES: spotted skink (Leiopisma lineocellatum) known from Mt Muntz. Scree skink (Leiopisma otagense form waimatense) present on Balaclava Ridge (northern limit, known elsewhere only from the Coleridge, Tekapo, Benmore and Hawkdun E.D.). Unnamed skink (aff. Leiopisma nigriplantare) from Lake Tennyson (known elsewhere only from Tekapo E.D.).

INSECTS: include a newly discovered large weta, Deinacrida sp. near Acheron Saddle (no specimens yet collected); D. parva occurs E of L. Tennyson (needs protection). The alpine cicada Maoricicada alticola is only known from the Crimea Range (on the driest areas e.g. Turk Ridge); M. mangu celer also occurs on Crimea Range.

## MIROMIRO ECOLOGICAL DISTRICT 43.03

Criteria: climate (continental), topography (glacial outwash).

TOPOGRAPHY: the Hanmer Range (highest point Miromiro, 1875m a.s.l.) and Hanmer basin; drained S by the Waiiau R. and W by the Clarence R.

GEOLOGY: Mesozoic Torlesse Supergroup greywacke and argillite with Pleistocene glacial outwash gravels in the Hanmer basin.

CLIMATE: continental; hot summers, cold winters; rainfall 1200-2000mm p.a.; becomes wetter towards the W; frosts may occur throughout the year; substantial snow fall in winter; NW foehn winds in spring and early summer.

SOILS: mainly shallow, stony steepland soils from greywacke and related slope deposits showing increasing leaching with increasing altitude and rainfall; stony soils on associated terraces, fans and moraines; in Hanmer Basin, soils from outwash gravels and sands fertile but droughty.

VEGETATION/MODIFICATIONS: some indigenous forest remains on the mountains: mainly mountain beech with pockets of red beech and silver beech in discontinuous stands; native and induced grasslands are farmed (extensive sheep and cattle); large part of lowland in exotic forest.

BIRDS: include N.Z. Falcon.

REPTILES: rough gecko (Heteropholis rudis) present in forest on the Hanmer Range (southern and western limit) and in scrub remnants on the Hanmer plains. Lewis Pass green gecko (Heteropholis poecilochlorus) known from the S of this district along the Hope and Lewis Rivers (eastern limit).

## TAPUAENUKU ECOLOGICAL DISTRICT 44.01

Criteria: topography, climate, vegetation.

TOPOGRAPHY/GEOLOGY: partially glaciated mountains of Mesozoic greywacke and argillite, reaching 2885m a.s.l., forming core of Inland Kaikoura Range, draining E to the Clarence and W to the Awatere River; Minor Cretaceous sandstone and basic volcanics; includes southern end of limestone hogsback (George district at the northern end).

CLIMATE: high rainfall, mountain climate, 1200-2800mm p.a., drier in the W.

SOILS: mainly shallow, stony stepland and alpine soils from greywacke and related slope deposits, bare rock and scree at higher altitudes; at lower altitudes soils moderately fertile with little erosion; at higher altitudes soils less fertile, prone to slip and scree erosion; the lower altitude hill country soils have compact pale-coloured subsoils, very droughty in summer; small areas of clayey soils from limestone (rendzinas) and basic rocks.

VEGETATION: formerly matagouri/fescue-agropyron shrub-tussockland in valley floors; some mountain beech forest in the N with extensive Leptospermum, patches of Hall's totara - Hoheria lyalii throughout; fescue tussockland, Chionochoa tussockland, Dracophyllum scrub, herbfield, and extensive areas of bare colluvium at higher altitudes.

FLORA: many north-eastern endemic species have their centres of distribution here, particularly scree species: Raoulia cinerea, Epilobium forbesii, Convolvulus fracto-saxosa. Particularly rich in species of shrubby Helichrysum including many hybrid combinations.

BIRDS: N.Z. Falcon common; colonies of Hutton's Shearwater may still persist in the upper Dee Stream area at 1500m; otherwise district highly modified and bird fauna depauperate.

MODIFICATIONS: modified by fire and grazing especially along the margins.

## DILLON ECOLOGICAL DISTRICT 44.02

Criteria: topography, climate and vegetation.

TOPOGRAPHY: partially glaciated mountains to 2609m a.s.l. (Mt Manakau) and intermontane basins drained mainly by Awatere and Clarence Rivers.

GEOLOGY: mostly Mesozoic Torlesse Supergroup greywacke and argillite.

CLIMATE: cool, wet hill climate, rainfall ranges from 700-1600mm p.a., north-westerlies prevail, snow may lie for weeks in winter.

SOILS: mainly shallow, stony steepland soils from greywacke and related slope deposits showing increased leaching with increasing altitude and rainfall, some soils podzolised; prone to slip and scree erosion; in intermontane basins, soils from outwash gravels stony and droughty; in lower altitude foothills, soils from basalt and gravels.

VEGETATION: formerly Aciphylla - matagouri/fescue - agropyron shrub-tussockland on valley floors, with fescue tussockland and Chionochloa tussockland above, and small areas of mountain beech forest and Dracophyllum - Cassinia scrub; extensive alpine vegetation and bare rock.

FLORA: many north-eastern endemic species present; western limits of many species occur in district, e.g. Celmisia traversii.

BIRDS: contains the largest populations of eastern N.Z. Falcon in Marlborough, especially common in Clarence Valley; robin; otherwise district highly modified and bird fauna depauperate.

REPTILES: rough gecko (Heteropholis rudis) occurs in beech forest remnants in the S. Black-eyed gecko (Hoplodactylus kahutarae) is known only from the Seaward Kaikoura Range and occurs in this district and the adjacent Manakau E.D. Spotted skink (Leiopisma lineocellatum) occurs at scattered sites.

INSECTS: include a newly discovered large wets Deinacrida sp. near Acheron Saddle (no specimens yet collected).

MODIFICATIONS: much modified by fire and introduced mammals with pastoral farming below 1000m; adventive woody weeds, especially sweet brier, important.

## MANAKAU ECOLOGICAL DISTRICT 44.03

Criteria: landform, climate and vegetation.

TOPOGRAPHY/GEOLOGY: steep Mesozoic greywacke and argillite mountains up to 2609m a.s.l. (Mt Manakau) forming eastern side of Seaward Kaikoura Range; some Cretaceous sandstone and Tertiary limestones in the N; drained to the E by four rivers, many streams.

CLIMATE: cool wet hill climate on foothills; high rainfall mountain climate at higher altitudes; rainfall ranges from 1400-2000mm p.a.

SOILS: mainly shallow and stony steepland soils from greywacke showing increased leaching with increasing altitude and rainfall; at low altitudes moderately leached, fertile with little erosion; at higher altitudes more strongly leached, some podzolised; prone to slip and scree erosion, much bare rock and scree. Soils on rolling lands from siltstone in the SE have compact, pale-coloured subsoils with impeded drainage; small areas of soils from basic rocks on hilly slopes S of Mason River.

VEGETATION: originally Hall's totara-broadleaf-fuchsia and mountain beech forests, with small areas of matai-hinau forest, Dracophyllum - Cassinia subalpine scrub, Chionochloa and fescue tussockland, Celmisia herbfield and extensive bare landforms.

BIRDS: world population (less than 20,000) of Hutton's Shearwater nest high on slopes of seaward Kaikoura Range at at least three localities above 1200m (below Mt Tarahaka, below Mt Urerau and in the upper part of Snowflake Stm, Kowhai R.); N.Z. Falcon and robin present.

REPTILES: rough gecko (Heteropholis rudis) present in forest along the E slopes of the Seaward Kaikoura Range (northernmost record at Mt Fyffe). Black-eyed gecko (Hoplodactylus kahutarae) is known only from the Seaward Kaikoura Range and occurs in this district and the adjacent Dillon E.D. This is one of the few areas where both the "mini" and "maxi" forms of common gecko (Hoplodactylus maculatus) occur together and is the northernmost locality or the "mini" form. These two forms of H. maculatus, which in time will probably be raised to specific status, are widespread in the South I. The "maxi" form is found throughout but is less common in the higher and drier country along the E side of the Alps; the "mini" form occurs in Marlborough, Canterbury and Otago, along the eastern side of the Alps, where it inhabits screes and outcrops. Spotted skink (Leiopisma lineocellatum) occurs up to 1700m on the Seaward Kaikoura Range.

INSECTS: include weta Deinacrida parva near Jordan Stm (needs protection).

MODIFICATIONS: modified by fire and introduced mammals but same basic patterns remains.

## KEKERENGU ECOLOGICAL DISTRICT 45.01

Criteria: climate, landform, geology and vegetation.

TOPOGRAPHY/GEOLOGY: Tertiary rocks consisting of limestone, conglomerate, sandstone and mudstone, forming coastal hills and scarps cut by the Clarence River and numerous small streams draining directly to the sea; some river terraces and flats near river mouths; rises to over 1000m a.s.l.; long gravel beaches and dunes.

CLIMATE: very warm dry summers, moderate winters; spring-summer dry, droughts common; rainfall 700-1000mm p.a.; moderate winters though snow at higher altitudes.

SOILS: weakly leached, fertile soils with compact, pale-coloured subsoils from loess and sandstone, dry in summer. Soils from argillite and conglomerate are more leached and less fertile. Small areas of fertile alluvial soils border the Clarence River; excessively drained sand soils occur on coastal dunes.

VEGETATION/MODIFICATIONS: formerly N of Ure (Waima) River partially forested (Leptospermum and totara dry forest), with areas of scrub and fescue-silver tussockland; elsewhere mostly forested; some wetlands. Now forest reduced to small remnants (mainly in gullies) in a pastoral landscape (including small areas of mountain beech-black beech forest; hardwood forests - mahoe, fivefinger, mapou - some with ngaio and titoki; akiraho forest; mixed podocarp forest - rimu, matai, totara - and Hoheria lyallii treeland). Small areas of scattered scrub (including tauhinu, kanuka-manuka, totara, mixed broadleaf - e.g. fivefinger, mahoe, tutu, mapou); Coprosma propinqua scrub. A small area of pingao sedgeland on sand dunes (mainly marram grass). No wetlands remain.

FLORA: Marlborough endemics e.g. in Woodside Creek limestone gorge including Pachystegia insignis, Hebe hulkeana, Notospartium glabrescens, Wahlenbergia mathewsii, N. carmichaeliae, Senecio monroi; other limestone plants include Gentiana astonii; Chionochloa affinity flavescens occurs above this gorge at unusually low altitude; other montane plants growing at low altitudes include Celmisia coriacea and Aciphylla spp.

BIRDS: district heavily modified; although essentially similar bird habitats and species occur on the E coast of both islands between Porangahau R. and the Motunau R., these coasts are rather desolate, with no offshore islets or stacks, no major estuaries, no places (other than Kaikoura) where large seabird colonies occur. Forest remnants now insufficient to support most endemic forest bird genera. Birds include N.Z. Falcon (abundant in Marlborough and on the eastern side of the Southern Alps; a large undescribed eastern race, which unlike other N.Z. races, is not basically a forest bird); South Island Rifleman in some forest patches; an interesting isolated population of robin occurs in eastern Marlborough extending from the Waima valley in Kekerengu to Kowhai Bush in Kowhai District and extending westwards into George, Manakau and Dillon; Spotless Crake and Marsh Crake in lower Flaxbourne R.; Pied Shag breed at Clarence River mouth.

SNAILS: include Thalassohelix zelandiae and Therasia cf. thaisa.

## ANISEED ECOLOGICAL DISTRICT 45.02

Criteria: topography, geology, vegetation and climate.

TOPOGRAPHY: steep broken hill country and coastal scarps lying between the Clarence and Hapuku Rivers; maximum altitude 1196m a.s.l.; drained mainly to the Hapuku River or directly to the sea.

GEOLOGY: Mesozoic Torlesse Supergroup greywacke and argillite forming coastal cliffs and inland high country; Cretaceous and Tertiary limestone of the Puhi Puhi syncline system, sandstone and mudstone forming more subdued hill country.

CLIMATE: very warm summers, moderate winters; spring-summer dry, rainfall 900-1800mm p.a., snow at high altitudes; mists and fogs common.

SOILS: shallow, stony steepland soils from greywacke; moderately to strongly leached; on easier hill country soils from mudstone and sandstone, deeper and more fertile.

VEGETATION/MODIFICATIONS: formerly dense forests including some beech forest, podocarp and podocarp/hardwood forest (rimu, matai, miro, totara, Hall's totara, kahikatea with mahoe, titoki, fivefinger, pigeonwood etc.); coastal scarp probably dense hardwood forest (e.g. mahoe, fivefinger); tussockland (Chionochloa pallens, Chionochloa aff. flavescens, Rhytidosperma setifolia) and a little subalpine scrub above 900m. Now forest mostly restricted to river valleys in a pastoral landscape {includes mountain beech-black beech forest, matai forest, mixed podocarp and mixed podocarp/hardwood forests, hardwood forests with ngaio and titoki, karaka forests; also Hoheria lyallii treeland). Also mixed hardwood and kanuka-manuka scrub on reverting farmland on coastal scarp and Mt Alexander; tussockland modified by burning and grazing.

FLORA: Marlborough endemics on coastal bluffs e.g. Pachystegia C var(ii), Nothospartium carmichaeliae, Senecio monroi, Carmichaelia ovata, Chordospartium stevensonii, Celmisia monroi. Other rare and endangered species include Pseudopanax ferox, Teucrium parvifolium. Chionochloa cheesemani and rangiora reach their southern limit.

BIRDS: include N.Z. Falcon and S.I. Robin.

REPTILES: spotted skink (Leiopisma lineocellatum) known from several coastal sites.

SNAILS: include Thalassohelix zelandiae, T. igniflua, Rhytida greenwoodi "stephensis" form.

## KOWHAI ECOLOGICAL DISTRICT 45.03

Criteria: landform, climate and vegetation.

TOPOGRAPHY: plain formed by rivers draining the Seaward Kaikoura Range with sequence of raised beaches and beach ridges along coast, plus Kaikoura Peninsula with gentle to rolling hills, 30m cliffs, extensive limestone reefs; maximum altitude 200m a.s.l. at the base of Mt Fyffe.

GEOLOGY: glacial outwash gravels and silts, and post-glacial alluvium forming the lowland areas; peninsula composed of Cretaceous sandstone and mudstone and Tertiary limestone.

CLIMATE: very warm dry summers; moderate winters; spring-summer dry, rainfall 800-1400mm p.a.; cyclonic storms a feature.

SOILS: mainly fertile, loamy alluvial soils with good to poor drainage; stony, shallow droughty soils on terraces; soils with compact, pale-coloured clayey subsoils from mudstone and sandstone on Kaikoura Peninsula.

VEGETATION/MODIFICATIONS: formerly dense podocarp and podocarp/hardwood forest containing kahikatea, matai and totara; areas of fire induced scrub and flood plain scrub; extensive swamp with fern, toetoe, flax, niggerhead, raupo, tutu and koromiko. Now forest restricted to small remnants on plains (including kanuka forest, coastal hardwood forest - some with black maire); areas of scrub on fans and creeks; only 10 ha of wetland (including Cyperus sedgeland and one area of Raupo rushland); elsewhere farmed.

FLORA: Marlborough endemics on limestone bluffs e.g. Pachystegia insignis 'A'. Southern limit of tawa in Hailes Bush.

BIRDS: largest Red-billed Gull colony in N.Z. outside Three Kings; White-fronted Tern nesting colony on Kaikoura Peninsula; high densities of forest birds in isolated Kowhai Bush including S.I. Robin and S.I. Rifleman; Paradise Shelduck, Grey Teal, N.Z. Scaup, Spotless Crake and Marsh Crake in remaining wetland; Southern Crested Grebe on L. Rotorua; N.Z. Falcon present. Good population of Variable Oystercatcher breed round Kaikoura Peninsula.

INVERTEBRATES: include snails Rhytida (Wainuia) edwardi, slug Pseudaneitea aspera; beetle Megadromus rectangulus (isolated population on Kairoura Peninsula coast). Type locality of 2 species of orb web spider plus a parasitic nematode.

## WEST WHANGANUI ECOLOGICAL DISTRICT 46.01

Criteria: geology, topography, climate, floral and faunal affinities (distinguished by the high conservation value of lowland and coastal systems still remaining on high fertility sites).

TOPOGRAPHY/GEOLOGY: comprises the generally low-lying land of relatively young rocks and the steep coastal Tertiary hills at the north-western extremity of the South Island; includes Farewell Spit formed from Holocene sand dunes, the Whanganui Inlet and the uplifted marine bench and terrace, small river valleys and low hills (maximum altitude 272m a.s.l.) to the SW, adjoining the older Paleozoic granites and sediments of the Heaphy and Whakamarama E.Ds. Cliff-forming Oligocene limestones, mudstones and sandstones dominate the coastal landscape. The Tertiary hill country includes kaast areas with associated cave systems. An extensive marine bench and its associated cliffs formed by inter-glacial marine transgression has been covered with Holocene deposits and uplifted; this plus the Holocene sand country provide most of the land of agricultural potential. Cretaceous coal measures and conglomerate in the N.

CLIMATE: warm, wet, windy, predominantly coastal climate; rainfall 1200-2000mm p.a.; strongly influenced by westerly weather patterns.

SOILS: strongly leached to podzolised soils from sandstones, limestones and mudstone on rolling and hilly land with bleached subsurface horizon and iron-humus pans; fertility low, drainage slightly impeded; small areas of alluvial soils on river flats, sandy and gravelly soils on coast and Farewell Spit.

VEGETATION/MODIFICATIONS: originally largely forested, much of the district now farmed; a long history of gold and coal mining, timber extraction and flax-cutting as well as pastoral farming. Large areas are in a derelict state or in secondary vegetation. Remoteness from markets has resulted in many areas of the original lowland and coastal forest remaining intact, including the catchments of the Big and Raukawa Rivers in the S. Many of these are significant because they comprise examples of the original natural landscapes that have been cleared from the remainder of N.Z. Most of the remaining vegetation on the Tertiary hill country is podocarp (rimu, kahikatea and matai) - hardwood forest. Beech species occur on lower fertility sites, more common on soils from Cretaceous rocks. All beech species present: hard beech and silver beech predominate; red beech confined to higher altitudes in the W and black beech to a few ridges near the coast in the S. Alluvial valleys S of Whanganui Inlet formerly contained tall forests of kahikatea, northern rata and pukatea: a few valuable remnants survive. Botanically interesting landscapes occur on the Holocene sand country and adjoining Cretaceous conglomerate and coal measures between Wharariki Beach and Cape Farewell.

FLORA etc: vegetation, flora and fauna show strong relationships with northern North Island: the district probably represents a remnant of a continuous pre-Pleistocene land mass. Many plant species, including major tree species, reach their south-western limits here (e.g. Dysoxylum spectabile, Paratrophis banksii, Entelea arborescens, Phyllocladus trichomanoides, Libocedrus plumosa); also present are the fern Blechnum fraseri and the psilopsid Tmesipterus lanceolata. The herb Cotula calcarea is endemic.

BIRDS: Farewell Spit is recognised as a wetland of international importance, with a very large number (83) of wetland bird species utilising the area, including many rare migratory waders; large flocks of wading

birds (e.g. 27,000 Knots, 19,000 godwits, 8,600 S.I.P.O.); major moulting site for (introduced) Black Swan (12,000); large breeding colonies of Caspian and White-fronted Tern. Recently established gannet breeding colony - only the second mainland site in N.Z. Whanganui Inlet also of high wildlife value with large numbers of S.I.P.O., Banded Dotterel and Black Swan, as well as rare migrant waders. Saltmarsh of Whanganui and Puonga important Banded Rail habitat. Swampy margins of the district's estuaries, Mangarakau wetland and L. Otuhie are important for Fernbird and Western Weka.

REPTILES: green geckos referable to Heteropholis tuberculatus relatively common in scrub and forest throughout this district. There is no clear geographical or morphological boundary between these animals and those considered to be Heteropholis stellatus which occur further E. Common gecko (Hoplodactylus maculatus) present near coast (all lizards except forest gecko (Hoplodactylus granulatus) are very scarce on the West Coast).

INSECTS: include an endemic beetle.

SNAILS: there is a degree of endemism in the invertebrate fauna which includes two new genera and species of punctid land snails; the large land snails Powelliphanta gilliesi brunnea, P. g. aurea and P. & subfusca are restricted to the district. It also includes part of the range of P. g. kahurangica.

## WAKAMARAMA ECOLOGICAL DISTRICT 46.02

Criteria: topography and geographic position, climate.

TOPOGRAPHY: the north-eastwards extension of the Wakamarama Range: hills, mostly 600-900m a.s.l., maximum altitude 958m; very steep hills in the E of the range, often forming cliffs (Mt Haidinger), gentler hills in the W above West Whanganui Inlet.

GEOLOGY: mostly Cretaceous arkosic sandstones and conglomerate with grit, shale and coalseams; cliff-forming conglomerate e.g. Mt Haidinger; also Lower Paleozoic greywacke, a small area of Upper Paleozoic Karamea Granite at Knuckle Hill and minor stocks of Cretaceous granite. Limestone and dolomite at Mt Burnett (of high economic value).

CLIMATE: distinctive - mild temperatures, with high cloud, rainfall 2000-4000mm p.a., with minimum in winter; prevailing SW winds but gales not frequent.

SOILS: strongly leached to podzolised soils in the NE on rolling and hilly land from sandstones etc.; fertility low, drainage impeded; on steeper country in the SW shallower, stonier, very strongly leached, low fertility soils from range of sedimentary and igneous rocks.

FLORA: some floral affinities with the North Island.

BIRDS: continuous mudflats along northern coast important for waders, also Banded Rail; Great Spotted Kiwi, Blue Duck, kaka, Yellow-crowned Parakeet present in forest.

REPTILES: Nelson green gecko (Heteropholis stellatus) reported from Mt Burnett and Pakawau.

SNAILS: includes the entire range of Powelliphanta gilliesi gilliesi and P. g. montana, and part of the range of P. superba superba (occurring sympatrically with P. gilliesi above about 760m a.s.l. along the Wakamarama Range.

Criteria: climate, topography, geology.

TOPOGRAPHY/GEOLOGY: the glacio-fluvial terraces and flats of coastal and lowland Golden Bay; maximum altitude 655m a.s.l. Mostly Pleistocene and Holocene deposits but also significant areas of Tertiary sediments including limestone outcrops.

CLIMATE: sunny, warm and wet, rainfall 2000-4000mm p.a.; receives very heavy rains at times from NE and N; the orographic affect of Whakamarama Range protects Golden Bay from prevailing westerly winds.

SOILS: moderately fertile loamy alluvial soils on river flats with good to poor drainage, parts liable to flooding; stony shallow soils on low terraces; deeper gleyed and weakly to moderately podzolised soils on higher terraces; very strongly leached to podzolised soils with impeded drainage on hilly land from siliceous sandstones and mudstones; very strongly leached shallow steepland soils on steeper country; small areas of moderately fertile clayey steepland soils (rendzinas) from marble in E.

VEGETATION/MODIFICATIONS: originally podocarp-hardwood-beech forest; remnants include groves of secondary totara forest in Takaka Valley, small stands of kahikatea, rimu, matai, miro, northern rata, pukatea with black beech and hard beech. Extensive areas of pakihi and taller scrub on terraces of both Takaka and Aorere valleys; also extensive areas of bracken. Most of the district is farmed (dairying with sheep and cattle for finishing).

BIRDS: extensive mudflats around Ruataniwha Inlet form an important part of the Farewell Spit-Golden Bay wader feeding grounds; besides many waders, district is important for Banded Rail and Fernbird; Marsh Crake and N.Z. Scaup also present. Other tidal mudflats in district are also important, particularly Wainui Inlet. Forest bird fauna reflects limited habitats still available.

SNAILS: large land snail Powelliphanta gilliesi compta is restricted to the limestone outcrop known as "The Castles".

## TOTARANUI ECOLOGICAL DISTRICT 46.04

Criteria: geology, vegetation, climate, topography.

TOPOGRAPHY/GEOLOGY: highly distinctive district formed from dissected granite hill country reaching about 700m a.s.l.; indented coastline; drained to the E and N.

CLIMATE: sunny with very warm summers, mild winters; drier than most of Region, rainfall 1500-2200mm p.a., winter maximum; very high intensity rains at times from NE and N.

SOILS: strongly leached low fertility hill and stepland soils from granite.

VEGETATION/MODIFICATIONS: affinities with NELSON and RICHMOND regions. Originally forested, some Polynesian and much European clearance: now largely in secondary or original forest; remnant pockets of podocarp-hardwood forest dominated by rimu and northern rata with matai, hinau, Hall's totara, occasional pokaka, miro and totara, (understory containing pigeon-wood, marbleleaf, mahoe, raurekau, tarata, kaikomako, occasional wineberry, titoki, kamahi, nikau); a few kahikatea and pukatea trees remain on damp sites; montane red beech forest occurs on moist deep soils of upper Wainui valley, also smaller stands of red beech, silver beech and black beech and some mixed beech stands; between 300m and 600m a.s.l. from Falls R. to Centre Peak a belt of red beech dominant forest occurs with rimu, matai, miro, hard beech, Hall's totara, hinau, kamahi and northern rata, at higher altitudes southern rata and pokaka. Much of district is in scrub, mostly manuka, kanuka, mingimingi and Pimelea; some red tussock and associated sub-alpine species at Moa Park; black beech dominated forest on drier coastal ridges and headlands, with associated kanuka, red beech, northern rata, hinau, rimu, hard beech; some areas of exotic woody adventive species, e.g. two Hakeas and two pine species. Adele I. is rat free.

BIRDS: include Great Spotted Kiwi, S.I. Kaka, Red-crowned Parakeet, Yellow-crowned Parakeet, S.I. Robin, Yellowhead, N.Z. Falcon, kea, Fernbird, Blue Duck. Mudflats at Awaroa Bay and Marahau provide useful wader habitat and breeding places for Banded Dotterel and Variable Oystercatcher. Banded Rail occur throughout; Marsh Crake at Marahau.

REPTILES: Nelson green gecko (Heteropholis stellatus) common in scrubland at Sandy Bay and Marahau, and on Adele I. only island population of this species); also known on the Takaka Hill.

SNAILS: the large land snail Powelliphanta hochstetteri hochstetteri occurs in forest above about 760m a.s.l.

## HEAPHY ECOLOGICAL DISTRICT 46.05

Criteria: topography, geology, climate, vegetation.

TOPOGRAPHY: rugged highly dissected hill slopes, particularly in Heaphy R. catchment rising to c. 1520m a.s.l. on the Domett Range; with coastal and inland downlands and hills of more gentle relief towards the coast.

GEOLOGY: Permian-Carboniferous Karamea Granite with some areas of Tertiary and Paleozoic sediments.

CLIMATE: warm, wet, strongly influenced by westerly weather patterns; rainfall 2800-5600mm p.a.

SOILS: on terraces moderately deep podzolised soils and podzols, most with poor drainage; on hilly slopes very strongly leached to podzolised soils with impeded drainage from siliceous sandstone and mudstone; shallow very strongly leached to podzolised steepland soils on steep slopes from range of indurated sedimentary rocks and granites; all soils have low natural fertility.

VEGETATION/MODIFICATIONS: largely unmodified. At lowest altitudes: in the W - dense, wet forest of northern rata, kahikatea, rimu, red beech, silver beech and kamahi with some nikau, mahoe, pigeonwood, kiekie and supplejack; in the E - rimu, red beech, silver beech, kahikatea, matai with some pukatea, miro, totara, black beech and hard beech. On mid-slopes: mixed beech-podocarp- hardwood forest. At higher altitudes: silver-beech dominated forest, often with southern rata, Hall's totara, Dracophyllum traversii and D. townsonii. On edges of downland: extensive areas of low forest and scrub of mountain beech, manuka, Quintinia acutifolia, southern rata, pokaka, stunted rimu, mountain toatoa, Dacrydium spp. and Dracophyllum traversii. Downlands modified by fire to varying extent; on Mackay Downs clearings of red tussock, Gleichenia sp. and pigmy pine interspersed with stunted forest; Gouland, Gunner and Gorton Downs have more extensive open tussock areas, impoverished by fire and former grazing.

FLORA: species reaching their southern limit in this district include titoki and Peperomia urvilleana (occur N of Kohaihai R.).

MAMMALS: northernmost breeding colony of N.Z. fur seal in the world near Kahurangi Point.

BIRDS: N.Z. stronghold of Great Spotted Kiwi - very abundant; also important for S.I. Kaka; Blue Duck widespread; N.Z. Falcon; Yellow-crowned Parakeet; kea widespread.

REPTILES: green gecko (Heteropholis sp.) reported.

SNAILS: very important for land snails with Powelliphanta gilliesi jamesoni and 5 subspecies of the large golden Powelliphanta superba (P. s. prouseorum, P. s. harveyi, P. s. mouatae, P. s. richardsoni, P. s. "Gunner River") confined to district; most of the range of P. s. superba is in Heaphy E.D.

## WANGAPEKA ECOLOGICAL DISTRICT 46.06

Criteria: topography, vegetation, geology, climate.

TOPOGRAPHY: complex mountainous hinterland; mostly 900-1500m a.s.l.; highest point Mt Kendall, 1810m; drained mostly to the N and W.

GEOLOGY: complex: includes Permian-Carboniferous Karamea granite and Lower Cretaceous granites in the W; Ordovician schist, sub-schist, shale, phyllite, quartzite form a central band running N-S; Upper and Lower Cambrian porphyritic andesites, basalts, volcanic sandstones etc. in the E; some Tertiary rocks.

CLIMATE: summers warm and sunny; winters cold with heavy frost, snowfalls at high altitudes; rapid weather changes; rainfall 4000-6400mm p.a.

SOILS: mainly shallow, low fertility very strongly leached and podzolised steepland soils from range of indurated sedimentary, metamorphic and igneous rocks; on easier slopes, drainage impeded, some soils have peaty topsoils. Includes small areas of more fertile clay soils (rendzinas) from marble.

VEGETATION: almost entirely indigenous; forest patterns complicated by changes in parent rock and drainage: podocarp and podocarp/beechn forest on lower slopes and valleys; black beech on lower alluvial terraces in E and N, absent in west-draining catchments; hard beech often occurs with black beech but has a more western distribution; extensive red beech forest with silver beech and mountain beech at higher levels - mountain beech at treeline in SE on limestone, silver beech dominates elsewhere, either species forms the treeline; above treeline subalpine scrub, tussockland, alpine herbfields; some pakihi areas.

MAMMALS: the vulnerable lesser short-tailed bat present; the only recent South Island positive identification of the latter species was in Roaring Lion R. in 1977.

BIRDS: relatively rich forest bird fauna characteristic of montane and submontane beech forest which cover most of the district. Birds include Great Spotted Kiwi (most abundant in the W), kaka (widespread), Blue Duck (widespread), N.Z. Scaup (common on inland lakes), N.Z. Falcon (widespread), Yellow-crowned Parakeet, kea (widespread), Rock Wren (widespread in suitable habitat), possibly Yellowhead.

REPTILES: Nelson green gecko (Heteropholis stellatus) recorded at Boulder Lake.

INSECTS: include giant wetas Deinacrida tipiospina at L. Cobb and L. Lockette, D. connectens on Mt Arthur tableland.

SNAILS: important for the large land snail genus Powelliphanta: includes the total range of Powelliphanta lignaria ruforadiata, P. l. unicolorata, P. l. o'connori, P. hochstetteri anatokiensis, and part of the range of P. gilliesi fallax, P. superba superba and P. rossiana patrickensis.

MODIFICATIONS: feral goats damaging forest on N, W and S edges of district.

## ARTHUR ECOLOGICAL DISTRICT 46.07

Criteria: geology, topography, climate.

TOPOGRAPHY: mountains and hills, mostly 600-1500m a.s.l.; highest points Mt Arthur, 1777m (on boundary) and Mt Owen 1875m; drained mainly to the SE, thence to Tasman Bay by NE trending rivers.

GEOLOGY: Complex: Silurian-Upper Ordovician Mt Arthur marble and indurated mudstone, phyllite, graptolitic shales, quartzitic sandstone, and schist along the W; Devonian amphibolite, hornblende-schist, porphyrite, metabasalt, serpentine and quartz schist, meta quartzite, biotite and garnet schist in the middle (Riwaka Complex) and Carboniferous? granite in the E.

CLIMATE: summers warm, sunny; winters cold, heavy frosts, snowfalls at high altitudes; drier than Wangapeka district, rainfall 1500-4000mm p.a.

SOILS: on steep country in the S and W low fertility, very strongly leached and podzolised steepland soils, some with impeded drainage, from range of indurated sedimentary, metamorphic and igneous rocks; moderately leached fertile clay soils (rendzinas) from marble in the N; moderately to strongly leached soils from mudstones, sandstones and conglomerates on hill country along NE boundary; reddish brown moderately fertile clayey soils from basic igneous rocks in central part.

VEGETATION: mostly indigenous; podocarp and podocarp/beech forest on lower slopes and valleys, red beech and silver beech with black beech on lower alluvial terraces; extensive beech forest at higher levels to between 1300 and 1400m a.s.l., mostly mountain beech at treeline, silver beech somewhat lower; above this subalpine scrub, red tussockland and alpine herbfield.

BIRDS: fairly rich bird fauna characteristic of montane and submontane beech forest which covers most of district; continuous extent of forest in NORTH-WEST NELSON allows kaka and parakeet populations to persist in Arthur E.D. Great Spotted Kiwi occur mostly in the S, Blue Duck widespread, N.Z. Falcon present, kea widespread, Yellowhead present.

REPTILES: Nelson green gecko (Heteropholis stellatus) known from widespread sites in the Arthur Range.

INSECTS: include wetas Deinacrida connectens on Hoary Head, D. tipiospina on Mt Owen and Mt Arthur.

SNAILS: include the large land snail Powelliphanta hochstetteri hochstetteri in forest above about 760m a.s.l. on marble N of Mt Arthur, and P. rossiana patrickensis above the bushline along the Arthur Range.

MODIFICATION: past and continuing logging and burning of forest edges; resulting scrub supports feral goats and pigs.

## KARAMEA ECOLOGICAL DISTRICT 46.08

Criteria: topography, geology.

TOPOGRAPHY: low coastal plain with rugged hills to the N, E and S; hills reach 900-1000m a.s.l. in the E. S of Wanganui Head the coast is high and steep; to the N are mainly dunes and two estuaries.

GEOLOGY: underlain by largely Calcareous rocks of Eocene and younger age; a block of lower Pleistocene Old Man Gravel between the Karamea and Little Wanganui Rivers; limited areas of upper Pleistocene gravels in alluvial and marine terraces; Karamea plain formed of Recent alluvial, swamp, estuarine and dune deposits; Karamea Granite outcrops in the N and E; small outcrops of Tuhua and Paparua Granite occur in the S and SW respectively.

CLIMATE: warm, wet, predominantly coastal; rainfall 2000-3200mm p.a.

SOILS: podzolised and gleyed soils with poor drainage on terrace and rolling lands; very strongly leached to podzolised soils on hill country from a range of rocks; moderately leached soils on steep and hilly slopes from limestone; sand soils on coastal dunes; alluvial soils; small areas of shallow strongly leached steepland soils on lower slopes of mountains; apart from alluvial and limestone soils, natural fertility very low.

VEGETATION/FLORA: originally mostly forested: from silver beech on upper slopes, through red beech, silver beech and hard beech with scattered rimu on mid-slopes, hard beech and kamahi with rimu on lower slopes (especially those with seaward exposure), to dense semi-coastal forest with northern rata, kiekie, nikau etc. at lowest altitudes near the sea. Forests dominated by silver beech occur on more fertile soils in Oparara and Corbyvale basins; forests dominated by rimu (some with hard beech codominant) occur on leached soils on upper Pleistocene terraces; remnants of formerly extensive kahikatea forests occur on the plain; stands of hill country podocarp/hardwood forest lacking beech occur on granite plateau W of upper Oparara R., also S of Karamea Bluff. Considerable areas of seral scrub and young forest on slips and slumps in S of district (formed by 1929 earthquake).

Modified forest remnants occur on plain and slopes, including trees rare in district: true totara, kowhai, akeake (Dodonaea), kanuka, karaka, pukatea, matai and silver fern. Pakihi vegetation is limited to two interglacial marine terraces adjoining the plain. Dune vegetation dominated by marram but supports pingao and other native species; native vegetation occurs in Karamea and Oparara estuaries; a few small areas of natural swamp occur in tributary valleys. A few areas of low-alpine vegetation above a depressed treeline including species typical of western Nelson mountains: e.g. Aciphylla hookeri, Celmisia dallii, Gentiana gracifolia. District forms part of southwards gradient of decreasing floristic diversity along west coast of South Island. Several species (e.g. Astelia trinervia, Pseudowintera axillaris extend a little S of the Kohaihai R.; pukatea and Alseuosmia macrophylla reach their southern limits in this district; apparent natural SW limit of karaka is S of Kohaihai bluff.

MAMMALS: include the vulnerable lesser short-tailed bat.

BIRDS: rich and diverse bird fauna particularly concentrated on more fertile sites such as limestone valley floors and the few remnants of coastal forest on alluvium near the sea. Great Spotted Kiwi abundant in places, Blue Duck in

Oparara only, N.Z. Falcon in S, kaka, kea and Yellow-crowned Parakeet in Oparara Forest. Several estuaries support high numbers of waterfowl, some migratory waders. Fernbird in swampy fringes and in remnant Kongahu swamp.

REPTILES: speckled skink (Leiolopisma infrapunctatum) occurs on the coast at Karamea.

FISH: include giant kokopu (Galaxias argenteus) and brown mudfish (Neochanna apoda).

SNAILS: two subspecies of Powelliphanta land snails restricted to Karamea: P. lignaria between Mokihinui R., Karamea Bluffs road and Six Mile Creek, and P. l. lusca between Six Mile Creek, Karamea Bluffs road and Little Wanganui. P. annectens occurs beside the Oparara R.; over half the range of this species is in this district.

MODIFICATIONS: largely farmed on coastal plain (semi-extensive sheep and cattle and dairying); the large Kongahu swamp draining into Karamea estuary now converted to farmland.

## MATIRI ECOLOGICAL DISTRICT 46.09

Criteria: topography (flat tops), geology, vegetation.

TOPOGRAPHY: "flat" topped mountains and steep sided valleys of Matiri Range plus Matiri R. catchment; mostly 900-1500m a.s.l.; drained to the S.

GEOLOGY: includes Lower Paleozoic Tuhua granite, Oligocene (Landon) limestones and Miocene marine mudstone, siltstone and sandstone.

CLIMATE: high rainfall (4000-5000mm p.a.), mountain climate.

SOILS: low fertility, generally shallow, very strongly leached to podzolised steepland soils from Tertiary mudstone, siltstone, sandstone and limestones and from granite; soils on easier slopes and basins have impeded drainage, some with peaty topsoils; small areas of strongly leached soils on terraces bordering lower reaches of Matiri River.

VEGETATION: almost entirely indigenous; reflecting the diversity of soil ages, drainage conditions and altitudes. Forests - mixed age silver beech dominant forests occur on young surfaces; silver beech forest (with scattered poles and Griselinia littoralis in the subcanopy, small leaved species in a shrub layer) forms the treeline at about 1280m a.s.l.; silver beech forest (with G. littoralis, Dracophyllum traversii, Olearia colensoi, O. lacunosa, Pseudopanax linearis, mountain beech and kaikawaka) occurs on steep wet or cold sites; red beech-silver beech forests with diverse subcanopy, shrub and ground layers, occur on sides of Matiri valley up to 900m; mountain beech forests, some with Dracophyllum traversii and Olearia colensoi, occur on mudstone and may form the treeline. Scrub - Dracophyllum longifolium in unburnt areas of Thousand Acres Plateau, (mountain flax with celmisias and red tussock on burnt areas); Coriaria sarmentosa with D. longifolium, composite shrubs and hebes on Misery Plateau margins and steep scarps; small leaved coprosmas on free draining coarse limestone colluvium below scarps. Dacrydium biforme and red tussock mosaics occur between forests and red tussocklands in poorly drained sites especially on Thousand Acres Plateau. Tussocklands - Chionochloa flavescens on young sunny sites on Tertiary rocks; C. pallens on older, less fertile sites, especially non Tertiary rocks; C. australis on Misery Plateau and wet peaty soils in the N; Rhytidosperma setifolium widespread immediately below scarps. There are several lakes and wetlands.

FLORA: trenches and sink holes in limestone support extremely variable flora. Certain calcicole species with restricted distribution occur, e.g. Poa sp.

BIRDS: include Great Spotted Kiwi, Blue Duck (widespread), N.Z. Falcon, kea (widespread), kaka and Yellow-crowned Parakeet.

SNAILS: include good numbers of the alpine land snail Powelliphanta rossiana patrickensis on calcium-rich tussocklands.

## MOTUEKA ECOLOGICAL DISTRICT 47.01

Criteria: geology, topography, climate.

TOPOGRAPHY: small district of lowland plains divided into two by Moutere District hill country; altitude less than 150m a.s.l. Shallow, protected coastline with estuaries at mouth of Waimea, Moutere and Motueka Rivers.

GEOLOGY: holocene terrestrial and minor marine alluvium etc. in the W ar Rabbit I. (marine); Pleistocene low terrace Moutere gravels elsewhere.

CLIMATE: sunny, rather sheltered; rains of high intensity at times from T and N, rainfall 1000-1400mm p.a.; very warm summers; mild winters.

SOILS: from weathered Pleistocene gravels on rolling and hilly land have clayey, pale textured subsoils and poor winter drainage but dry out in summer; natural fertility medium to low. On terraces shallow, stony, medium fertility soils, droughty in summer. Alluvial soils on river flats generally fertile, well drained. Excessively drained sand soils on coasta dunes. Small areas of clay-textured moderately deep fertile soils (rendzinas) from calcareous rocks along SE boundary.

VEGETATION/FLORA: originally mostly forested (tall podocarp-hardwood-beec forests); some Polynesian clearance; formerly grassland, Leptospermum scrub, bracken, fernland and wetlands (flax, raupo swamps), with an area of podocarp forest in the NW; now wetlands are mainly drained, and only tiny remnants of podocarp forest and lowland hardwood forest survive. Plants of estuaries include Scirpus nodosus, Samolus repens, Selliera radicans, Leptocarpus simplex, Juncus maritimus, Salicornia australis; Spartina x townsendii spreading. Dunes are in marram grass; ngaio occurs on bluffs; Calystegia soldanella, Carex pumila and Muehlenbeckia complexa on gravel and sandy shores.

BIRDS: extensive estuaries provide valuable habitat for waterfowl and waders, 52 estuarine species have been recorded in the regionally important Waimea Inlet including Arctic breeding migrants and N.Z. endemic migrants Banded Rail and Marsh Crake in saltmarsh fringes. Most of rest of district modified and of little value for indigenous birds.

FISH: include giant kokopu (Galaxias argenteus).

MODIFICATIONS: dairy farming with sheep and cattle grazing; horticulture exotic forests; urban settlement.

## MOUTERE ECOLOGICAL DISTRICT 47.02

Criteria: topography, geology, climate.

TOPOGRAPHY: rolling hill country descending from about 800m a.s.l. in the S to sea level; drained to Tasman Bay via Mouteka R. and Wai-iti R.

GEOLOGY: almost entirely Lower Pleistocene deeply weathered Moutere Gravel overlying lignite and clay; Glenhope formation in the W.

CLIMATE: sheltered by surrounding mountains, very warm summers, mild winters (cooler inland); rains of very high intensity at times from NE and N; rainfall 1200-1500mm p.a.; occasional heavy snowfalls inland.

SOILS: mainly from weathered Pleistocene gravels on rolling and hilly land: soils under lower rainfall in the N, have clayey textured pale-coloured subsoils with impeded drainage, moderate to low natural fertility but droughty in summer; with increasing rainfall southward, leaching increases and soils have browner, more friable subsoils, more even moisture conditions; some areas of very strongly leached and podzolised soils; small areas of stony, shallow soils on terraces; fertile alluvial soils on river flats; heavy textured strongly leached steepland soils in the S.

VEGETATION: originally forested throughout: mainly beech forest - black beech dominant at seaward end of district, hard beech becomes prominent further inland, especially on ridges; still further inland red beech dominant with silver beech; at southern, most inland end of district, where younger glacial material overlies Moutere Gravels, mountain beech and silver beech forests occur. Tall podocarps (totara, matai, rimu, miro and kahikatea) originally dominant in forests of broad river valleys; some lowland tall hardwood forests with podocarps occurred near coast (tawa, pukatea, titoki, karaka, mahoe, and totara, matai and some nikau). Today there are only small remnants of podocarp and hardwood forests, and more frequent larger remnants of beech forest with large areas of continuous forest in southern uplands (Big Bush).

BIRDS: breeding site for Banded Dotterel, Pied Stilt and Black-fronted Tern on braided sections of upper Motueka R. Kaka, N.Z. Falcon and parakeet occur in Big Bush, the only large forest tract in the district.

REPTILES: Nelson green gecko (Heteropholis stellatus) in remnant forest patches throughout, especially in the S. Spotted skink (Leiopisma lineocellatum) and speckled skink (L. infrapunctatum) known from S of Golden Downs SF.

MODIFICATIONS: much of lower part of district modified: semi extensive sheep and cattle farming, horticulture, exotic forests.

## BRYANT ECOLOGICAL DISTRICT 47.03

Criteria: geology, flora, topography, climate.

TOPOGRAPHY: steep hill country, mostly less than 1500m a.s.l.; highest point Gordon's Knob, 1664m; drained to the NW.

GEOLOGY: complex: Permian rocks including large areas of green sandstone and argillite; several important areas of ultramafic rocks, mafic volcanics (especially Dun Mountain); Maitai Group greywackes, siltstones, mudstones; Tertiary marine and non-marine sediments; Jurassic non-marine and Triassic marine sediments.

CLIMATE: in the NW sunny and sheltered; very warm summers, mild winters; high intensity rains at times from NE and N; rainfall 1200-2000mm p.a.; cooler and wetter in the S and at higher altitudes though drier than mountains to the W.

SOILS: on basic intrusive rocks in NE soils have clayey moderately deep subsoils, medium natural fertility but droughty in summer. Soils on ultramafic dunite and serpentine rocks of Dun Mountain region have low natural fertility with toxic levels of magnesium, chromium and nickel. On clacareous rocks on hilly and steep country along NW boundary moderately deep fertile soils (rendzinas and related soils) with clayey subsoils. Steepland soils on greywacke, argillite and subschist near coast are shallow and stony with yellowish brown friable subsoils; natural fertility moderate to low. At higher altitudes and rainfalls soils very strongly leached to podzolised with low natural fertility.

VEGETATION: indigenous vegetation restricted to higher hills in E and S. Forests - mixed beech-podocarp forest, dominated by red beech, silver beech, the black beech-mountain beech complex and occasionally hard beech, with rimu, miro, matai and occasionally totara; tanekaha may be quite common in sub-canopy; beech species, except mountain beech, diminish with altitude and on higher altitude, mainly non-ultramafic materials, mountain beech forest with kaikawaka, Hall's totara and Dacrydium bidwillii occurs. Scrub - at lower altitudes closed, mixed, manuka dominated scrub occurs; on the ultramafics there is open mixed scrub and shrubland dominated by slow-growing manuka, mountain flax and Cassinia vauvilliersii var serpentina. Tussockland - a distinct population of red tussock; is restricted to high altitude areas of Dun Mountain; elsewhere the dominant species is mostly snowgrass, Chionochloa pallens, with carpet grass, C. australis in some areas.

FLORA: on high altitude ultramafic screes flora includes many species with type localities on Dun Mountain e.g. Myosotis monroi, Anisotome filifolia; seepage vegetation includes Carex traversii also with type locality here. Rare species found in alpine grasslands of Mt Rintoul include Celmisia macmahonii var hadfieldii, C. sinclairii, C. cordatifolia and Hebe gibbsii. Colobanthus wallii, undescribed subspecies, occurs on ultramafics (also in Red Hills, Pelorus, D'Urville and an outlier in Wangapeka). Eastern hills contain several tree species, widespread in northern New Zealand, locally common here at their SE limit, e.g. tanekaha.

BIRDS: important shore bird habitat inside Boulder Bank including both Arctic breeding and N.Z. migrant waders; also provides breeding site for Red-billed Gull and Blue Penguin. Forest birds include N.Z. Falcon, kaka, kea, Blue Duck in the S, Yellow-crowned and Red-crowned Parakeet.

REPTILES: Nelson green gecko (Heteropholis stellatus) common along the western slopes of the Bryant Range; this is the north-eastern limit and here it adjoins the range of Marlborough green gecko (H. manukanus). Spotted skink (Leiopisma lineocellatum) occurs at scattered sites along the coast S of Cable Bay, on the Boulder Bank, and along the western foothills of the Bryant Range and Richmond Range. These are the westernmost localities for L. lineocellatum.

MODIFICATIONS: much of district in exotic forests and farms (semiextensive sheep and beef; dairying with sheep and cattle for finishing). Severe feral goat and pig damage on Bryant Range.

## RED HILLS ECOLOGICAL DISTRICT 47.04

Criteria: geology and its influence on soils and vegetation.

TOPOGRAPHY/GEOLOGY: elevated zone of ultramafic rock with soils rich in magnesium, waterlogged in places; minor influence of glaciation.

CLIMATE: warm dry summers; substantial winter snow; rainfall 1600-2000mm p.a.

SOILS: shallow stony steepland soils from ultramafic rocks, low natural fertility with toxic amounts of magnesium, chromium and nickel. Stony strongly leached soils on terraces and fans along Wairau River are stony, strongly leached to podzolised with many areas having poor natural drainage (gleyed).

VEGETATION: has been burnt many times, probably since Polynesian times: predominantly red tussock (distinct population); limited forest (mountain beech) in better drained areas; scattered shrubland on tallus.

FLORA: a number of plant species endemic to northern South Island ultramafic rocks; includes an endemic Notothlaspi sp., Olearia virgata var. serpentina and Colobanthus wallii, an undescribed subspecies (also found on ultramafics in Bryant, Pelorus and D'Urville, and an outlier in Wangapeka).

REPTILES: green geckos (Heteropholis sp.) reported.

MODIFICATIONS: parts once grazed, now retired, substantial shrubland (manuka) regeneration.

## NGAKAWAU ECOLOGICAL DISTRICT 48.01

Criteria: geology, topography, vegetation.

TOPOGRAPHY: W trending coastal hills and low mountains up to 1400m a.s.l. in the NW; also deep gorges e.g. Ngakawau and Waimangaroa Rivers.

GEOLOGY: includes large areas of Eocene quartz sandstone, grit and conglomerate with coal seams (Brunner coal measures) forming dissected plateaux near Denniston and Stockton with highly distinctive vegetation; some siltstone of the same age (Kaiata formation); and smaller areas of Precambrian Gneiss, Tuhua Granite (e.g. Mt Augustus) and Greenland Group greywacke and argillite.

CLIMATE: mild temperatures near coast, bleak and wet on plateaux, high rainfall, 2800-6000mm p.a., with winter minimum.

SOILS: on rolling and hilly land very strongly leached to podzolised, very low fertility soils, many with poor drainage from siliceous sandstone, quartzite, conglomerate and granite. On steeper country, stony stepland soils from greywacke, sandstone, granite and conglomerate with low natural fertility.

VEGETATION: much of district in indigenous vegetation. Forests - (podocarp)/beech forest predominating - rimu/silver beech (mountain beech) forest - with concentrations of rimu and kahikatea on riparian terraces and pure silver beech forest forming a low treeline (1300m) on Glasgow Range. Coal plateaux vegetation (reserved in Ngakawau Ecological Area) - a mosaic of tussockland (including endemic Chionochloa juncea), scrub (where disturbed, Leptospermum with Phormium cookianum, Gleichennia circinata, Epacris pauciflora; elsewhere dense scrub dominated by bog pine, some manuka, inaka, Epacris etc.), distinctive low forest (mountain beech, mountain toatoa, Dracophyllum spp., kaikawaka, yellow-silver pine, Cordyline indivisa) very different from the taller forest on surrounding granite, gneiss and greywacke; includes alpine and subalpine species not usually found at this altitude. Gully vegetation in limestone areas - includes Pseudopanax linearis, Myrsine divaricata, kamahi, mountain toatoa, occasional mountain beech. Between Charming Creek and upper Ngakawau Gorge, mountain beech-yellow-silver pine forests, with emergent silver pine occurs, related to low fertility, poorly drained soils and cold air drainage. Pakihi bogs.

FLORA: Celmisia morganii endemic, virtually confined to Ngakawau Gorge; Chionochloa juncea probably endemic to Stockton and Denniston Plateaux; Sticherus flabellatus occurs in district - a disjunct distribution; locally rare Olearia cheesemanii and Metrosideros parkinsonii present.

BIRDS: fairly diverse bird fauna in forested basins on fertile sites; fauna of heavily modified coal plateaux very depauperate. Great Spotted Kiwi (mostly in N and E), Blue Duck (widespread), N.Z. Falcon, kea on plateaux.

REPTILES: brown skink (Leiolopisma zelandicum) occurs on the coast near Seddonville (southern limit; the nearest populations are at Cable Bay in the D'Urville E.D.).

FISH: include short jawed kokopu (Galaxias postvectis).

INSECTS: include the weta Hemideina broughi.

SNAILS: include Powelliphanta spp.

MODIFICATIONS: mining and burning have modified plateau vegetation considerably; deer and possums present. Dairy farming with sheep and cattle for finishing near Seddonville; exotic forests in the N.

## FOULWIND ECOLOGICAL DISTRICT 48.02

Criteria: topography (low-lying, rolling and flat), geology (terraces), vegetation.

TOPOGRAPHY: coastal plains and interglacial marine terraces surrounding Cape Foulwind, crossed by the Buller R. and several smaller rivers; altitude less than 150m a.s.l.

GEOLOGY: largely Upper Pleistocene marine gravel and sand with Holocene deposits on coastal plain and along larger rivers; small area of Constant gneiss and Tertiary sedimentary rocks occur at Cape Foulwind.

CLIMATE: mild and humid; gales not frequent; rainfall 2000-3200mm p.a.

SOILS: on terrace and rolling lands very strongly leached, podzolised and gleyed soils with poor to very poor drainage. On coastal dunes sand soils, better drained, with moderate natural fertility. On river flats alluvial soils, most with poor drainage, and associated peaty areas. On hilly country very strongly leached to podzolised low fertility soils with slightly impeded drainage.

VEGETATION: originally largely podocarp-hardwood forest of which some cut over areas remain.

MAMMALS: N.Z. fur seals breed at Cape Foulwind and on Steeples Islands.

BIRDS: except for Charleston State Forest largely deforested; despite this Great Spotted Kiwi widespread. On the rat free Steeples Islands off Cape Foulwind there are breeding petrels including Sooty Shearwater, Diving Petrel, Spotted Shag. The Orowaiti estuary and lagoon is the richest feeding area for shore birds in North Westland and probably on the West Coast S of Farewell Spit, the three egret species occur here; the Totara R. estuary is of less importance. Swampy pakihi throughout district support Fernbird, N.Z. Shoveler; robin present in Charleston S.F. and Caroline Terrace.

REPTILES: Green gecko (Heteropholis sp.) in scrub near coast. Specked skink (Leiolopisma infrapunctatum) present on the coast near Waimangaroa (southern limit; nearest populations are at Lake Rotoiti).

FISH: include giant kokopu (Galaxias argenteus), short jawed kokopu (G. postvectis), and brown mudfish (Neochanna apoda).

INSECTS: include weta Hemideina broughi.

MODIFICATIONS: much of the marine gravel was mined for gold - a major cause of vegetation modification; much of district farmed (dairying with sheep and cattle for finishing); deer, possums etc. present.

## BULLER ECOLOGICAL DISTRICT 48.03

Criteria: topography (steep), vegetation, geology.

TOPOGRAPHY: mostly very steep country with ridges plunging sharply from altitudes of 1000 to 1450m a.s.l. down to narrow valley-floors lying below 300m along most of their courses (e.g. Ohikanui and Blackwater). High Quaternary terraces of glacial outwash flank the river in the eastern part of the district. Deep and cold glaciated valleys drain into the Buller from the granite Paparoa mountains. The Buller is a very old river, older than the ranges on either side which it cuts straight across to form the lower Buller Gorge.

GEOLOGY: complex and varied: includes gneiss and granite in the Ohikanui and Blackwater catchments, Cretaceous Hawks Crag Breccia in the lower Blackwater valley to the middle section of the Buller Gorge, early Paleozoic Greenland Group greywacke and argillite north of the Gorge, and Tertiary sedimentary rocks with many limestone outcrops and bluffs within the Inangahua catchment on the E.

CLIMATE: mountain climate, rainfall 4000mm to 8000mm p.a. over highest land in the SW.

SOILS: very strongly leached, low fertility shallow steepland soils from a range of siliceous indurated rocks in the W. In the E less leached, more fertile soils from limestone and associated Tertiary rocks with many bare bluffs and rock outcrops.

VEGETATION: most of district retains original vegetation: in the SW and S treeline unusually low and irregular, (800 - 1000m a.s.l.); mountain beech-pink pine - southern rata forest widespread; unusual altitudinal sequence where beech forest is displaced by stunted podocarp-hardwood forest toward the treeline on Ohikanui-Blackwater divide (reserved in Blackwater Ecological Area); at lower altitudes mixed beech forest with scattered to locally frequent podocarps. The forest vegetation in the long narrow valleys such as the Ohikanui has a montane character despite the low altitude, as a result of cold air drainage.

BIRDS: deeply dissected glacial landscape subject to climatic extremes; most of the forest is on infertile sites with limited food resources for forest birds; however Great Spotted Kiwi occur throughout, N.Z. Shoveler near Buller R., Blue Duck abundant in Ohikanui R., N.Z. Falcon in E, kea occasional, kaka widespread, Yellow-crowned Parakeet in Ohikanui and Buller River area, Yellowhead (Hawkes Crag, 1979), robin throughout.

REPTILES: Nelson green gecko (Heteropholis stellatus) is known from the Ohikanui River (southern limit).

FISH: include short jawed kokopu (Galaxias postvectis).

INSECTS: include the weta Hemideina broughi.

SNAILS: between the Grey and Buller Rivers Powelliphanta occurs only near Berlins and in Punakaiki District (Mt Ryall).

## REEFTON ECOLOGICAL DISTRICT 48.04

Criterion: topography (changes occur in vegetation, geology and climate from west to east).

TOPOGRAPHY: large inland district of mountain ranges (Brunner and Victoria), cut across in the N by the Upper Buller Gorge, in the W the Inangahua Valley, in the E the Maruia Valley; country rises steeply from valleys (300m a.s.l.) to approx. 1600m along the Victoria Range, 1400m along the Brunner, and 1000-1350m on the southern spurs of Lyell Range in the N.

GEOLOGY: high land largely Tuhua Group Granite and older gneiss, with early Paleozoic Greenland Group greywacke and argillite on western flanks and in lower Waitahu catchment of Victoria Range; also Eocene coal measures and outcrops of Cretaceous Hawks Crag Breccia; series of glacial outwash terraces (oldest and highest Waimaungan, 150-350m a.s.l.) narrow alluvial plains flank the Inangahua and Maruia rivers; some Tertiary mudstone and siltstone hill country in the N; L. Pleistocene finely-dissected conglomerate (Old Man Gravels) S of Cronadun.

CLIMATE: varies with altitude: rainfall 2000mm p.a. in Inangahua and Maruia valleys; higher rainfall mountain climate on ranges, up to 4800mm p.a.; warm sunny summers, inland valleys cold in winter with valley fogs.

SOILS: very strongly leached to podzolised shallow, stony steepland soils on mountains, many with impeded drainage; very strongly leached and podzolised soils on hill country; gleyed and podzolised soils with associated peats on higher terraces with very poor drainage, associated with deep peaty soils. On lower terraces stony soils with better drainage, moderate natural fertility. Alluvial soils, ranging from well to poorly drained, on river flats.

VEGETATION/MODIFICATIONS: originally podocarp-beech and beech forests on lowest terraces and valley bottoms: much of Inangahua Valley cleared or modified by logging or burning: now dairy farming with sheep and cattle for finishing. Indigenous vegetation remains in upper valleys, on highest terraces and slopes of ranges: in the W a sequence of podocarp-beech to more or less pure beech forest, montane shrubland or tussockland with an anomalous altitudinal sequence occurring on the Brunner Range with almost total absence of beech in uppermost forest (reserved in Coal Creek Ecological Area). In the E forests of Upper Maruia and Grey R. headwaters (reserved within Lake Christobel Ecological Area and Lewis Pass National Reserve) are almost entirely beech: red beech dominant to 900m, silver beech on upper slopes with stands of silver beech or mountain beech and mixed stands towards tree-line; hard beech present only in Maruia valley; podocarps and common understory hardwoods were uncommon even before lower valley cleared for farming; kanuka and kowhai stands on river banks.

BIRDS: the richest forests for birds have been removed; remaining forests (mostly beech) support a diverse bird fauna of moderate density including Great Spotted Kiwi in a few places, Blue Duck N of the Buller R. but apparently absent from Victoria Range, N.Z. Falcon widespread in Victoria Range; the Victoria Range represents the usual eastern limit of weka in this part of the country; kea widespread in Victoria Range, kaka in forested areas; Rock Wren occur on higher parts of Victoria Range from Buller S to Inangahua R.; robin abundant throughout reaching highest densities in N.Z. on the W bank of the Maruia R.

REPTILES: Green geckos reported from Rahu Saddle and along the Maruia R. are supposedly Lewis Pass green gecko (Heteropholis poecilochlorus) (western limit). Nelson green gecko (Heteropholis stellatus) has been collected from Lyell.

INSECTS: include the weta Hemideina broughi; the Osariine beetle Paratrochus angustus has been collected from humus and 'A' horizon beneath red beech, silver beech, kamahi and miro at Caplestone and occurs up to 670m at Rahu Saddle.

MODIFICATIONS: include red and fallow deer, chamois, pigs, goats and possums.

## PUNAKAIKI ECOLOGICAL DISTRICT 48.05

Criteria: geology, climate, land use, topography, vegetation.

TOPOGRAPHY/GEOLOGY: the western slopes and alpine crests of the Paparoa Range, the adjoining lowland hills and basins, and steep coastal hills and narrow plains comprise three structural units. The steep dissected mountains of the main Paparoa Range rising to 1485m a.s.l. (Mt Faraday) are mostly very old crystalline rocks and sediments (Paleozoic gneiss and granite, Precambrian greywacke and Cretaceous Hawks Crag Breccia). Lying parallel with the mountain range and the coastline is a syncline containing Tertiary sediments (coal measures, limestones, mudstones and sandstones) and Quarternary gravels. The landscape is uplifting and is far younger than the river courses that transect it. Several of these rivers have spectacular upper and lower gorges where they cut through the inland and seaward escarpments of the syncline. The syncline supports a major karst plateau, a self-draining karst basin (polje) in the bed of the syncline and a major cave system. The limestone hills to the W of the syncline drop steeply to the sea forming spectacular coastal cliffs. Quarternary and Holocene gravels and sands form terraces that have been uplifted along the coast and major river courses; a strip of coastal dunes and flats near Barrytown and some lower valley flats.

CLIMATE: the geographical location of the Paparoa Range has led to a distinctive local climate, particularly in the coastal zone which is shielded by the range from much of the potential cold air drainage in winter and influenced by the ameliorating effect of the subtropical oceanic Westland Current. Generally mild and humid, colder on the range; rainfall 2000-6000mm p.a.; fog common at upper altitudes.

SOILS: on mountains shallow, stony, very strongly leached, gleyed and podzolised steepland soils from granite, schist, gneiss and greywacke, many at higher altitudes having poor drainage. Soils on hilly and steep slopes from limestone and associated Tertiary rocks in the NE less leached, more fertile but many bare bluffs and rock outcrops. Alluvial soils, some gleyed, on narrow coastal belt in the S.

VEGETATION/MODIFICATIONS: the broken nature of the limestone and karst country and the coast has proved a barrier to the commercial exploitation of forests in this district. Most of the area remains under indigenous forest except for extensive pakihis in logged areas of the Tiropahi Valley, a strip of coastal flats near Barrytown and some lower valley flats and coastal gullies which are farmed or modified by gold and coal mining. A distinctive belt of hardwood forest, with few podocarps, occurs on the high fertility coastal Tertiary hill country. Beech species are confined to lower fertility ridge sites, but become co-dominant with podocarps (rimu, miro and kahikatea) further inland. Beech species become predominant in the montane zone and S of the Punakaiki R. The subalpine zone is a mixture of conifers (e.g. pink pine, mountain toatoa), mountain beech, hardwood trees and shrubs. Throughout the district there is a very high diversity of vegetation types according to the drainage and fertility offered by an equally high diversity of landforms. The district is unusual in the variety and quality of the indigenous forests that remain.

FLORA: the moss flora is noted for its high level of diversity. Seal I. supports an endemic Senecio sp.

BIRDS: forest bird communities are varied and diverse reflecting complexity in forest types and varying fertility of sites. Highest densities of forest birds on the N.Z. mainland have been recorded in tall forest on limestone tallus in the Pororari E.A.; nearby are more diverse yet less numerous bird populations in podocarp-beech forest on Tertiary mudstones. Several species, e.g. robin, kaka, parakeet, are absent from the limestone kaarst plateaux adjacent to the coast which otherwise support large bird populations. Great Spotted Kiwi abundant throughout, often in very high densities; recent unconfirmed records of both Little Spotted Kiwi and Brown Kiwi; weka present. Swampy areas along coasts support moderate numbers of N.Z. Scaup, N.Z. Shoveler, Grey Teal, Grey Duck, Fernbird. Blue Duck occur in upper parts of most major river systems from Totara R. S to Canoe Creek; N.Z. Falcon very rare, probably not breeding; kea present in Paparoa Range, occasionally descending to coast; kaka, Yellow-crowned Parakeet and robin widespread in lowland forest in synclinal basins. The district also includes winter breeding sea bird colonies including the only breeding colony of Westland Black Petrel (population c 20,000) on coastal hills between Punakaiki R. and Lawson's Creek; Spotted Shag at Perpendicular Point; district encompasses the southern limit of Cook Strait subspecies of Blue Penguin. The flora and fauna is much influenced by the warm coastal current and upwelling along the continental shelf provides a large food supply for sea birds especially in winter. Seal I. supports burrowing Sooty Shearwater and Blue Penguin; has been modified by fire and tidal connection to mainland allowing access by predators.

INSECTS: include the large weta Hemideina broughi.

SNAILS: there is a high diversity amongst the micromollusc fauna in the high fertility sites.

## MAIMAI ECOLOGICAL DISTRICT 48.06

Criteria: topography, aspect, climate (rainshadow east of Paparoas).

TOPOGRAPHY/GEOLOGY: covers most of the E flank of Papa roa Range from less than 300m to 1500m; drained to the N (Inangahua R.) and SW (Grey R.); mountainous country consists of several long, steep-sided glaciated valleys between major south-trending spurs, ending abruptly at a belt of little-dissected glacial outwash terraces; main aspect of high country is south-easterly. Mainly ancient gneiss (Charleston Metamorphic Group) and granite, with wide belt of Quaternary aggradation terraces of granitic alluvium, reaching Inangahua and Mawheraiti (Little Grey) Rivers in the N and Grey R. in the S.

CLIMATE: rainfall 6400mm p.a. over range, drops sharply to 1500-2000mm near Grey R. because of rain shadow effect; sheltered in the E; small temperature range.

SOILS: on the range strongly leached and podzolised steepland soils from indurated rocks; on hill country stony soils from weathered Pleistocene gravels; on higher terraces infertile gleyed and podzolised soils with very poor drainage and associated peaty soils; on lower terraces more fertile stony soils, many with poor drainage; on river flats alluvial soils, some gleyed.

VEGETATION/MODIFICATIONS: virgin forest covers steep country: pure silver beech common on higher faces, up to treeline and as riparian strips in cold valley bottoms; mountain beech with pink pine occur locally on high altitude wide ridge crests (altitudinal sequence of forests reserved in Saxton Ecological Area); on other low country the original mosaic of podocarp-beech stands almost entirely logged and cleared for farms on best ground; frequent burning of high terrace vegetation has led to development of pakihi bogs. Deer, possums etc. present.

BIRDS: contains montane forests which support large and diverse bird populations especially in Fletcher's Creek (partially protected by Ecological Area), and Otututu (Rough) R. Very high populations of Great Spotted Kiwi in coal measure vegetation on range crest, present elsewhere in forested areas; few records but Blue Duck presumed to be in Otututu R. and Big R.; kaka not widespread but abundant in Fletcher's Creek; Yellow-crowned Parakeet in forested areas, not abundant; Yellowhead (Otututu R., 1973); Fernbird in Grey Valley; robin throughout in indigenous forest, especially common in Fletcher's Creek E.A.

REPTILES: green geckos (Heteropholis sp.) reported.

INSECTS: include the weta Hemideina broughi. Osariine beetle Paratrochus augustus has been collected from humus and 'A' horizon beneath red beech, silver beech and miro; silver beech alone; red beech, kamahi, Quintinia and rimu and also beneath pine and Formosan bamboo, all at Fletcher's Creek.

## TOTARA FLAT ECOLOGICAL DISTRICT 48.07

Criteria: topography, geology, vegetation.

TOPOGRAPHY/GEOLOGY: southern end of Victoria Range, the low mountains associated with Mt Ramases and low land around the Grey and Ahaura Rivers; highest point Mt Ramases, 1463m a.s.l.; S of Snowy R. the western faces of the granite range plunge very steeply to a general altitude of approx. 350m a.s.l.; low hills in the NW are early Paleozoic Greenland Group greywacke and argillite, with Lower Pleistocene weathered conglomerate (Old Man Gravels), E of Mawheraiti R. and Totara Flat and a series of glacial outwash aggradation terraces with some morainic deposits near Grey R.

CLIMATE: rainfall 2000mm p.a. in the W, rising to 5600mm p.a. over the mountains in the SE; rain shadow due to Paparoa Range affects valleys (e.g. Grey valley).

SOILS: on hill country soils from weathered Pleistocene gravels and Tertiary rocks; on ranges strongly leached and podzolised steepland soils from indurated rocks; on higher terraces and moraines very strongly leached infertile soils with very poor drainage and associated peaty soils; on lower terraces more fertile stony soils, some with poor drainage; on river flats alluvial soils, some gleyed.

VEGETATION: unusual preponderance of hard beech forest on Old Man Gravel hill country; red beech and silver beech almost confined to stream flats; complex mosaics of beech-podocarp forest types on glacial outwash terraces (including low-fertility species e.g. silver pine); on southern end of Victoria Range N of Grey R., red beech-silver beech forest occurs to 1100m a.s.l., then pure silver beech or mountain beech or mixed stands of both to treeline, approx. 1200m; S of river tree line falls as low as 950m a.s.l. in places; red beech reaches tree line or beeches are superseded by fringe of kaikawaka and pink pine or montane shrubs.

BIRDS: low fertility and the great reduction in low altitude forest have reduced the diversity and abundance of forest birds in this district. Blue Duck in upper Grey R., N.Z. Falcon in mountains, kea in mountains, kaka in forested areas but not abundant, Yellow-crowned Parakeet widespread but not abundant, Rock Wren in upper Clarke R., Yellowhead in Merrijigs, Fernbird in Grey valley, robin throughout but not common.

INSECTS: include the weta Hemideina broughi.

MODIFICATIONS: most of the terrace forest S of Snowy R. has been modified; more fertile low terrace country widely cleared for farming (dairying with sheep and cattle for finishing); deer, possums etc. present.

## BLACKBALL ECOLOGICAL DISTRICT 48.08

Criteria: geology, topography, climate and vegetation (beech-podocarp interface).

TOPOGRAPHY: steep broken country at southern end of Paparoa Range; maximum altitude 1204m a.s.l.; drained into Grey R. or directly to the sea.

GEOLOGY: N of Mt Watson, range is composed of early Paleozoic Greenland Group greywacke and argillite; S of this lie Cretaceous and Eocene coal measures overlain by late Eocene calcareous siltstone and sandstone (Island sandstone, Kaiata Formation).

CLIMATE: rainfall ranges from 2800mm p.a. in Grey valley (rain shadow) to 5600mm on Paparoa Range; frequent low cloud or fog.

SOILS: on ranges strongly leached and podzolised steepland soils from indurated rocks; on hilly country strongly leached and podzolised soils, many with impeded drainage from weathered Pleistocene gravels and Tertiary rocks; on higher terraces very strongly leached infertile soils with very poor drainage and associated peaty soils; on lower terraces more fertile stony soils, some with poor drainage; on river flats alluvial soils, some gleyed.

VEGETATION/MODIFICATIONS: largely forested: in the N silver beech predominates at higher altitudes but in the S mountain beech becomes common with pink pine, kaikawaka and mountain toatoa; treeline drops: often below 900m; much of range crest and major spurs in dense montane shrubland, has been burnt in some areas; beech forest with scattered podocarps occurs SW of Mt Watson and around Blackball, modified by coal mining; podocarp-beech forests occur on terraces above the Grey R. and in lower catchment of Moonlight Creek, widely logged and partly cleared, same forest type also in SE portion of Paparoa Range; largely unmodified podocarp-hardwood forest, lacking beech, occurs in the catchment of Blackball Creek within the Roaring Meg Ecological Area - a significant part of the "podocarp-beech interface" of northern West Coast. Deer, possums etc. present.

BIRDS: devastation of forest by fire in southern half of district has greatly reduced its value for birds; good populations of forest birds remain only in eastern and western mountain areas in the head of Ten Mile and Moonlight Creeks; these include Great Spotted Kiwi, Blue Duck, N.Z. Falcon more abundant in E, kea present on range occasionally descending to coast, Fernbird in Grey valley; district represents southern limit of continuous robin distribution on West Coast except for L. Brunner, L. Kaniere, and Ross R. to Waiho R. Forest faunas on alluvium removed with forests. Sooty and other burrowing petrels apparently still breed on mainland at Twelve Mile Bluff and on small offshore stacks (Motukiki Rocks) nearby; Spotted Shag also breed on these stacks.

FISH: include giant kokopu (Galaxias argenteus).

## HOCHSTETTER ECOLOGICAL DISTRICT 48.09

Criteria: vegetation: a decrease in beech southwards; topography.

TOPOGRAPHY/GEOLOGY: predominantly upper Pleistocene glacial outwash aggradation terraces and morainic deposits resulting from ice advances from the Main Divide extending well into the Grey Depression, locally forming lakes, e.g. Hochstetter, Haupiri and Ahaura; relatively minor areas of well dissected hill country underlain by Tertiary siltstones and sandstones near the Grey R. along western boundary; in the SE are two rounded hills: Bell Hill (c850m) - early Paleozoic greywacke and argillite (Greenland Group) and Granite Hill (c1200m).

CLIMATE: mild though with frosts and fog in winter, rainfall ranges from 3200mm p.a. in the W to 4000mm in the E.

SOILS: from Tertiary rocks strongly leached and podzolised, many with impeded drainage. On higher terraces and moraines very strongly leached infertile soils with poor drainage and associated peaty soils; on lower terraces more fertile, better drained, stony soils; alluvial soils on river flats.

VEGETATION: outstanding feature of forest-type pattern is the replacement of podocarp-beech by podocarp-hardwood forest from Ahaura R. southward to Arnold R.: in the S an increasing density of podocarps occurs in mixed forests, with occasional pure podocarp stands on both hill and terrace sites and beeches become generally confined to riparian sites; escarpments and marginal gullies of terraces. Red beech, silver beech, hard beech and mountain beech all present though hard beech and silver beech are absent in the S; principal podocarp rimu; hardwoods include kamahi, southern rata, quintinia and toro. Transect across portion of podocarp-beech interface of the northern Westland lowlands reserved in Lake Hochstetter and Deep Creek Ecological Areas; podocarp-hardwood forest in Deadman Ecological Area.

BIRDS: highest populations of forest birds around L. Hochstetter and in dense forests in S of district, Southern Crested Grebe on L. Hochstetter, N.Z. Shoveler on L. Haupiri, kaka widespread but not numerous, Yellow-crowned Parakeet abundant, Fernbird in Arnold and Grey valleys, robin widespread in forested areas but not particularly abundant.

FISH: include short jawed kokopu (Galaxias postvectis) and giant kokopu (G. argenteus).

MODIFICATIONS: both classes of forest widely logged and considerable areas cleared for farming; deer, possums etc. present.

## GREYMOUTH ECOLOGICAL DISTRICT 48.10

Criteria: topography, geology (limestone hill country), vegetation.

TOPOGRAPHY/GEOLOGY: includes long, steep-sided Oligocene Cobden limestone and Tertiary Blue Bottom Group mudstone ridges rising southward from Pt Elizabeth along the Twelve Apostles Range and Peter Ridge to Kakawau Trig (approx. 400m a.s.l.), thence north-eastwards along the Kaiata Range to form northern boundary of the New River catchment; ridges enclose a lowlying area of upper Pleistocene alluvial flats and glacial-outwash terraces on both sides of Grey R. and moderately hilly upper Eocene sandstone-siltstone country; upper half of New River valley is middle and upper Tertiary Blue Bottom Group mudstone, sandstone and siltstone hill country, 100-400m a.s.l.

CLIMATE: mild, rainfall about 3000mm p.a.

SOILS: moderately leached soils on parts of hill country from limestone and associated rocks; more leached, less fertile soils on more siliceous Tertiary rocks, many with impeded drainage; infertile podzolised soils with very poor drainage on higher terraces; more fertile stony soils and alluvial soils on low terraces and alluvial flats; generally well drained sandy soils on coastal dunes; central area of strongly leached and podzolised stepland soils.

VEGETATION/MODIFICATIONS: distinctive because of the absence of beeches except along the eastern boundary which follows the podocarp-beech interface. Dense unlogged mixed hardwood forest occurs on the ridge-like ranges with podocarps scattered on ridge tops and sometimes abundant on less steep country, e.g. Rapahoe Scenic Reserve. Some hill forests logged; partially-logged and remnant virgin stands occur on valley floors, e.g. in Card Creek Ecological Area; most other valley floors originally covered by dense rimu and kahikatea forests, are cleared, some have been worked for gold and greenstone. Coastal marine terraces and sand dunes between Taramakau R. and Greymouth have largely been cleared for dairy farming with sheep and cattle grazing. There are some exotic forests.

FLORA: several tree and shrub species reach their southern limit on the West Coast in this district.

FISH: include giant kokopu (Galaxias argenteus) and short jawed kokopu (G. postvectis).

## BRUNNER ECOLOGICAL DISTRICT 48.11

Criteria: geology, vegetation, topography, climate.

TOPOGRAPHY/GEOLOGY: a large dome-like series of steep sided Paleozoic granite mountains W of the Alpine Fault: the Hohonu Range, 1000-1356m a.s.l., Te Kinga, 1226m; extensive and complex flat to rolling terrain between these mountains comprised of moraines, outwash and alluvium lying over Tertiary deposits; stream valleys floored with recent alluvium; large L. Brunner and smaller Lady, Kangaroo and Poerua lakes are major features, scoured out hollows created by glacial retreat.

CLIMATE: mild, though winter frosts common, rainfall ranges from 3000 to 5600mm p.a.

SOILS: infertile podzolised soils with poor drainage and associated peaty soils on terraces and moraines. Strongly leached and podzolised steepland soils from granite, many with impeded drainage, and fertile alluvial soils generally with imperfect to poor drainage, on river flats; small areas of strongly leached and podzolised soils on hill country from Tertiary rocks.

VEGETATION: the almost complete absence of beeches is a feature of the district: rare riparian beech occurs in the upper reaches of the Taramakau R. and there is a large beech outlier including mountain beech, red beech, some silver beech and hard beech occurs in Greenstone Ecological Area, which also contains terrace podocarp forest. Unmodified podocarp-hardwood or steepland hardwood forest covers mid slopes of Te Kinga and Hohonu mountains: altitudinal vegetation belts include rimu-kamahi, quintinia, toro forest at low altitudes with some kahikatea swamps, rising to ratakamahi forest, then kaikawaka, pink pine forest, then Olearia colensoi scrub, and alpine vegetation.

FLORA: Podocarpus acutifolius and hybrids of it with P. hallii occur; subalpine and alpine flora rich; southern limit of Chionochloa australis, Metrosideros parkinsonii, Senecio rufiglandulosus and local southern limit of mountain beech, red beech, silver beech and hard beech occur here; Eleocharis sphacelata, Leptocarpus similis etc. occur in swamps around L. Brunner.

BIRDS: include kaka, Yellow-crowned Parakeet (now much reduced), kea, robin, Yellowhead; Southern Crested Grebe breed on L. Brunner and L. Poerua; Little Grebe (a recent colonist) breed on Lady Lake; N.Z. Scaup and N.Z. Shoveler on L. Brunner and nearby lakes, Marsh Crake, N.Z. Falcon; the Taramakau is close to southern boundary for continuous distribution of weka apart from Fiordland; Fernbird widespread in low country.

REPTILES: common gecko (Hoplodactylus maculatus) collected at L. Brunner (all lizards except forest gecko (Hoplodactylus granulatus) are very scarce on the West Coast).

FISH: include giant kokopu (Galaxias argenteus) and short jawed kokopu (G. postvectis).

MODIFICATIONS: former dense podocarp forests of the river plains, low country and lower hill slopes almost entirely cleared by logging for dairy farming with cattle and sheep grazing; some exotic forests; goats, red deer and possums present.

## ROTOROA ECOLOGICAL DISTRICT 49.01

Criteria: topography, geology, climate, vegetation.

TOPOGRAPHY: hill-country, highest point Mt Mantell, 1605m; includes L. Rotoroa and part of L. Rotoiti; lies NW of Alpine Fault; drained to the N by Buller and to the W by Maruia River.

GEOLOGY: Paleozoic gneissic, quartz-hornblende diorite surrounding L. Rotoroa; granite (Mt Murchison); Tertiary sedimentary rocks in the NE; Lower Paleozoic greywacke and argillite in the S; Lower Pleistocene weathered conglomerate E of Warwick Junction; glacial outwash terrace sequences and Holocene alluvium in river valleys; limestones in west Glenroy and elsewhere; ultramafics at head of Station Creek (near Matakitaki R.).

CLIMATE: moist; summer dry spells important; rainfall 1600-2800mm p.a.; occasional wind storms.

SOILS: shallow, stony, strongly leached to podzolised steep-land soils from gneiss and greywacke, low fertility, liable to severe erosion; slightly more fertile but erodible steep-land soils from basic intrusive rocks on central belt; strongly leached soils from weathered Pleistocene gravels and Tertiary rocks on NE hill country; stony soils on terraces.

VEGETATION: most of district in indigenous vegetation: mostly red beech - silver beech forest with silver beech - mountain beech forest at higher altitudes; mountain beech treelines; hard beech important along midslopes near Buller R. and occurs as far inland as the southeastern end of L. Rotoroa; tall podocarps present on warmer sites.

BIRDS: diverse bird fauna associated with forests which provide mostly montane and sub-montane habitats; therefore remaining forest on valley floors has special significance for birds. Great Spotted Kiwi (uncommon), N.Z. Falcon (few), Spotless Crake at L. Rotoroa, kea in high mountains, kaka in extensively forested areas.

REPTILES: Nelson green gecko (Heteropholis stellatus) widespread and, in places, relatively common; has been found above the bush line on the Robert Range. Common gecko (Hoplodactylus maculatus) occurs at the head of L. Rotoroa (nearest known populations are in the drier country E of the Main Divide). Spotted skink (Leiopisma lineocellatum) (southwestern limit) and speckled skink (Leiopisma infrapunctatum) (southern limit) occur on river terraces near St Arnaud and on the upper Buller R.

MODIFICATIONS: areas near Murchison, Top House-St Arnaud and Springs Junction farmed (semi-intensive sheep and cattle). Exotic forest plantations extensive N of the Buller R.

## TRAVERS ECOLOGICAL DISTRICT 49.02

Criteria: climate, geology, vegetation and soils.

TOPOGRAPHY/GEOLOGY: Glaciated, steep sided mountain ranges of Triassic greywacke and argillite, with narrow valleys and rivers flowing approximately NW; mostly 900-2100m a.s.l.

CLIMATE: high rainfall, 3200-4800mm p.a., mountain climate.

SOILS: mainly stony, shallow alpine soils with large areas of bare rock and scree; strongly leached and podzolised steepland soils at lower altitudes.

VEGETATION/MODIFICATIONS: red beech, silver beech and mountain beech forest with some subalpine scrub, extensive alpine grassland, herbfield and fellfield modified by fire, introduced animals and natural catastrophe - wind and snow.

BIRDS: diverse bird fauna richest in large forest tracts: Great Spotted Kiwi (uncommon), Southern Crested Grebe (L. Rotoiti, rare), Blue Duck, N.Z. Falcon (in all areas), kea (abundant), Yellow-crowned Parakeet (widespread); kaka (throughout), Rock Wren (locally abundant on Robert Ridge and elsewhere); last record of Yellowhead in this district at Sabine Forks, 1977.

REPTILES: Nelson green gecko (Heteropholis stellatus) known from scattered sites. Forest gecko (Hoplodactylus granulatus) (eastern limit) and common skink (Leiolopisma nigriplantare) known from above the bush line on the Travers Range.

SNAILS: district includes the most easterly known locality for Powelliphanta rossiana patrickensis.

## ELLA ECOLOGICAL DISTRICT 49.03

Criteria: geology, topography.

TOPOGRAPHY: glaciated, N trending, steep mountain ranges and valleys drained by tributaries of Buller R. in the N and Grey R. in the S; highest point is Mt Una, 2301m a.s.l., on eastern boundary.

GEOLOGY: almost entirely Haast Schist with degree of metamorphism increasing towards the W; some Triassic Torlesse Supergroup greywacke and argillite in the S and E; Holocene gravels, sands and silts in major valley floors.

CLIMATE: high rainfall, 3000-5600mm p.a., cool mountain climate, severe at high altitudes with patches of snow persisting through summer on highest peaks.

SOILS: mainly shallow, stony, very strongly leached and podzolised steepland soils from schist, greywacke and argillite; soils on gentler slopes may have impeded drainage, some have peaty topsoils; soils on terraces strongly leached, stony, some with poor drainage; at higher altitudes alpine soils with much bare rock and scree.

VEGETATION: lower slopes and part of valley floors clad in red beech - silver beech forest grading upwards into silver beech - mountain beech forest; treeline is formed by mountain beech. Tussockland above treeline, dominated by Chionochloa pallens and C. australis with C. rubra dominant on some broad level ridges at treeline and poorly drained soils at the lower ends of cirques well above treeline; Chionochloa oreophila and C. crassiuscula occupy late snow patch sites in high country at the heads of Matakkitaki and Glenroy valleys.

BIRDS: several species reach high abundances in the intact forests of the valley floors, particularly D'Urville, Matakkitaki, Glenroy, Maruia and Robinson and around L. Daniels; Blue Duck in upper Glenroy and Matakkitaki Rivers, N.Z. Falcon widespread, kea throughout, Yellow-crowned Parakeet, Yellowhead persist near L. Daniels and L. Christobel, kaka widespread, Rock Wren in Spencer Mountains only.

MODIFICATIONS: possums destroying mistletoes; pigs numerous in lower Matakkitaki valley; in lower reaches of Glenroy and Matakkitaki valleys, river flats, dominated by sweet vernal, exotic and indigenous herbs, sedge and shrub communities are grazed by stock; burning of these flats and nearby forests has modified the vegetation.

## LEWIS ECOLOGICAL DISTRICT 49.04

Criteria: vegetation - beech, carpet grass tops, wide grassy valley floors; topography; climate.

TOPOGRAPHY: eastern slopes of Spenser Mountains and lower mountains from upper Clarence and Waiau Rivers to Amuri Pass, including opera and Libretto ranges and northern part of St James Range; 900-2300m a.s.l.

GEOLOGY: mostly Triassic Torlesse Supergroup greywacke and argillite, small areas of basic volcanics, Upper Pleistocene glacial outwash gravel and Holocene river gravels in valley floors.

CLIMATE: cool moist climate, warm summers, rainfall lower than in W of region, 2800-4800mm p.a.; snow persisting at high altitudes from June-October.

SOILS: stony, strongly leached steepland soils from greywacke and related slope deposits grading to alpine soils at higher elevations; scree erosion common with many rock outcrops; stony soils on terraces; sandy and gravelly alluvial soils on river flats.

VEGETATION: forests - relatively undisturbed in upper valleys; towards the E modified by fire: patchy forests with extensive manuka scrub, bracken and induced grassland (browntop and sweet vernal etc.). Altitudinal sequences occur from red beech - silver beech forest to silver beech mountain beech forest with pure mountain beech at tree-line on colder sites; above treeline a narrow band of scrub, with Dracophyllum uniflorum, Podocarpus nivalis, Hebe spp. etc.; grassland above dominated by carpet grass: Chionochloa australis, Chionochloa pallens, C. flavescens near treeline; C. rubra on some level, poorly drained sites. Bogs on terraces in the forest have Dracophyllum bidwillii, Empodisma, Oreobolus strictus and Sphagnum. Stable streams in valley floors with open grasslands: Fescue tussock, induced browntop etc.; also marshy areas with Carex coriacea etc.

FLORA: notable for screes and scree vegetation (c.f. areas of granites on W of Alpine Fault which do not form screes). Scarce plants include Traversia baccharoides.

BIRDS: diverse bird faun especially in valley floors, e.g. Doubtful R.; Blue Duck widespread, N.Z. Falcon widespread, Yellow-crowned Parakeet in N and near Doubtful R., kaka present, Rock Wren near Lewis Pass only, eastern boundary approximates the eastern boundary of weka in the South Island (reflecting dependence on forest cover), and of rifleman and robin until the shrubland-dwelling Marlborough populations are encountered.

REPTILES: Lewis Pass green gecko (Heteropholis poecilochlorus) present along the Lewis and Boyle Rivers. Spotted skink (Leiopisma lineocellatum) has been recorded near Lewis Pass.

MODIFICATIONS: Change from continuous beech forest to patchy forest, scrub and grassland is correlated with decreasing rainfall gradient from W to E, but results from burning by sheep graziers; wide valleys grazed by sheep, cattle and horses (e.g. St James Station); introduced mammals include red deer, a few chamois, possums and hares.

## HOPE ECOLOGICAL DISTRICT 49.05

Criteria: topography, vegetation.

TOPOGRAPHY: low mountains between Amuri Pass and Harper Pass; mostly below 1500m a.s.l.; drained to the W by tributaries of the Grey R. and to the E by the Hurunui.

GEOLOGY: mostly Triassic Torlesse Supergroup greywacke and argillite with Haast Schists with degree of metamorphism increasing westwards, and Holocene river deposits in the major valleys.

CLIMATE: semi-continental, cool, moist, with higher rainfall in the W, 3200-5600mm p.a.; snow persists above tree line from June-October.

SOILS: stony, strongly leached steep-land soils from greywacke and related slope deposits; scree erosion common with many rock outcrops; stony soils on terraces; sandy and gravelly alluvial soils on river flats.

VEGETATION/FLORA: extensive forests: W of the main divide silver and mountain beech are dominant in the Grey and Inangahua tributaries, red beech appears below c.900m; a little lower rata, kamahi and Quintinia enter. Kaikawaka locally common; on poorly drained sites at lower altitudes it may be associated with pink pine. Treeline (between 1200 and 1300m) may be dominated by either silver beech or mountain beech. In the S, towards Mt Alexander, the forest changes: treeline becomes lower and ill-defined; beeches become scattered; forest dominated by conifers and hardwoods (dominant species Hall's totara, kaikawaka, pink pine, Hoheria glabrata, Dracophyllum traversii, Olearia ilicifolia, O. lacunosa). Above treeline W of main divide shrublands dominated by Dracophyllum longifolium, D. uniflorum, D. traversii, O. colensoi, O. lacunosa, pink pine and Phormium cookianum.

E of the main divide in the headwaters of the Hurunui and Waiiau Rivers, forests are much simpler, treelines higher (1300m or more): mountain beech, silver beech and red beech all present; mountain beech forms treeline; Hall's totara and kaikawaka occasionally occur as isolated stands. Towards the E silver beech disappears, red beech becomes rare, the forest becomes progressively more discontinuous with large areas of induced Leptospermum shrublands and tussock grassland.

Above treeline a narrow, discontinuous belt of Dracophyllum uniflorum subalpine shrubland occurs on some sites but often forest gives way directly to alpine grasslands.

BIRDS: include Blue Duck widespread, N.Z. Falcon widespread, Yellow-crowned Parakeet, kaka widespread, Rock Wren.

MODIFICATIONS: valley bottoms are grazed; low populations of red deer, chamois and pigs are present; possums locally common, high populations in the SW.

## HOKITIKA ECOLOGICAL DISTRICT 50.01

Criteria: landform (glacial outwash and alluvial surfaces), geology (extent of Greenland and Tuhua rocks), vegetation (mixed forest without beech), flora (some species at their southern limit), climate.

TOPOGRAPHY/GEOLOGY: Recent alluvial valleys separated by moraine hills and plateaux underlain by late Cenozoic muddy sandstone and mudstone (Blue Bottom Group) in the N; a few scattered outcrops of early Paleozoic Greenland Group greywacke and argillites, Tuhua Granite and Oligocene limestone, latter supporting limestone plant species at their southern limits for Westland; maximum altitude 1361m a.s.l.

CLIMATE: high rainfall, 2500-4000mm p.a. with winter minimum, mild temperatures, but winter frosts.

SOILS: strongly leached and podzolised soils on lower altitude hill country; stony, strongly leached stepland soils on mountain slopes; very strongly leached soils with poor drainage on terraces and moraines; sandy and stony alluvial soils, some with poor drainage on river flats; free-draining sand soils on coastal dunes. Most soils have very low natural fertility; alluvial and sand soils more fertile, developed for farming.

VEGETATION: once extensive dense rimu and kahikatea dominated forest on lowland plateaux and hills, largely cleared. Mixed podocarp-hardwood forest (mainly rimu with kamahi, southern rata, quintinia and 'toro) remains on higher hill country, much of it logged. Beech is unknown; extensive kahikatea, silver pine swamps occur in valleys. Large area of lowland podocarp and podocarp-hardwood forest protected in Lake Kaniere Scenic Reserve.

FLORA: southern limits of lemonwood (Totara River), northern rata (Lake Mahinapua) and kanuka (Arahura River).

BIRDS: aberrant distribution of forest birds, apparently caused by lack of beech and clearance of extensive forest from much of district except hill country, and around L. Kaniere. No weka S of L. Kaniere; falcon, kaka, and Yellow-crowned Parakeet widespread in forest; Rifleman with restricted distribution (only in the S); Yellowhead previously widespread N of Taramakau R. (still present at junction of Wainihinihi and Taramakau Rivers); robin only near L. Kaniere and in hill country in S of district. Kea present above bush line; Fernbird, Marsh Crane and Spotless Crane in suitable habitats throughout; Southern Crested Grebe on L. Kaniere; Scaup on lakes, Blue Duck present on the lower Kokotahi R. Northernmost breeding side of Southern Blue Penguin at Hokitika R. mouth.

REPTILES: green geckos (Heteropholis sp.) reported from Kaniere SF.

FISH: include giant kokopu (Galaxias argenteus), short jawed kokopu (G. postvectis) and brown mudfish (Neochanna apoda).

MODIFICATIONS: Recent alluvial flats and coastal marine terraces and sand dunes between Taramakau R. and Hokitika largely cleared and farmed (dairying with sheep/cattle grazing), some exotic forests; logging, especially of rimu, has occurred in lower altitude forests. Deer, possums etc. present.

## WHITCOMBE ECOLOGICAL DISTRICT 50.02

Criteria: climate (highest rainfall measured in New Zealand), geology (metamorphic rocks), landform (peaks rising above permanent snowline), vegetation (beech absent except for outliers in north).

TOPOGRAPHY: large, heavily glaciated, mountainous district; maximum altitude 2621m a.s.l.; glaciers occur in Whitcombe head.

GEOLOGY: Torlesse Supergroup greywacke and argillite in the E and Haast Schist in the W; also nephrite, serpentine, talc, high grade schist etc; nephrite outcrops in a reef in upper Arahura.

CLIMATE: very high rainfall, mountain climate; 4800-9000mm p.a.

SOILS: dominantly stony, strongly leached steepland soils with many screes and bare rock outcrops, grading to alpine soils at higher altitudes; alluvial soils, some with poor drainage, on river flats; strongly leached, gleyed and podzolised soils with poor drainage associated with peaty soils on terraces and moraines.

VEGETATION: south of Taramakau-Otira watershed an altitudinal sequence of vegetation belts characteristic of high rainfall areas lacking beech occurs: mixed podocarp-hardwood forest on lower slopes, occasional miro, Hall's totara, a few matai and kahikatea (rich epiphytes on the trees including ferns and many angiosperms normally rooted on the ground); at higher altitudes rata-kamahi forest; then kaikawaka and pink pine; a wide belt of subalpine scrub, Olearia colensoi, Dracophyllum traversii etc.; cushion bogs on upper valley flats and some subalpine ridges; also red tussock in addition to snow tussock, herbfield and high-alpine vegetation. Taramakau-Otira catchment contains local southern limit of beech species between central and north Westland. Some beech outliers occur in the Taramakau catchment: red beech, mountain beech and some silver beech mainly on valley floor and some distance up slope, plus hard beech with yellow-silver pine at L. Kaurapataka; the Otehake has extensive forests of red beech, mountain beech and some silver beech; in the Otira red beech occurs on the flats and up the slopes; also mixed forest: rimu, kamahi, kaikawaka etc.

FLORA: minor floristic differences from Wilberg district; Geum uniflorum, Ranunculus insignis and Senecio bidwillii may have southern limits or Westland in Whitcoe.

BIRDS: kiwi, kaka, Yellow-crowned Parakeet, Yellowhead (in the NE); robin in forest habitats; falcon throughout; Kea and Rock Wren above bush line; scattered records of Blue Duck along rivers

MODIFICATIONS: introduced mammals include common deer, chamois, possums and goats and occasional tahr.

## HUNDALEE ECOLOGICAL DISTRICT 52.01

Criteria: geology, topography, soils, climate, vegetation.

TOPOGRAPHY: coastal hills S of Kaikoura: youthful steep sided hills, sharp ridges and peaks, dropping very quickly to narrow valley floors; mostly less than 900m a.s.l., highest point Totara, 965m; drained to the E and S via the Waiau R.

GEOLOGY: mostly indurated Mesozoic Torlesse Supergroup greywacke and argillite with Tertiary calcareous siltstones, marine sandstones, limestones, coal measures, glauconitic sandstone with very thick basaltic flows (up to 1500m) and volcanoclastics; some Pleistocene glacial outwash gravels.

CLIMATE: subhumid with mild summers and cool winters; day temperatures occasionally exceed 32°C with dry foehn NW winds; rainfall 900-1200mm p.a. with winter maximum.

SOILS: moderately leached steepland soils from greywacke on steeper hill country in moderate rainfall areas; in lower rainfall hilly and rolling land soils moderately fertile but droughty with pale-coloured and compact subsoils. Soils on basic volcanic rocks have darker coloured, heavier textured subsoils. Small areas of stony droughty soils on terraces.

VEGETATION: originally beech forest in southern sector, coastal hardwood forest on eastern border and mixed podocarp-hardwood forest predominated. Patches of forest remain: beech forest (black beech and red beech) dominant in the S (presence of these beech species important); coastal hardwood forest (mahoe, mapou, ngaio, kawakawa, akeake, titoki, hinau); lowland mixed podocarp/hardwood forest (matai, totara, rimu, hinau); mixed hardwoods (mahoe, fivefinger, broadleaf, fuchsia); small areas of kanuka and Hall's totara; scrub: bluff scrub important (Senecio monroi, Hebe hulkeana, Pachystegia), extensive second growth kowhai (one of largest areas in South Island); modified tussockland.

FLORA: red beech and rimu at eastern limit; black maire and probably Cyathea cunninghamii at southern limit; several Marlborough and northern species occur in district e.g. Pachystegia; Nothospartium torulosum at northern limit.

BIRDS: poor bird fauna because district is highly modified by farming activities. Falcon present; robin occur in some forest remnants (part of the isolated robin population on the Kaikoura coast); Scaup have been reported from some wetlands.

REPTILES: rough gecko (Heteropholis rudis) present in scrub and forest patches.

MODIFICATIONS: most of district farmed (mostly semi-extensive sheep and cattle).

## LESLIE ECOLOGICAL DISTRICT 52.02

Criteria: geology, topography, climate, vegetation.

TOPOGRAPHY: mainly south-east facing inland hills crossed by the Waiau R.; almost all below 900m a.s.l.

GEOLOGY: mostly indurated Mesozoic Torlesse Supergroup greywacke and argillite (less indurated rocks than Southern Alps, more fertile) with some Tertiary limestone, sandstone, conglomerate and basaltic flows and pyroclastics with crystalline limestone (Hanmer Marble) near Broom Stm. and some Pleistocene glacial outwash gravels near the Waiau R. which follows the Hope Fault; Cretaceous quartz sanidine rhyolite at Counting Stm.

CLIMATE: subhumid, very warm summers; day temperatures occasionally exceed 32°C with dry foehn NW winds; cool winters; rainfall 1200-1600mm p.a.

SOILS: stony steep-land soils from greywacke and related slope deposits with those at lower altitude and rainfall droughty in summer while those with higher rainfall in the NW have more even moisture conditions: on hilly slopes stony but moderately deep soils from Pleistocene gravels and heavy textured and dark-coloured soils from basaltic rock and limestone (rendzinas); droughty shallow soils on terraces; alluvial soils in valleys.

VEGETATION/MODIFICATIONS: originally mostly podocarp/hardwood forest (mainly matai, totara, broadleaf, fivefinger, lancewood) on SE facing country with beech forest (mainly black beech and mountain beech) at higher levels on the Amuri Range and facing the Hanmer R.; similar patterns on adjacent Culverden Range with less beech. More remnants on former than latter. Snow tussock (mainly Chionochloa macra, C. cf. flavescens) and mixed subalpine scrub at higher levels throughout. Now extensive short tussockland, scattered mixed shrubland, remnant forest patches, extensive broom and spreading pines on Amuri Range; many patches of dwarf kowhai; treeland of cabbage tree, kowhai; patches of Leptospermum scrub. Today district mostly farmed (semi-extensive sheep and cattle grazing).

FLORA: limestone and rock communities of interest. Northern limit of Bulbinella augustifolia. Waiau R. a major boundary for northern species e.g. Bulbinella hookeri.

BIRDS: highly modified for farming; only bird of note is the falcon.

REPTILES: rough gecko (Heteropholis rudis) occurs in forest near Waiau. Spotted skink (Leiopisma lineocellatum) occurs near Waiau and at Montrose.

## CULVERDEN ECOLOGICAL DISTRICT 52.03

Criteria: topography, geology, soils, climate, vegetation.

TOPOGRAPHY: inland Culverden basin surrounded by low ranges; all below 300m a.s.l.; crossed by the Waiiau, Pahau, Hurunui and Waitohi Rivers.

GEOLOGY: mostly Quaternary glacial outwash gravel deposits with Holocene river gravel, sand and silt in the river beds; minor area of Torlesse Supergroup moderately indurated greywacke and argillite, Tertiary sandstones, siltstones, volcanics and limestones on low hills to NE and E.

CLIMATE: subhumid; very warm summers, day temperatures occasionally exceed 32°C with dry foehn NW winds; cool winters; rainfall 700-800mm p.a., with winter maximum.

SOILS: on terraces moderate to low fertility shallow droughty and stony soils are extensive; on rolling land, moderately fertile soils from loess have pale-coloured and compact subsoils, impeded drainage and dry out in summer; on river flats sandy silty and gravelly well drained alluvial soils.

VEGETATION: formerly short tussockland (Festuca novae-zelandiae, Poa caespitosa on recent soils); mixed with extensive stands of kanuka, minor manuka, matagouri, native broom, Coprosma species, Hymenathera. Some kowhai-cabbage tree woodland along river margins. Feature of the area is the long term occupancy of the basin by kanuka and short tussock. There may have been some podocarp-hardwood forest along some rivers and in the poorer draining eastern margin below Lowry Peaks Range.

BIRDS: no land bird species of note as district is highly modified for farming. Black-fronted Tern breeding colonies occur on the Waiiau R.

MODIFICATIONS: most of district farmed (intensive sheep, cattle and crops); now irrigated in northern sector; extensive exotic forests (Balmoral).

## WAIIAU ECOLOGICAL DISTRICT 52.04

Criteria: topography, geology, climate, history (deforestation), vegetation.

TOPOGRAPHY: the Lowry Peaks Range and hills to the N and SW; mostly below 600m a.s.l.; highest point Devil's Hill, 867m; drained entirely to the E, crossed by the Waiau R. in the N and the Hurunui R. towards the S.

GEOLOGY: mostly moderately indurated Mesozoic Torlesse Supergroup greywacke and argillite with some Tertiary limestone and marine siltstone and sandstone near Scargill Creek; minor areas of Quaternary outwash gravels along drainage rivers; minor areas of volcanics in the N.

CLIMATE: subhumid, very warm summers, day temperatures occasionally exceed 32°C with dry foehn NW winds, cool winters; rainfall 800-1000mm p.a.

SOILS: mainly stony steepland soils from greywacke and related slope deposits; moderately fertile, but droughty in dry seasons; small areas of moderately fertile but droughty soils from loess with compact subsoils on rolling land.

VEGETATION: originally dominated by podocarp/hardwood forests (totara, matai, broadleaf, fivefinger, mahoe etc.); formerly short tussockland (Festuca novae-zelandiae, Poa caespitosa) at low altitudes, some snow tussock on higher tops. Some beech forest remnants on northernmost fringe, mainly scattered mixed scrub throughout with many riparian fringes of remnant hardwood forest along streams draining Lowry Peaks Range. Scattered pockets of dwarf kowhai, Muehlenbeckia astonii, Clematis afoliata mixed scrub, cabbage tree treeland; extensive bracken, matagouri in bouldery gullies.

FLORA: southern limit for Pachystegia insignis (2 forms), Hebe hulkeana. One of the few known populations in New Zealand of the rock fern Pleurosorus rutifolius.

BIRDS: no bird species of note as district is highly modified for farming.

MODIFICATIONS: most of district farmed (semi-extensive sheep and cattle grazing); prominent broom and blackberry infestations.

## CHEVIOT ECOLOGICAL DISTRICT 52.05

Criteria: topography, geology, climate, vegetation, flora.

TOPOGRAPHY: coastal hills, mostly below 600m a.s.l. and plains mostly below 150m, between the Conway and Hurunui Rivers.

GEOLOGY: hill country mostly moderately indurated Mesozoic Torlesse Supergroup greywacke and argillite; uplifted and dissected plains of Tertiary quartzose sandstone, greensand, siltstone and limestone with Quaternary glacial outwash gravels and Holocene river gravel, sand and silt along the rivers; calcareous blue grey siltstone common near Conway R.; sharp boundary along Kaiwara fault to the W.

CLIMATE: subhumid, very warm summers, day temperatures occasionally exceed 32°C with dry foehn winds; cool winters, mild near coast; rainfall 800-1000mm p.a., with winter maximum.

SOILS: on flattish rolling and hilly land soils from loess and sedimentary rocks have pale-coloured clayey and compact subsoils; soils moderately fertile but droughty, however those on flattish and rolling slopes have impeded drainage. Soils on steep slopes from greywacke stony with browner, more friable subsoils and more even moisture conditions. Small areas of droughty shallow and stony soils on terraces; silty, sandy and gravelly well drained alluvial soils on river flats.

VEGETATION: formerly short tussockland (Festuca novae-zelandiae, Poa caespitosa) with some snow tussockland at higher altitudes. Extensive forest patches in coastal ranges, especially along and in the heads of streams draining east. Beech forests dominant in gullies to the N, petering out southwards along the coast. Elsewhere vegetation dominated by podocarp/hardwood and mixed hardwood forests in lowlands and hills; mixed podocarp/hardwood coastal forests also common remnants; extensive riparian and hill stands of kanuka, kowhai (Sophora microphylla). Coastal forests with ngaio, akeake (Dodonaea viscosa), pigeonwood, titoki, Olearia paniculata, a few totara and matai, mahoe, mapou, puka. Mixed podocarp/hardwood forests of totara, matai, Plagianthus regius, Hoheria augustifolia, hinau, titoki, pigeonwood, mahoe, fivefinger, lancewood, broadleaf, fuchsia. Upland hardwood forests with broadleaf, mapou, fivefinger, lancewood, fuchsia.

FLORA: southern coastal limits of Hebe hulkeana, Pachystegia sp. (unnamed), Metrosideros perforata. District near southern limits for a number of species whose precise limits have not been determined.

BIRDS: district highly modified for farming; only birds of note reported breeding are Australian Little Grebe, Scaup and Australasian Coot (St Anne's Lagoon).

MODIFICATIONS: most of district farmed (semi-extensive sheep and cattle grazing).

## MOTUNAU ECOLOGICAL DISTRICT 52.06

Criteria: geology, topography, vegetation, soils.

TOPOGRAPHY: coastal hills and valleys between the Hurunui and Waipara Rivers; all below 600m a.s.l.; drained mostly to the E by small rivers incised on the Motunau Plain.

GEOLOGY: inland hills of strongly indurated Mesozoic Torlesse Supergroup greywackes and argillites; the rest of the district includes Tertiary marine mudstones, sandstones, conglomerates, limestones and quartz sands; areas of Quaternary glacial outwash gravels, some of them loess-covered and weathered, and coastal marine gravels and sands.

CLIMATE: subhumid, very warm summers, day temperatures occasionally exceed 32°C with dry foehn NW winds; cool to mild winters; rainfall 700-800mm p.a. with winter maximum.

SOILS: stony steepland soils from greywacke and slope deposits on steep slopes; soils with compact clayey, pale-coloured subsoils on hilly, rolling and flattish slopes from Tertiary sedimentary rocks and loess, moderately fertile but droughty in dry seasons; soils on terrace and rolling land have impeded drainage.

VEGETATION: formerly short tussocklands, cabbage tree treeland, mixed shrubland; extensive areas of coastal mixed podocarp/hardwood forest (totara, mahoe, mapou, akeake, ngaio, broadleaf), kanuka forest (with minor manuka), riparian beech forests (black beech), upland mixed hardwood forest (broadleaf, fuchsia, lancewood, fivefinger, kowhai). Now beech confined to incised streams N of Motunau, but reaches right to the coast (most unusual). Evidence that beech was once more widespread. Remnant indigenous forests and shrublands still extensive and significant (several new reserves). A small stand of southern rata on siliceous sands at Omihi State Forest is notable. Remnant tussockland on Motunau I. has never been grazed by stock, although there is a history of fire; rabbits were eradicated by 1962.

FLORA: the southern limit of several limestone plants occurs here e.g. Epilobium wilsonii, Senecio monroi; also many other species e.g. an unnamed Blechnum sp., Celmisia monroi. Many other interesting records e.g. filmy ferns.

BIRDS: no land-bird species of note as district highly modified for farming. Motunau I. (c.3.65 ha) is the most important sea-bird breeding site on the E coast between the Bay of Plenty and Foveaux Strait. Main breeding colony of White-flipped Penguin (1,000 pairs, elsewhere only on Banks Peninsula); one of the major N.Z. breeding colonies of Fairy Prions (10,000 pairs); significant colonies of N.Z. White-faced Storm Petrel (500 pairs) and Sooty Shearwater (100 pairs). Black-backed Gull (100 pairs) nest on the island regularly; White-fronted Tern and Variable Oystercatcher do so occasionally; Spotted Shag roost on the island; Pied Shag nest on the nearby coast. Wrybill reported from the coast.

REPTILES: spotted skink (Leiopisma lineocellatum) common on Motunau I.

MODIFICATIONS: district mostly farmed (semi-extensive sheep and cattle).

## WAIKARI ECOLOGICAL DISTRICT 52.07

Criteria: geology, climate (dry), vegetation.

TOPOGRAPHY: dry hills and flat-bottomed valleys centred on Waikari; mostly below 600m a.s.l.; drained to the E via the Waikari R. in the N and the Waipara R. in the S.

GEOLOGY: hills of moderately indurated Mesozoic Torlesse Supergroup greywacke and argillite and Tertiary marine siltstone, sandstone, limestone and basal coal measures; extensive Quaternary glacial outwash gravels in the wide river valleys.

CLIMATE: low rainfall, 600-750mm p.a.; warm summers with occasional hot foehn NW winds giving temperatures above 32°C; cool winters with frequent frosts and occasional light snowfalls; prevailing winds NW and E.

SOILS: mainly clayey textured soils with pale-coloured compact subsoils on rolling and hilly slopes from loess and Tertiary sedimentary rocks with steepland soils from greywacke on steep slopes; moderately fertile but droughty in dry season; however soils on easier slopes have slow drainage. Heavy textured and dark-coloured soils (rendzinas) on lime-rich rocks.

VEGETATION: formerly mainly short tussockland and mixed scrub (Coprosma spp., dwarf kowhai, Hymenanchera alpina, Carmichaelia spp.). Minor area of mixed hardwood forest remnants in gullies (broadleaf, fivefinger, kowhai, mahoe). Evidence of more extensive mixed podocarp/hardwood forest in the past, with much matai and totara, but now largely deforested.

FLORA: Hebe raoulii var maccaskillii almost endemic to the district (also occurs on limestone a little further S). Extensive limestone flora of interest, especially in the Weka Pass and Waipara Gorge.

BIRDS: no bird species of note as district highly modified for farming.

MODIFICATIONS: district is farmed (intensive sheep, cattle and crops).

## MINCHIN ECOLOGICAL DISTRICT 53.01

Criteria: vegetation (beech forest), topography, climate.

TOPOGRAPHY: glaciated mountains including part of the Main Divide, Poulter Range and Crawford Range; mostly 900-1500m a.s.l., maximum altitude 1820m; drained to the E via South Branch of Hurunui R. and S via Poulter R.

GEOLOGY: mainly Mesozoic Torlesse Supergroup greywacke and argillite.

CLIMATE: humid to superhumid mountain climate: cold winters, cool summers; rainfall decreases eastwards, from the Poulter R. to L. Sumner, 2400-3200mm p.a.

SOILS: very strongly leached, low fertility stony steepland soils from greywacke and related slope deposits with alpine soils at higher altitudes; soils on easier slopes and flattish basins have poor drainage with peaty topsoils.

VEGETATION: mainly beech forests (black beech, red beech and silver beech, treeline about 1200m) and subalpine scrub, alpine vegetation including tussockland (Chionochloa pallens, C. crassiuscula, C. australis); also valley floor grasslands (Festuca novae-zelandiae, Poa colensoi) and riverbed vegetation.

BIRDS: good diversity of forest birds. Great Spotted Kiwi present; falcon, kaka, Yellow-crowned Parakeet (Red-crowned Parakeet also reported), Yellowhead and robin widespread in forest; kea and Rock Wren above tree line; Blue Duck along rivers.

MODIFICATIONS: introduced mammals include red deer, a few chamois, hare, possum; cattle graze valley floors, some sheep.

## ARTHUR'S PASS ECOLOGICAL DISTRICT 53.02

Criteria: climate, vegetation, terrain.

TOPOGRAPHY: glaciated mountains immediately east of crest of Southern Alps; much land 1500-2100m a.s.l.; maximum altitude 2377m; drained to the E via the Waimakariri and Avoca Rivers.

GEOLOGY: Mesozoic Torlesse Supergroup greywacke and argillite.

CLIMATE: humid to superhumid mountain climate: cold winters, cool summers; high rainfall, 2000-6400mm p.a.

SOILS: predominantly strongly leached and podzolised stony steep land soils from greywacke and related slope deposits; soils on easier slopes with peaty topsoils and impeded drainage; alpine soils at higher altitudes and areas of bare rock and scree; gravelly and sandy alluvial soils in valleys.

VEGETATION: mainly alpine vegetation including tussockland (e.g. Chionochloa pallens, C. crassiuscula, C. oreophila, Celmisia discolor, C. armstrongii); subalpine scrub (e.g. Dracophyllum uniflorum, Podocarpus nivalis and, in sheltered places, Senecio eleagnifolius, Olearia nummularifolia, Phormium cookianum, Hebe subalpina etc.) and beech forests (mainly mountain beech, some red beech and a small amount of silver beech); some patches of Hall's totara - kaikawaka forest; also species such as Pseudopanax simplex, P. lineare, Archeria traversii, Dacrydium biforme, Dracophyllum traversii, D. longifolium; cushion bogs with Oreobolus pectinatus, Donatia, Carpha etc., and rarer Schizaea fistulosa, Empodisma, Mitrasacme novae-zelandiae; red tussockland; lower in valleys on burned over beech forest, extensive areas of manuka.

FLORA: includes northern limit of Ranunculus godleyanus, Bulbinella gibbsii var balanifera, Rostkovia magellanica and southern limit of Parahebe cheesemani, Chionochloa australis; Myosotis explanata is endemic; uncommon to rare plants include Rostkovia, Ranunculus crithmifolius, R. godleyanus, Bulbinella gibbsii, Abrotanella pusilla; includes type localities of over 40 vascular and many non-vascular plant species.

BIRDS: extensive beech forests support a diversity of forest birds. Great Spotted Kiwi present (southern limit E of main divide); widespread forest species are falcon, weka, kaka, Yellow-crowned Parakeet (including the orange-fronted morph), Red-crowned Parakeet, and Yellowhead (E of the main divide they are absent between here and Huxley E.D.); kea and Rock Wren above tree line; Blue Duck occur along rivers; Fernbird have also been reported.

MODIFICATIONS: introduced mammals include red deer, chamois, hare and goats.

## SUMNER ECOLOGICAL DISTRICT 54.01

Criteria: topography (very broken, jagged country), climate, altitude (lower than Poulter).

TOPOGRAPHY: moderately glaciated broken and jagged mountains, intermontane basins and valleys, N of the Hurunui R.; including L. Scanner, L. Taylor, L. Sheppard, L. Katrine and L. Marion; mostly 900-1500m a.s.l.; highest point Mt Longfellow, 1898m; drained to the E via the Hope R. in the N and the Hurunui R. in the S.

GEOLOGY: mainly Mesozoic Torlesse Group greywacke and argillite with some Pleistocene glacial outwash gravels and Holocene river deposits in the valleys.

CLIMATE: subhumid mountain climate: cold winters, cool summers. Rainfall 1600-2000mm p.a.

SOILS: moderately to strongly leached steep-land soils from greywacke and related slope deposits; deeper soils on rolling and flattish slopes of terraces, fans and moraines.

VEGETATION: includes extensive beech forests (red beech and mountain beech); tussockland including Festuca novae-zelandiae, Poa colensoi at lower altitudes, with Chionochloa macra, C. flavescens and red tussock at higher altitudes; mixed scrub including extensive kanuka scrub and low forest in deforested areas (formerly beech forest); alpine vegetation and prominent tarn and lakeside communities around lakes etc.

FLORA: species reaching their southern limits here include Helichrysum selago (intermedium) var. acutum, Celmisia traversii, Raoulia bryoides; those reaching their northern limits include Bulbinella angustifolia, Carmichaelia uniflora, Raoulia mamillaris, Celmisia lyallii; those reaching their eastern limits include Podocarpus acutifolius - which gains passage via low passes in stream headwaters.

BIRDS: diverse avifauna, especially near L. Sumner and L. Katrine. Kiwi (probably Great Spotted) have been reported; other widespread forest species are falcon, weka, Yellow-crowned Parakeet, and robin; the orange-fronted morph of the parakeet is known from the Hope R.; kaka only in the vicinity of L. Sumner; kea occur above tree line; N.Z. Shoveler, Scaup and Southern Crested Grebe are present on the lakes; Blue Duck occur on some rivers.

REPTILES: spotted skink (Leiopisma lineocellatum) found near the Hope R.

MODIFICATIONS: introduced mammals throughout including red deer and chamois.

## POULTER ECOLOGICAL DISTRICT 54.02

Criteria: vegetation (beech forest), flora, topography, climate.

TOPOGRAPHY: moderately glaciated mountains and valleys; mostly over 900m a.s.l.; maximum altitude 1986m, Mt Crossley; drained to the E via Hurunui R., to the S via Waimakariri R.

GEOLOGY: mainly Mesozoic Torlesse Supergroup greywacke and argillite; small areas of Tertiary sediments and some Pleistocene moraines and glacial outwash gravels and Holocene river deposits in valleys.

CLIMATE: mountain climate: cold winters, moderately warm summers; moderate to high rainfall, 1500-3000mm p.a.

SOILS: moderately leached steepland soils with yellowish brown friable, stony subsoils at lower altitudes in the E grading into more strongly leached and podzolised steepland soils in the W at higher altitudes; many areas of shallow soils, bare rock and scree. Slightly deeper gravelly and sandy soils on flattish to rolling slopes of terraces, fans and moraines with small areas of gravelly and sandy alluvial soils in valleys.

VEGETATION: originally almost unbroken forest; Polynesian fires in E; some further fires in E in early European times; today vegetation includes beech forests (black beech, red beech and silver beech; treeline about 1200m), valley floor grassland (Festuca novae-zelandiae, Poa colensoi) and riverbed vegetation, mixed scrub and alpine grasslands (Chionochloa pallens, C. crassiuscula, C. australia, C. macra on E).

BIRDS: forested areas support a diverse bird fauna. Great Spotted Kiwi have been reported; other forest species are falcon, kaka, Yellow-crowned Parakeet (Red-crowned Parakeet also reported), Yellowhead, and robin; kea occur above tree line; Blue Duck are found on some rivers.

MODIFICATIONS: introduced mammals include red deer, a few chamois, hare, possum; cattle graze valley floors, some sheep (sheep earlier grazed tops also).

## CASS ECOLOGICAL DISTRICT 54.03

Criteria: geology, topography, flora, climate

TOPOGRAPHY: glaciated valleys, intermontane basins, hills; wide river floodplains of Waimakariri and Esk Rivers and tributaries; small lakes, wetlands; mostly 600-900m a.s.l.; highest point Mt Binser, 1895m; evidence of deforestation by fire, accelerated gullying, debris flows.

GEOLOGY: mainly Mesozoic Torlesse Supergroup greywacke and argillite, higher greywacke hills have bare rounded (cryoplaned) summits and thick gravel slope deposits, large gravel fans; Pleistocene moraines, extensive glacial outwash gravels, Holocene river deposits in the valleys; area of Cretaceous to Tertiary sediments including limestone with distinctive landscapes and unique flora in Esk River and around Castle Hill.

CLIMATE: hill climate: cold winters, moderately warm summers; rainfall 800-1750mm p.a.; NW winds prevail, occasional very strong gales; snow may lie in valley floor for short periods, and on tops for two months or so in winter. SOILS: moderately to strongly leached soils with yellowish brown friable subsoils on flattish to strongly rolling slopes of terraces, fans and moraines, some soils at higher altitude and rainfall showing podzolisation; stony steepland soils on steep mountain country with large areas of scree and bare rock; gravelly, sandy and silty alluvial soils on river flats; small areas of heavy textured dark-coloured soils (rendzinas) on limestone hills.

VEGETATION: includes short tussockland - induced grassland (Festuca novae-zelandiae, Poa colensoi, browntop, sweet vernal) in basins and valleys; discontinuous black beech forests and mixed scrub (manuka and some kanuka in Broken and Waimakariri Rivers) on slopes; subalpine and alpine vegetation on hill tops (including Chionochloa macra); tarns and lakes are important: vegetation includes Typha, Carex secta, Phormium.

FLORA: Vagabond Inn tarn is a Project Aqua site - very distinctive diatom flora. Type localities of approximately 25 plant species occur in this district; uncommon to rare plants include, Schoenus apogon, Gingidia enysii, Hebe armstrongii, H. cupressoides, Picris hieracioides, Lepidium sisymbrioides, Helichrysum dimorphum; on Castle Hill limestone Poa acicularifolia; endemics Wahlenbergia brockiei, Ranunculus crithmifolius ssp paucifolius, Myosotis traversii var cinerascens; the local southern limit of red beech and possibly Hebe glaucophylla.

BIRDS: the relative lack of forest in this district means a less diverse forest avifauna although species such as kaka and robin are present at a few localities. Falcon present throughout; kea occur at higher elevations; Southern Crested Grebe, Scaup, Marsh Crake and Spotless Crake are associated with the wetlands.

REPTILES: spotted skink (Leiopisma lineocellatum) recorded from Cass.

MODIFICATIONS: most of district grazed (extensive sheep and some cattle on valley floors); introduced wild mammals include red deer, a few chamois, possums, hares, some rabbits, pigs.

## TORLESSE ECOLOGICAL DISTRICT 54.04

Criteria: topography and landscape, vegetation, climate.

TOPOGRAPHY: long narrow mountain district including moderately glaciated Puketeraki, Torlesse and Big Ben Ranges, crossed by the Waimakariri River; also drained eastwards via Hurunui, Waipara and Ashley Rivers in the N and Selwyn and Rakaia Rivers in the S; mostly 900-1500m a.s.l., maximum altitude 1996m, Castle Hill Peak.

GEOLOGY: mainly Mesozoic Torlesse Supergroup greywacke and argillite with small areas of Pleistocene glacial outwash gravels, some Tertiary deposits; bare debris and scree.

CLIMATE: cool moderately moist hill climate; rainfall 1000-2400mm p.a.; NW winds prevail with occasional very strong gales; snow lies on tops for about 3 months in winter.

SOILS: mainly strongly leached stony steep land soils from greywacke and related slope deposits with yellowish brown friable subsoils; areas of bare rock and scree common; soils at lower altitudes in the NE less leached; small areas of shallow soils on terraces and fans.

VEGETATION: includes tussockland in the valleys (Festuca novae-zelandiae plus Agrostis tenuis etc.), patchy beech forest on the slopes (mountain beech) and scattered to dense scrub (especially Dracophyllum acerosum); patchy subalpine and alpine vegetation including tussock (Chionochloa macra); scree and rock vegetation; extensive fell-field vegetation in places

BIRDS: much of this district is highly modified for farming and the avifauna is consequently poor. Kea present at higher elevations; falcon occur throughout; isolated records of parakeets (probably Yellow-crowned); Southern Crested Grebe are known from L. Lyndon; Wrybill have been reported from braided riverbeds.

INSECTS: include giant weta Deinacrida connectans on Torlesse Range.

MODIFICATIONS: Most of district grazed (extensive sheep and cattle); introduced wild mammals include red deer, chamois, pigs, hares, possums.

## CRAIGIEBURN ECOLOGICAL DISTRICT 54.05

Criteria: topography and landscape, vegetation, climate.

TOPOGRAPHY: moderately glaciated Craigieburn and nearby ranges and valleys of the Harper and Avoca Rivers; mostly between 1500 and 2100m a.s.l.; maximum altitude Mt Enys, 2195m.

GEOLOGY: Mostly Mesozoic Torlesse Supergroup greywacke and argillite, small areas of sandstone and conglomerate, Pleistocene glacial outwash gravel and Holocene river deposits.

CLIMATE: cool, wet mountain climate; rainfall 1400-2400mm p.a.; NW winds prevail with occasional very strong gales, especially along river courses; snow lies on tops about 3 months in winter.

SOILS: stony steep-land soils extensive, ranging from moderately to strongly leached at lower altitudes to strongly leached and podzolised at higher altitudes; areas of bare rock and scree extensive; on easier slopes of terraces and fans shallow to moderately deep silty and sandy soils.

VEGETATION: mountain beech forests on lower slopes; narrow band of subalpine scrub (especially Dracophyllum acerosum); subalpine tussockland (Chionochloa macra, some C. pallens and C. crassiuscula), and alpine vegetation at higher altitudes; rock vegetation (Raoulia eximina, Hebe tetrasticha); extensive fell-field vegetation in places (Dracophyllum pronum, Phyllacne colensoi).

FLORA: scree flora notable (Notothlaspi, Stelleria roughii, Lobelia roughii, Ranunculus haastii, Epilobium pychnostachyum, vegetable sheep).

BIRDS: the relative uniformity of the beech forests supports a limited forest avifauna. Falcon found throughout the district; kea and Rock Wren present above tree line, the latter in the headwaters of the Harper R.; Southern Crested Grebe and Scaup have been reported from lakes; Blue Duck from rivers; Wrybill and Caspian Tern breed on braided riverbeds.

MODIFICATIONS: fire induced modifications at lower altitudes (fescue tussock in valleys, Leptospermum and Dracophyllum shrubland); part of district grazed (extensive sheep); introduced wild animals include red deer, chamois, pigs, hares, possums.

## COLERIDGE ECOLOGICAL DISTRICT 54.06

Criteria: topography (including lakes and wetlands), vegetation, climate.

TOPOGRAPHY: relatively low glaciated area with some hills, mostly 600-1500m a.s.l.; centred on L. Coleridge - a deep clear lake drained by the Rakaia R. and modified by hydro-electricity development.

GEOLOGY: hills of Mesozoic Torlesse Supergroup greywacke and argillite; localised outcrops of sandstone, basalts and coal measures (Acheron Coalmine); rolling terrain of Pleistocene moraines, fluvio-glacial, lacustrine and glacial outwash deposits; Holocene river gravels along riverbeds.

CLIMATE: cold winters with frosts and some snow, warm summers; rainfall 750-1500mm p.a.; NW winds prevail, often with very strong gales; in winter snow may lie for short periods in valleys, and two months or more on high ground.

SOILS: mainly shallow to moderately deep with yellowish brown, friable subsoils showing a leaching sequence from weakly to moderately leached in lower rainfall areas in the S to strongly leached and podzolised in higher rainfall areas in the N; soils in lower rainfall areas droughty in dry seasons; soils mainly from greywacke and related slope deposits, till, alluvium, colluvium and loess; gravelly, sandy and silty alluvial soils generally with good drainage, on river flats.

VEGETATION/MODIFICATIONS: includes fire-induced tussockland - at high altitudes Chionochloa macra, with Celmisia spectabilis and Chionochloa rubra on wet sites; at lower altitudes fescue tussock, some silver tussock plus browntop, sweet vernal and much developed ryegrass and clover pasture; mixed scrub (Matagouri, Leptospermum, mixed coprosma); relatively small patches of forest (mostly black beech, but some mixed hardwoods, Griselinia littoralis, Pittosporum tenuifolium, Pseudopanax crassifolius etc.); Sophora microphylla on stable flood plains; Schoenus pauciflorus, Typha, Carex secta, Phormium etc. in swamps.

The district is grazed (extensive sheep and cattle). L. Coleridge contains introduced brown and rainbow trout and quinnat salmon. Hydra Water and other swamp creeks are important quinnat salmon spawning areas; the Rakaia is the most important salmon fishery.

FLORA: uncommon to rare plants include Baumea rubiginosa, Sophora prostrata, Metrosideros umbellata round Lake Coleridge and Gingidia geniculata, Muehlenbeckia ephedroides.

BIRDS: no forest birds of note. Falcon throughout; Southern Crested Grebe and Scaup on lakes throughout district; Marsh Crake reported from Lakes Coleridge and Selfe; the Rakaia R. provides important habitat for riverbed species including Wrybill, Banded Dotterel, S.I. Pied Oystercatcher, Black-billed Gull, Caspian Tern, and Black-fronted Tern, many of which breed there. The Rakaia riverbed is the single most important nesting locality for Wrybill.

REPTILES: old museum specimen of Otago skink (Leiopisma ottagense form waimatense) from L. Coleridge (known elsewhere only from the Balaclava, Tekapo, Benmore and Hawkdun E.D.).

## ASHLEY ECOLOGICAL DISTRICT 55.01

Criteria: topography (low altitude), geology (mixed greywacke, Tertiary, Pleistocene gravels), climate, vegetation.

TOPOGRAPHY: non-glaciated low hill country between the Pahau and Kowai rivers drained to the E also via the Hurunui R in the N and the Waipara R in the south; mostly 300-900m a.s.l.

GEOLOGY: Mesozoic Torlesse Group greywacke and argillite with a complex area of Tertiary deposits near Heathstock, including calcareous siltstone and sandstone, marine siltstone and sandstone, Amuri limestone and some basal coal measures etc. and Pleistocene glacial outwash gravels (Kowai gravel) west of Masons Flat.

CLIMATE: rainfall 800-1400mm p.a. Warm summers with occasional hot foehn northwesterlies giving temperatures above 32°C; cool winters with frequent frosts and occasional light snowfalls.

SOILS: mainly shallow and stony steep-land soils from greywacke and related slope deposits: at lower altitudes and rainfall weakly to moderately leached, droughty in dry seasons; in higher rainfall areas of the N and W soils more strongly leached with more even moisture conditions; small areas of heavy-textured soils (rendzinas) from limestone and droughty soils with pale-coloured compact subsoils on strongly rolling downlands from loess.

VEGETATION: former vegetation mostly forest and tussockland (both short and tall tussock). Extensive forest remains near Mt Grey and in the Grey R. catchment including red beech (excellent stands), mountain beech and stands of rimu with minor kahikatea, matai and miro. Significant forest remnants in gulleys of Ashley State Forest (exotic) include rimu and beech. Manuka scrub occurs on poorly drained Tertiary deposits.

FLORA: red beech and kamahi reach their eastern limit here; Hebe raoulia var. maccaskillii reaches its southern limit. Many terrestrial orchids occur in the district.

BIRDS: highly modified for farming; only bird of note is the falcon.

MODIFICATIONS: most of the district is farmed (mainly semi-extensive sheep and beef); exotic forests in the south.

## OXFORD ECOLOGICAL DISTRICT 55.02

Criteria: topography, climate, vegetation.

TOPOGRAPHY: moderately glaciated higher hill country and river flats between the Okuku and Waimakariri rivers; drained to the E also by the Ashley and Eyre Rivers; mostly between 300 and 900m a.s.l., maximum altitude 1141m, Okuku Hill.

GEOLOGY: Mesozoic Torlesse Group greywacke and argillite with Pleistocene glacial outwash gravels and Holocene river deposits in the river courses.

CLIMATE: rainfall 1000-1200mm p.a. Warm summers with occasional hot foehn northwesterlies giving temperatures above 32°C; cool winters with frequent frosts and occasional light snowfalls.

SOILS: mainly moderately leached hill and steepland soils from greywacke and related slope deposits: droughty shallow to moderately deep stony soils on terraces; alluvial soils, some with poor drainage, on river flats; clayey textured soils with compact pale-coloured subsoils and slow drainage on rolling downlands from loess.

VEGETATION: former vegetation lowland short tussockland, tall tussockland and forest. Extensive beech forest remains (mountain and black beech, minor red beech); also significant areas of mixed beech/podocarp forest with rimu, kahikatea and minor matai and miro. Patches of hardwoods occur (e.g. Ashley Gorge) with broadleaf, mahoe, fivefinger etc. Extensive manuka, kanuka scrub (Ashley Gorge); silver and fescue short tussockland; Chionochoa macra and red tussock, tall tussockland. A few patches of kahikatea swamp forest.

FLORA: one of the few places in New Zealand where Carmichaelia kirkii and Coprosma obconica occur; an undescribed Coprosma species also found here.

BIRDS: highly modified for farming; only land bird of note is the falcon. Black-fronted Tern and Banded Dotterel breed on braided sections of the Ashley R.

REPTILES: spotted skink (Leiopisma lineocellatum) recorded from Mt Grey.

MODIFICATIONS: much of district farmed (semi-extensive sheep and cattle); areas of exotic forest in the N and S.

## WHITECLIFFS ECOLOGICAL DISTRICT 55.03

Criteria: topography, vegetation (mixed components in forest vegetation), climate, geology.

TOPOGRAPHY: hill country and plains from 300-900m a.s.l., between the Waimakariri and Rakaia Rivers; drained to the E also by the Selwyn R.

GEOLOGY: includes Mesozoic Torlesse Supergroup greywacke and argillite (Wangapeka plant beds), rhyolite, hypersthene augite andesite, coal measures, quartzose sandstone, basalt flows, bentonite (quarried at Harper Hills), extensive Pleistocene glacial outwash gravels and small areas of Holocene river deposits.

CLIMATE: moderate rainfall, 1200mm p.a.; warm summers; occasional hot foehn northwesterlies giving temperatures above 32°C; cool winters with frequent frosts and occasional light snowfalls.

SOILS: hill and steep-land soils from greywacke and related slope deposits with thin cover of loess: soils under lower rainfalls have paler coloured, more compact subsoils and tend to be droughty; on rolling to easy hill country soils from loess have compact subsoils and slow internal drainage; droughty shallow to moderately deep stony soils on terraces; small areas of alluvial soils on river flats.

VEGETATION: former vegetation lowland short tussockland, forest and scrub; now small to extensive patches of indigenous forest (including black beech, occasional matai, kahikatea, various hardwoods); some scrub (manuka); silver tussock and Chionochloa rubra.

FLORA: Notospartium torulosum reaches its southern limit here; locally rare species include Urtica ferox, Scandia geniculata, Metrosideros umbellata and Lepidosperma australe.

BIRDS: most of district now farmed but the few forest remnants contain species such as parakeet (probably Yellow-crowned) and robin, as well as more common birds, e.g. Bellbird and N.Z. Pigeon; falcon present; kea occur at higher elevations; Fernbird have been recorded; Wrybill breed on the Waimakariri R.; large Black-backed Gull colony at the Waimakariri Gorge.

MODIFICATIONS: much of district farmed (intensive sheep, cattle on hills, some crops on plains); extensive pine plantations; introduced mammals include hares, some red deer, pigs, possums and rabbits.

## HIGH PLAINS ECOLOGICAL DISTRICT 56.01

Criteria: climate, topography: vegetation and soils influenced by the former two criteria.

TOPOGRAPHY: a long narrow district of higher altitude coalesced fans fringing the eastern foothills of the Southern Alps from the Okuku R. to the Rangitata; between 150 and 600m a.s.l.; drained also by the Ashley, Waimakariri, Selwyn, Rakaia, Ashburton, Hinds, Orari and Opihi Rivers.

GEOLOGY: mainly Pleistocene glacial outwash gravels and Holocene alluvial deposits; minor emergent volcanic outcrops, some forming small hills, Cretaceous in the S, late Miocene in the N.

CLIMATE: low rainfall though higher than Low Plains, 800-1000mm p.a.; in the S slightly more rain in summer than other seasons; warm summers with occasional hot foehn northwesterlies giving temperatures above 32°C; cool winters (cooler than Low Plains), frequent easterly showers, though winds less fierce than Low Plains, frequent frosts and occasional snowfalls (more snow than Low Plains).

SOILS: mainly droughty shallow and stony soils on terraces and low angle fans; alluvial soils ranging from stony sands to deep silt loams on river flats and low terraces; apart from deeper siltier soils most are droughty; on higher terraces and rolling downs deep clayey soils from loess with compact subsoils and slow internal drainage; deep silty and fine sandy soils on terraces bordering rivers where loess is currently accumulating.

VEGETATION: originally largely forested; former vegetation mainly lowland short tussockland; stands of kanuka above Eyrewell and Moronan; few remnants of indigenous vegetation remain: tall tussock (Chionochloa rigida) S of Rakaia, C. macra and red tussock (C. rubra) N of Rakaia, latter on poorly drained soils; extensions of hill beech/hardwood forest near Oxford, Alford and Mt Somers; well developed riparian mixed scrub and hardwood woodland along river banks and terraces edges (kowhai, kohuhu, cabbage tree etc.); minor areas of mixed scrub throughout tussockland.

FLORA: southern limit for Pomaderris phyllicifolia var. ericifolia.

BIRDS: highly modified for farming and no land birds of note have been reported. The large rivers (Waipara, Ashley, Waimakariri, Ashburton, Rangitata, Orari, Rakaia), are important for species adapted to braided riverbeds such as Wrybill (especially on the Rakaia R. where there are 1,000-1,500 birds) and Caspian Tern.

MODIFICATIONS: most of district farmed (intensive sheep, cattle and crops), with plantations of exotic trees.

## LOW PLAINS ECOLOGICAL DISTRICT 56.02

Criteria: climate (drier than High Plains), topography: vegetation and soils resulting from the interaction of these two.

TOPOGRAPHY: large area of coalesced fans N and S of Banks Peninsula ranging from sea level to about 300m a.s.l.; extending from the Waipara R. in the N to the Washdyke Creek in the S, drained also by the Ashley, Waimakariri, Selwyn, Rakaia, Ashburton, Hinds, Rangitata, Orari and Opihi Rivers.

GEOLOGY: mainly Pleistocene glacial outwash gravels and Holocene alluvial deposits; significant areas of Holocene coastal swamp deposits near Tuahiwi/Ohoka, Marshlands, Doyleston, Longbeach, Seadown; significant areas of beach gravels from Christchurch to Waipara R. and at Seadown in the S; extensive coastal sands from Christchurch to Waipara R.; minor areas of inland dunes centred on Halkett.

CLIMATE: low rainfall: 600-800mm p.a.; in the S slightly more rain in summer than other seasons; warm summers with hot foehn northwesterlies giving temperatures above 32°C; cool winters with frequent frosts and occasional light snowfalls.

SOILS: shallow, stony, droughty soils on terraces and coalescing low angle fans with poorly drained, gleyed, silty and clayey soils on lower parts of fans; alluvial soils on river flats and low terraces, ranging from excessively drained stony sands to well drained deep silty soils; local areas of more poorly drained alluvial and peaty soils where water-tables are high; excessively drained sandy soils on both coastal and terrace dunes; salty soils bordering Lake Ellesmere where high water-tables are saline; deep clayey soils with compact subsoils and impeded drainage from loess on flattish to strongly rolling downlands.

VEGETATION: vegetation types and yellow-grey earth soils reflect the dry climate. Former vegetation mainly lowland short tussockland with some floodplain forest; forest remnants (podocarp-hardwood) formerly occurred at Rangiora, Kaiapoi and Woodend; still occur at Riccarton and Arowhenua; extensive kanuka, with minor manuka, stands at Eyrewell, Bankside and Moronan; extensive flax, sedge, cabbage tree etc.; swampland on swamp deposits listed above; dry riparian kowhai-mixed hardwood woodland flanking major rivers, especially on Great Island at Rakaia mouth; elsewhere mixed short tussock, native grasses, shrubs (e.g. matagouri, Coprosma, Olearia).

FLORA: Hinau and Gahnia xanthocarpa reach their southern limits in eastern South Island in Riccarton Bush; species with eastern limits include Iphigenia novae-zelandiae, Bulbinella angustifolia, Stackhousia minima and Carmichaelia monroi.

BIRDS: highly modified for farming and there are no land birds of note (there is an isolated report of robin from the N). The large rivers (Waipara, Ashley, Waimakariri, Ashburton, Rangitata, Orari, Rakaia) are valuable habitat (both feeding and breeding) for species adapted to braided riverbeds such as Wrybill, Caspian Tern (also coastal), Black-fronted Tern, and Black-billed Gull; Red-capped Dotterel have bred with the high breeding populations of Banded Dotterel on the Ashley R.; Black-fronted Dotterel breed on the Ashburton, Orari and Opihi Rivers. The large estuaries are valuable sites for waders and for birds such as the bittern and Marsh Crake (also known from swamps and wetlands elsewhere in the district); Scaup are known from this district. Southern Blue Penguin breed at Ashburton beach.

REPTILES: jewelled gecko (Heteropholis gemmeus) reported from Eyrewell SF (northern limit) and Brighton. Spotted skink (Leiolopisma lineocellatum) present on the coast at Spencerville and inland at Macleans I.

FISH: include the Canterbury mudfish (Neochanna burrowsius), between the Ashley and Waitaki Rivers from sea level to 350m a.s.l.

MODIFICATIONS: most of district farmed (intensive sheep, cattle and crops), some areas of exotic forest, numerous small settlements, plus major urban centre of Christchurch.

## ELLESMERE ECOLOGICAL DISTRICT 56.03

Criteria: geology (formation of barrier ridge), waterfowl on lagoon landforms and terrain (dunes, sand plains and stony beach ridges on spit), climate (harsh, dry), archeology (Polynesian ovens, burial sites, "factory" sites).

TOPOGRAPHY/GEOLOGY: shallow brackish lagoon (Lake Ellesmere) of approximately 20 000 ha, receiving water from Selwyn and Irwell Rivers; separated from the sea by a Holocene gravel and sand bank (barrier ridge), Kaitorete Spit, the largest naturally vegetated dunelands in New Zealand. The flattened greywacke stones of the Spit are river and sea worn up to 100mm diameter; overlain with extensive dunes reaching 5m a.s.l. on the seaward side and composed of coarse sand.

CLIMATE: coastal, harsh and dry, cool winters with onshore southerlies and fogs; dry summers, cool easterlies common; rainfall 400-550mm p.a. on spit (driest part of Canterbury), up to 650mm further inland around lake; salt spray frequent.

SOILS: saline soils with salty high water table border the lagoon margin; excessively drained sandy and stony soils on the Kaitorete Spit.

VEGETATION/MODIFICATIONS: lagoon formerly surrounded by extensive swamp, now mostly drained for farming which, with sewage effluent from towns, contributes to eutrophication. Plant communities include: lagoon margins - extensive saltmarsh and, away from brackish margins, Juncus gregiflorus; lagoon edge - Plagianthus, Juncus maritimus, Salicornia, Selliera, Mimulus etc.; Spit and stony beach ridges dominated by very dry coastal shrubland, poorly developed elsewhere in New Zealand - Muehlenbeckia astonii, M. ephedroides, M. complexa, Rubus squarrosus, Coprosma crassifolia, C. propinqua, Hymenanthera alpina, matagouri etc.; dunes have largest population of pingao (Desmoschoenus) in South Island, probably in New Zealand; occupies broader coastal band than most pingao communities; blowouts - Raoulia, Carex pumila, unnamed Asperula sp. (with very local distribution, an unnamed Craspedia sp. (probably the main population); sandflats - abundant coastal Pimelea urvilleana Zoysia, Poa caespitosa; rear dunes Muehlenbeckia spp., Carmichaelia appressa the species largely confined to the Spit).

FLORA: The southern limits of Dodonea viscosa and Muehlenbeckia astonii are found on Spit, and of Cyperus ustulatus (for eastern South Island) on lagoon edge; uncommon to rare plants include: lagoon edge - Spiranthes sinensis, Baumea rubiginosa, Scirpus lacustris, Colobanthus brevisepalus, Lepidosperma australe; lagoon is type locality of Ruppia megacarpa, R. polycarpa and Lepilaena bilocularis.

BIRDS: L. Ellesmere is an extremely valuable wetland for both freshwater species and migratory waders, and has the highest recorded number of bird species of any N.Z. wetland. The lagoon is one of the most important breeding sites for Black Swan (and is also one of the very few places where Mute Swan live in the wild) and Canada Goose, as well as a variety of ducks and marsh birds (e.g. Spotless Crake, Marsh Crake (common), Pukeko). A large variety of Arctic breeding waders visit the area and it is an important over-wintering ground for some species. Waders commonly recorded there include: Pied Stilt, S.I. Pied Oystercatcher, Wrybill, Banded Dotterel, godwit, Turnstone, Golden Plover, Red-necked Stint, Curlew Sandpiper, Sharp-tailed Sandpiper and Pectoral Sandpiper. Caspian Tern breed on the lagoon shore and Kaitorete Spit; the lagoon is an important feeding ground for large post-breeding flocks of Banded Dotterel and Pied Stilt.

REPTILES: spotted skink (Liolopisma lineocellatum) common on Kaitorete Spit.

INSECTS: include two endemic flightless moth species on the spit; large earwigs on sandflats.

SPIDERS: include katipo spiders on sandflats.

## PORT HILLS ECOLOGICAL DISTRICT 57.01

Criteria: flora (history, endemics etc.), climate (very dry), topography, geology.

TOPOGRAPHY: small district of hills, maximum altitude 573m a.s.l.; drained to W, N, E and SW.

GEOLOGY: Miocene Lyttelton volcanics: basaltic flows and pyroclastics with a fringe of deep Pleistocene loess of generally coarse texture.

CLIMATE: very dry; rainfall 600-700mm p.a.; warm summers; cool winters with frequent frosts and occasional light snowfalls; often capped by clouds.

SOILS: on lower slopes mainly from loess with pale-coloured compact subsoils, droughty in summer. On higher slopes, with increased rainfall soils from basalt or loess or mixtures of these: those from basalt have dark brown blocky structured stony clay loam subsoils, those from loess have yellowish brown friable to firm silty subsoils, those from mixed loess/basalt have intermediate features.

VEGETATION: former vegetation mostly lowland short tussockland on N slopes (silver tussock dominant except for fescue tussock along summit ridge); isolated snow tussock on Coopers Knob (most easterly in region); much scattered mixed scrub and flax on these N slopes. Large patches of dry podocarp/hardwood forests in main gullies (e.g. kahikatea, totara, matai, Hall's totara); on ridge crests mixed hardwood forests (e.g. ribbonwood, mahoe, kowhai, fuchsia etc.). (Various reserves, e.g. Mt Vernon, Bowenvale, and a Queen Elizabeth IT Trust covenant, Ahuriri, protect remnants of tussockland and summit rock/scrub/forest vegetation and mixed coastal/lowland forest.) On slopes facing Lyttelton similar vegetation with more extensive scrub, flax, Leptospermum and larger, more continuous gully forests; forest composition similar with additional coastal species (e.g. ngaio, Olearia paniculata, kawakawa); (only 2 remnants reserved).

FLORA: Senecio saxifragoides endemic to district; several species endemic to region, e.g. Cotula minor (best populations here), Hebe lavaudiana, H. strictissima; northern limit of Olearia fragrantissima; southern limit of rare Cotula nana; good populations of rare fern Pleurosorus rutifolius, and of Senecio sciadophilus.

BIRDS: despite their small size and isolation, the forest remnants support a surprisingly diverse avifauna reflecting the past richness of the area. Species such as N.Z. Pigeon, Yellow-breasted Tit, Bellbird, Tui, Brown Creeper and Rifleman persist. Because the opportunities for recolonisation are slight, these small populations are vulnerable to localised extinctions, and some of these species may yet die out on Banks Peninsula, as have falcon, Yellowhead and robin. Important Spotted Shag colonies at Sumner.

REPTILES: jewelled gecko (Heteropholis gemmeus) common in forest remnants; the Banks Peninsula populations are unusual in being sexually dichromatic. Spotted skink (Leiopisma lineocellatum) occurs in the Port Hills and at Cashmere.

MODIFICATIONS: district mainly farmed (semi extensive sheep and beef); recent exotic forest plantings; urban settlement on north-facing slopes and along Lyttelton Harbour.

## HERBERT ECOLOGICAL DISTRICT 57.02

Criteria: flora, climate (moist and mild), topography, geology, history (much deforestation in Polynesian and European times).

TOPOGRAPHY: hills, valleys, deep bays and harbours: highly indented coastline; maximum altitude Herbert Peak, 919m a.s.l.; drained radially directly into bays, harbours and L. Ellesmere.

GEOLOGY: Miocene Lyttelton, Akaroa and Diamond Harbour Volcanics: basalt and trachyte flows and pyroclastics; Cretaceous volcanics: rhyolite and andesite; Mesozoic and Tertiary sandstones and mudstones; Pleistocene loess of mixed textures on lower slopes and in valleys.

CLIMATE: moist and mild climate: warm summers, cool winters, much cloud cover and snow on high points; rainfall 650-1400mm p.a.

SOILS: at lower altitudes, soils mainly from thick loess deposits with compact, pale-coloured subsoils, moderately fertile but droughty, tunnelgully erosion common; at higher altitudes and rainfalls, soils from loess have yellowish brown friable silty subsoils, more even moisture conditions; soils from basalt have dark-coloured clayey and stony subsoils; soils with intermediate features common; small areas of poorly drained alluvial soils on valley floors.

VEGETATION: former vegetation mostly podocarp or conifer-hardwood forest with large areas of lowland short tussockland in the E and N; small remnants of podocarp-hardwood and modified tussockland remain (some reserved). Main forest types: lowland matai, totara, kahikatea, titoki, pokaka and other hardwoods; upland Hall's totara-kaikawaka (relics only), mixed hardwoods; midslope matai, totara, mixed hardwoods; coastal mixed hardwoods (pigeonwood, ngaio, titoki, kawakawa etc.); various secondary hardwood associations. FLORA: plants endemic to the region include Hebe lavaudiana, Cotula minor; probable southern limits of Griselinia lucida in the E, and Corynocarpus laevigatus occur here; Little River valley only known area of rimu in region (only 2 male trees remain); Port Levy area only locality of miro in region (small stand); high peaks (Herbert, Sinclair) main sites for subalpine vegetation in region (e.g. Chionochloa rigida, relic kaikawaka, Ourisia sp. etc.); some pingao remains on beaches.

BIRDS: despite their small size and isolation, the forest remnants support a surprisingly diverse avifauna reflecting the past richness of the area. Species such as N.Z. Pigeon, Yellow-breasted Tit, Bellbird, Tui, Brown Creeper and Rifleman persist. Because the opportunities for recolonisation are slight these small populations are vulnerable to localised extinctions and some of these species may yet die out on Banks Peninsula, as have The falcon, Yellowhead and robin. White-flippered Penguin breed around coast of Banks Peninsula (outside BANKS E.R. the only other breeding locality is Motunau I. (Motunau E.D.)), as do Southern Blue Penguin, Spotted Shag and perhaps Sooty Shearwater.

REPTILES: jewelled gecko (Heteropholis gemmeus) common in forest remnants; the Banks Peninsula populations are unusual in being sexually dichromatic.

INSECTS: include the rare bush weta Hemideina ricta (also in Akaroa District).

MODIFICATIONS: most of district farmed (semi-extensive sheep and beef).

## AKAROA ECOLOGICAL DISTRICT 57.03

Criteria: flora (presence of beech, endemics, species limits), climate, topography, geology, much deforestation in European times.

TOPOGRAPHY: hills surrounding Akaroa Harbour; maximum altitude 841m a.s.l.; drained radially and into Akaroa Harbour; highly indented coastline; includes L. Forsyth.

GEOLOGY: Miocene Akaroa volcanics: basalt to trachyte flows and pyroclastics with late Pleistocene loess (mainly of fine texture) in valleys and on lower slopes.

CLIMATE: moist cool climate: moderate summers, cold winters, ridge tops often capped with cloud; rainfall 650-1200mm p.a.

SOILS: at lower altitudes soils mainly from thick deposits of loess with compact, pale-coloured subsoils, moderately fertile but droughty, tunnel-gully erosion common; at intermediate altitudes loess soils have mottled subsoils indicating poor winter drainage; at higher altitudes loess soils have yellowish brown friable silty subsoils, more even moisture conditions; soils from basalt have dark-brown clayey and stony subsoils; soils with intermediate features common.

VEGETATION: former vegetation mainly podocarp-hardwood forests, with beech forests S, W and E of Akaroa, lowland short tussock grassland to the S and E, and ridge top snow tussock grassland; small areas of beech forest remain near and W of Akaroa, also remnants of conifer-hardwood forest. Upper forests: beech, kaikawaka, Hall's totara, hardwoods; in absence of beech, Hall's totara, hardwoods. Lower forests: kanuka and mixed totara, matai, kahikatea (gully bottoms), mixed hardwoods (broadleaf, mahoe, fuchsia etc.). In coastal areas: ngaio, akaeake, kawakawa, Olearia paniculata. Modified tussocklands throughout (many reserved); snowgrass occurs regularly on most high points throughout district.

FLORA: several endemic species, e.g. Hebe lavaudiana (formerly in riverbeds of Canterbury Plains), H. strictissima (also in Herbert district), Celmisia mackau (local endemic); only beech forest in region occurs here (red beech and mountain beech), with associated beech mistletoe, Alepis flavida; this district has main area of snow tussock (Chionochloa rigida, type locality), Dracophyllum acerosum and kaikawaka in region; southern limit (on E) of kawakawa, pigeonwood, Cyathea medullaris, Tetrapathea tetrandra, titoki, nikau (mainland); northern limit of Carmichaelia appressa (occurs at Fisherman's Bay and east of L. Forsyth).

BIRDS despite their small size and isolation, the forest remnants support a surprisingly diverse avifauna reflecting the past richness of the area. Species such as N.Z. Pigeon, Yellow-breasted Tit, Bellbird, Tui, Brown Creeper and Rifleman persist. Because the opportunities for recolonisation are slight these small populations are vulnerable to localised extinctions and some of these species may yet die out on Banks Peninsula, as have falcon, Yellowhead and robin. Yellow-eyed Penguin (northern limit) and White-flippered Penguin (outside BANKS E.R. the only other breeding locality is Motunau I. (Motunau E.D.)) breed around the coast of Banks Peninsula, as do Southern Blue Penguin; Sooty Shearwater breed on the coast at Tumbledown Bay and perhaps elsewhere; Fairy Prion breed on some offshore rocks and stacks; Spotted Shag breed on the cliffs.

REPTILES: jewelled gecko (Heteropholis gemmeus) common in forest remnants; the Banks Peninsula populations are unusual in being sexually dichromatic. Spotted skink (Leiopisma lineocellatum) present at Akaroa and Birdlings Flat.

INSECTS: include the rare bush weta Hemideina ricta (also in Herbert). The weevil, Megacolabus sculpturatus (Broun), is known only from Akaroa (collected over 100 years ago). Birdlings Flat is the only place where the grass moth Kupea electilis has been found (moth similar to Orocrambus)

MODIFICATIONS: most of the district is farmed (semi-extensive sheep and cattle).

## CHATHAM ECOLOGICAL DISTRICT 80.01

Criteria: isolation, endemism.

TOPOGRAPHY/GEOLOGY: islands at latitude 44°S on the present day subtropical convergence: Northern half of main Chatham very low-lying, characterised by extensive consolidated Pleistocene sands, remnant Cenozoic basalt volcanoes, and Cenozoic limestone and sandstone resting on basement of Mesozoic schist; lagoons a feature. Southern half of this island a sloping flow-basalt plateau reaching 260m a.s.l. on the Southern Tablelands. Offshore islands generally hilly; mostly of Cenozoic volcanic origin, except for northern half of Pitt Island - Cretaceous and Cenozoic sediments.

CLIMATE: oceanic; cool, cloudy and windy, south-westerlies prevailing; rainfall varies with altitude from about 900mm to 1500mm p.a.

SOILS: from peat are mainly strongly acid and of low fertility from high moor or raised ombrogenous bogs (water supply only from rain) forming a continuous blanket over the landscape; smaller areas of basin peats occur in low-lying bogs which are slightly more fertile and less acid; in coastal situations significant amounts of wind-blown quartz sand occurs in the peat; podzolised sands underlie or interfinger with the peat in many places and pumiceous bands are common. Volcanic soils from basic tuffs and basaltic rocks occur mainly around Waitangi township and along the western edge of the southern uplands, ranging from moderately fertile soils near the coast where formed under broadleaf forest, to more strongly leached and less fertile podzolised soils with bleached topsoils and cemented subsoils further inland where Dracophyllum was more common. Sand soils from windblown quartz sand show increasing development and leaching inland with raw sands near the coast, with slight organic matter accumulation grading through yellowish brown soils with deep dark-coloured topsoils to acid and strongly leached sand podzols with peaty topsoils, bleached subsurface horizons and cemented iron/humus pans. Schist soils from quartzo-felspathic schist are confined to the northern part of the island; strongly acid with low fertility; topsoils pale-coloured and subsoils iron/humus cemented. Limited areas of alluvial soils, mainly near Lake Huro; high water-table and impeded drainage. Shallow and stony steep-land soils occur on cliffs of southern coast and poorly drained salty soils occur along eastern margin of Te Whanga lagoon.

VEGETATION/MODIFICATIONS: main indigenous vegetation types on Chatham I. include coastal karaka-mixed hardwood forests, mixed hardwood forests, ribbonwood on more fertile sites, akeake (Olearia traversii) on dunes, Dracophyllum arboreum forests on uplands, and Sporadanthus traversii moorlands; Dracophyllum and Sporadanthus communities are the principal peat producers. Lowland forests are reduced to fragments, but relatively large Dracophyllum forests and Sporadanthus moorlands survive, the latter acutely threatened by fire. Some farms on lowlands, also extensive unimproved grazing. Pitt Island hilly, substantially lacking dune or peat communities; formerly forested throughout; one large area remains; elsewhere farmed. South East and Mangere Islands formerly forested; cleared for farming; now reserved and reverting to forest. Smaller offshore islands relatively undisturbed. Pigs and possums on main Chatham, pigs on Pitt I.

FLORA: many endemic plants: endemic species dominated over half the original vegetation e.g. Dracophyllum arboreum, D. paludosum, Olearia traversii, O. semidentata, O. chathamica, Coprosma chatamica, Hymenantha chathamica, Pseudopanax chathamicum,

Senecio huntii, S. radiolatus, Cyathodes robusta, C. parviflora, Hebe dieffenbachii, H. chathamica, Myosotidium hortensia, Aciphylla dieffenbachii, Corokia macrocarpa, Disphmya papillatum, Embergeria grandifolia, Geranium traversii, Cotula featherstonii, Poa chathamica, Festuca coxii and a newly described endemic fern, Asplenium chatamense. Other species have restricted distribution e.g. Urtica australis (also in RAKIURA region).

MAMMALS: N.Z. fur seal breed on Sisters and South East Island

BIRDS: the Chatham Island avifauna has been highly modified by habitat loss and the impacts of introduced predators. Many species have become extinct or are now very rare. This is particularly true for forest birds which, in many cases, were endemic species or subspecies. The Black Robin (endemic species) population has been intensively managed over the last decade and now numbers about 30 individuals, mostly on Southeast I. Chatham Island Pigeon (endemic subspecies) are now confined to forest on the southern part of the main island (less than 50 birds), and perhaps 1-3 birds on Pitt I. Forbes Parakeet (endemic subspecies) (less than 60 birds) is now confined to Mangere I. and Little Mangere I. Chatham Island Warbler (endemic species), and Chatham Island Red-crowned Parakeet, Fantail, Tit, and Tui (all endemic subspecies) are still common on the southern end of the main island and on some of the smaller islands. Some authorities consider the pipits on the Chathams are also a distinct subspecies. Buff Weka (subspecially distinct) now survive only on the Chatham Islands where they were introduced from Canterbury in 1905. Chatham Island Snipe (endemic subspecies) are now found only on Southeast and Mangere Islands where they are relatively common. Both Marsh Crake and Spotless Crake occur - probably recent arrivals. Te Whanga Lagoon supports a large and diverse waterfowl population dominated by an estimated 3,000 Black Swan. Chatham Island Oystercatcher (endemic species, less than 50 birds) are now mostly confined to Mangere, Southeast and Pitt Islands; N.Z. Shore Plover, formerly widespread in the N.Z. region, are now confined to Southeast I. and the total population is about 100 birds. Banded Dotterel breed along the coast and on some of the peat bogs. Northern breeding limit for Southern Great Skua. Reef Heron scarce. Chatham Island Shag (endemic species, less than 5,000 birds) are widespread, largest breeding colonies on the Star Keys; Pitt Island Shag (endemic species) are widespread in the group but more common S of Pitt Strait. A wide diversity of petrel species breed in the Chatham group, some of them in very large numbers. The most notable of the petrels are the Chatham Island Taiko (endemic species, less than 50 birds) for which the breeding colony has yet to be located (probably on the southern part of the main island); and the Chatham Island Petrel (endemic species, less than 25 breeding pairs) found only on Southeast I. Sub-antarctic Little Shearwater breed on several islands in the group (elsewhere in N.Z. only in the Antipodes group); N.Z. Diving Petrel, Sooty Shearwater, Fairy and Broad-billed Prion (abundant) breed throughout the group; Fulmar Prion breed on Motuhara and Pyramid Rock; both Grey-backed and N.Z. White-faced Storm Petrel breed at the Chathams, the latter in very big colonies (more than 1 million on Southeast I.); Black-winged Petrel are recent colonists on Southeast and Pitt Islands. Northern Buller's Mollymawk (endemic subspecies) breed on Motuhara (c. 24,000 pairs) and The Sisters (c. 2,000 pairs), as do Northern Giant Petrel; Chatham Island Mollymawk (endemic sub-species) breed only on Pyramid Rock (c. 4,000 pairs); Northern Royal Albatross breed on Motuhara (c. 5,000 pairs) and The Sisters (c. 2,700 pairs) (elsewhere only at Taiaroa Head). The Chatham Island Blue Penguin (endemic subspecies) occurs throughout the group; Yellow-eyed Penguin are rare breeders.

REPTILES: Chathams skink (Leiolopisma n. nigriplantare), a Chatham Island endemic, known from Pitt I. and all the smaller islands but never recorded from the main island. Very dense populations in some places, e.g. Southeast I. The populations on the different islands show morphological differences.

FISH: include giant kokopu, (Galaxias argenteus).

INSECTS: many endemic e.g. giant weevil, Hadramphus spinipennis, on rat free islands, restricted to Aciphylla (occurs on A. dieffenbachii); giant ground beetle, Mecodema alternans; stag beetle, Dorcus capito - now extinct on 2 main islands, survive on rat-free islets and islands; also giant click beetle, Amychus candezei etc.; weevil Stephanorhynchus purus (on Sonchus grandifolius and S. petioles); moth Cosmiotes new species (restricted to Festuca coxii); 2 Lepidoptera extinct on main islands, still present on South East I. Over 30 endemic Lepidoptera e.g. the grass moth, Orocrambus horistes (Meyrick) n. comb.; many endemic beetles restricted to indigenous vegetation e.g. 5 flightless endemic beetles: Cacephatus propinquus (Brown) from sea level to 137m; Dysnocryptus pilicornis, on Chatham, Pitt, Sisters and South East Islands from near sea level to 140m, common in Muehlenbeckia australis; Lichenobius cristatellus from near sea level to 137m on dead branches of Olearia traversii and old branches of Myrsine chathamica; Notochoragus chathamensis n. sp. on Chatham and Pitt Islands from near sea level to 135m in litter layer; Sharpus chathamensis from sea level to 137m on Myoporum laetum, Muehlenbeckia australis and leaf litter. One of many endemic beetles, the nest-dwelling Zeonidicola chathamensis n. sp. is found in nests of ground and burrow-nesting birds on small islands in the Chathams including Sooty Shearwater, Fairy Prion, Giant Petrel, Northern Royal Albatross and Pipit; it is confined apparently (like other endemic beetles) to small islands free of rats. A click beetle, Amychus candezei Pascoe, is locally common Chatham Island (Hapupu), also occurs on South East Island. A longhorn beetle, Xyloteles costatus Pascoe, formerly occurred on Pitt Island; status uncertain. Endemic cave wetas and cicada also present. Unusual plant-insect associations include tortricid moth Merophyas n.sp. on Dicksonia; another tortricid moth bores bark of Coprosma chathamica trunks; anthribid beetle, Lichenobius silvicola mines crustose lichens/algae on tree trunks; subsocial weevil Kentraulax flavisetosus on live Pseudopanax. Rich littoral and strand insect fauna, especially Diptera and Coleoptera; includes mite Thioseius ramsayi. Some faunal gaps - no native scarabaeid beetles, no porina moths, no sandflies, no tree weak, no tiger beetles, 2 Australian beetles which occur all over New Zealand mainland are absent here (also from Three Kings and Stewart Islands).

SNAILS: include several endemic land snails.

## **MAP APPENDIX**

### **35 EASTERN WAIRARAPA**

#### **35.01 Eastern Wairarapa**

Dry hill country characterised by steep conical sandstone landforms with low, gentler, poor fertility slopes; coastal reefs, sandy beaches, rocky points, cliffs; diverse geology; very warm summers, droughts; complex pattern of soils related to parent rock and climate; originally forested, many small remnants, large areas secondary forest; largely farmed, some exotic forests.

### **36 WAIRARAPA PLAT**

#### **36.01 Wairarapa Plains**

Alluvial terraces, plains, large lake; dry, warm summers; includes a range of soils dependent on parent material, physiographic position and rainfall; largely farmed, few forest remnants, some scrub, extensive wetlands E of lake.

### **37 AORANGI**

#### **37.01 Aorangi**

Steeply dissected greywacke and argillite range reaching 983m a.s.l.; mostly rocky coastline; strong dry northwest winds prevail but gale-force saltladen southerlies with rain common; mainly steepland soils; altitudinal sequence of largely forested vegetation; scrub and grassland on seaward faces.

### **38 TARARUA**

#### **38.01 Tararua**

Steep, dissected greywacke and argillite hills and mountains reaching 1571 m; heavily faulted, severe erosion particularly in Rimutaka Range; gale-force westerlies common, rainfall ranges from 1600mm to over 10,000mm; mainly steepland and hill soils, yellow-brown soils from Pleistocene drift material or loess on easier slopes; largely in indigenous vegetation: altitudinal zonation of forests, subalpine scrub, tussock and alpine herbfield; some burnt areas now in gorse, small areas exotic forest.

### **39 SOUNDS -WELLINGTON**

#### **39.01 Wellington**

Steep, strongly faulted greywacke and argillite hills and ranges, harbours, estuary, large river valley; very windy, frequent NW gales; includes range of soils from greywacke and Pleistocene drift material and loess; alluvial, peaty and stony soils in valleys; originally mostly forested; largely modified; farms, gorse and other scrub, forest remnants and saltmarsh; extensive urban development.

#### **39.02 Cook Strait**

Coastal cliffs, terraces, headlands, islands either side of Cook Strait; diverse geology; maritime climate, very frequent severe gales; mainly shallow, stony soils with skeletal soils, bare rock, scree on coastal cliffs; originally coastal forest with flax shrubland on steepest slopes and cliffs; modified by burning and grazing, now shrublands, grasslands; important endemic animals; some islands with no or few introduced mammals.

### **39.03 Sounds**

Complex system of drowned valleys, ridges, hills; mostly greywacke and argillite in W, schist in E, ultramafic rocks on. D'Urville I.; warm summers, mild winters; maritime influence in outer sounds; mainly leached and podzolised stony steep-land soils from the various parent rocks and their slope debris, some podzolised; originally forested; now very restricted coastal forest remnants, much scrub, secondary forest; some farms, exotic forests increasing.

### **39.04 D'Urville**

Coastal steep-lands; hills, gullies, flats and inlets; mostly argillite and igneous conglomerate, extensive areas of ultramafic rocks; maritime climate, W to NW winds, gales; steep-land soils from the various parent rocks and their solifluvial debris; originally forested, some Polynesian and European clearance, large areas indigenous vegetation: forests, cliff communities, scrub with regenerating hardwoods; ultramafics in low forest, scrub some farms, exotic forests increasing.

## **40 RICHMOND**

### **40.01 Pelorus**

Inland hill country and mountains to 1762m a.s.l.; schist in SE, Richmond Range greywacke and argillite, ultramafics near Dun Mountain and Bryant Range; rainfall reliable, lowland valleys wet; cool, winter fogs; strongly leached to podzolised stony steep-land soils, small areas of soils from Pleistocene gravels and alluvial soils; hill country forested, lowland valleys few forest remnants; some farms.

### **40.02 Para**

Steep, finely dissected schist hills to 1310m a.s.l., broad valleys with deep alluvium, moist, mild winter, valley fogs, strongly leached to podzolised stony steep-land and hill soils from various parent rocks, minor areas of alluvial soils; upper slopes forested; elsewhere pasture, exotic forest, wetlands, forest remnants.

### **40.03 Fishtail**

Schist and greywacke mountains, high peaks to 1655m cool, moderately wet; mainly strongly acid, stony, leached and podzolised steep-land soils, minor areas of soils from moraines, outwash gravels, alluviums; mainly beech forest distinctive sub alpine vegetation; farms and exotic forest on lower slopes, remnant valley forests.

## **41 WAIRAU**

### **41.01 Blenheim**

Low lying outwash plains, prograding coastline, coastal lagoons; dry, sunny; well to poorly drained alluvial soils on river flats, shallow stony soils on terraces; formerly mosaic of forest, wetland, shrubland; now farms, horticulture, urban.

### **41.02 Wither Hills**

Steep, dissected sedimentary hills in E; low greywacke mountains in W to 1234m a.s.l.; extreme summer desiccation; leached steep-land soils from greywacke on steeper country, weakly leached soils from loess with compact subsoils on hills; stony shallow soils on terraces; formerly xeric shrubland, gully forests, tussockland; now mostly pasture, secondary forest.

### **41.03 Grassmere**

Highly saline L. Grassmere, coastal cliffs, dunes, wetlands, high river terraces, low sedimentary foothills in S to 293m a.s.l.; very warm, dry; weakly leached soils with compact subsoils from loess on terrace, rolling and

hilly land, saline soils round L. Grassmere, fertile alluvial soils on river flats formerly coastal forest, scrub, tussockland; now farms; patches of kanuka forest, scrub.

#### **41.04 Flaxbourne**

Finely dissected sedimentary hills in N, higher greywacke in S to 838m a.s.l.; very warm, dry; soils from loess with compact subsoils on terrace and rolling land, soils from argillites and conglomerates on hills (slips common), shallow, stony soil from greywacke on steep slopes; originally forested, now mostly farms, forest remnants.

#### **41.05 Hillersden**

Low north facing, slopes of greywacke and argillite range to 1415m a.s.l., sedimentary river terraces; dry summers; mainly moderately fertile steepland soils; formerly mosaic of forest, shrubland; tussockland; now largely farmed, scattered kanuka forest, few forest remnants.

### **42 INLAND MARLBOROUGH**

#### **42.01 Waihopai**

Steep greywacke mountains to 2000m a.s.l.; range of altitude and climate; relatively dry; shallow, stony steepland soils, some stony soils on terraces; formerly diverse vegetation types; now largely farmed; remnants include beech and kanuka forests, shrubland, fellfield.

#### **42.02 Medway**

Steep sedimentary hills to 1400m a.s.l., many gorges; very warm dry summers; mainly stony steepland and hill soils formed under wide range of altitude and rainfall; originally beech forest in W, podocarp-hardwood and hardwood forests in E, some tussockland; now largely farmed, forest remnants and scrub.

#### **42.03 Bounds**

Partially glaciated, steep greywacke mountains to 2200m a.s.l.; dry summers; shallow, stony high country steepland soils, alpine soils bare rock; originally beech forest, fellfield; modified by fire and wild mammals.

#### **42.04 George**

Steep, dissected hills; sedimentary including limestone in N, greywacke in S; very warm dry summers N and E, cooler, wetter in hills; mainly stony, shallow steepland soils from greywacke, limestones and calcareous sandstones; originally forested; now forest remnants in extensive scrub, tussockland and pasture.

### **43 MOLESWORTH**

#### **43.01 Sedgemere**

Glacial outwash island basin, numerous tarns, surrounding rounded greywacke and argillite mountain to 1600m a.s.l.; low rainfall, cold winters, mainly stony, shallow droughty steepland soils; predominantly short tussockland and wetland; grazed by cattle, extensively planted in exotics.

#### **43.02 Balaclava**

Mainly rounded greywacke mountains to 2000m a.s.l., screens, dry continental climate; mainly stony, shallow steepland soils, leaching increasing with rainfall and altitude; scattered beech forest remnants in W, tussockland elsewhere; cattle grazing.

### **43.03 Miromiro**

Greywacke and argillite range to 1875m a.s.l. and glacial outwash basin; hot summers, cold winters, wetter in W; mainly shallow, stony steep-land soils, leaching increasing with rainfall and altitude; some beech forest on range; tussock and grasslands grazed; exotic forest in basin.

## **44 LARENCE**

### **44.01 Tapuaenuku**

Partially glaciated greywacke and argillite mountains to 2885m a.s.l., minor sandstone and basic volcanics plus limestone in N; high rainfall mountain climate; drier in W; mainly shallow, stony steep-land and alpine soils with bare rock and scree; vegetation modified by fire and grazing: shrub-tussockland in valley floors; some beech forest in N; extensive kanuka, patches of low forest tussocklands, scrub and herbfield.

### **44.02 Dillon**

Partially glaciated greywacke and argillite mountains to 2600 a.s.l., intermontane basins; cool, wet hill climate; NW winds prevail; mainly shallow, stony steep-land soils, leaching increasing with altitude and rainfall; formerly shrub-tussock land in valley floors, tussockland, small areas of beech forest, scrubland, extensive alpine vegetation, bare rock; modified by fire, wild mammals, farmed below 1000m.

### **44.03 Manukau**

Steep greywacke and argillite SE facing mountain face to c. 1800m a.s.l.; cool, wet; mainly shallow, stony steep-land soils, leaching increasing with altitude and rainfall; forests, subalpine scrub, tussockland; herbfield; modified by fire and wild mammals.

## **45 KAIKOURA**

### **45.01 Kekerengu**

Sedimentary low coastal hills and scarps, some limestone, gravel beaches, dunes; very warm dry summers; weakly leached, fertile soils with compact subsoils from loess and sandstone; formerly forests, scrub, tussockland; now small remnants in pastoral landscape.

### **45.02 Aniseed**

Steep broken hill country to 1196m a.s.l., coastal scarps; cliff and higher country greywacke and argillite, subdued hills sedimentary, some limestone, very warm dry summers; shallow, stony leached steep-land soils, deeper, more fertile soils on hill country; formerly forest; now patches of scrub in pastoral landscape.

### **45.03 Kowhai**

Glacial outwash and alluvial plain, sedimentary peninsula with limestone; very warm dry summers, cyclonic storms important; mainly fertile, loamy alluvial soils, stony, shallow soils on terraces, soils with compact clayey subsoils on peninsula, formerly forests, scrub; now remnants, *Leptospermum* forest, scrub, farmland.

## **46 NORTH-WEST NELSON**

### **46.01 West Whanganui**

Narrow band of steep high-fertility coastal hill country with cliff-forming limestones, adjoining gentler low fertility inland hill country from coal measures; a tidal inlet uplifted marine terraces, glacial alluvium and sands; mild-warm coastal climate; strongly leached to podzolised soils on rolling to hilly land, small areas of alluvial soils, sandy, gravelly soils on coast and spit; lowland and coastal forests, cliff and sand dune vegetation; floral and faunal affinities with northern North Island; high level of invertebrate endemism; Farewell Spit wading bird habitat of international significance.

#### **46.02 Wakamarama**

North-eastward trending hills to 958m, very steep with cliffs in E, gentler in W; mostly sedimentary rocks with coal seams, minor granite; mild, high cloud common; strongly leached to podzolised soils in N on rolling and hilly land, shallower, stony strongly leached soil on steeper country in SW; substantial areas in indigenous forest; some farming in the N.

#### **46.03 Golden Bay**

Glacio-fluvial terrace and flats, some Tertiary sediments; sunny, warm, sheltered from westerlies; a range of moderately to very strongly leached and podzolised soils related to parent rock and topography, impeded drainage common, more fertile alluvial soils on flats, stony soils on terraces; originally forest; now very little forest remains; mostly farmed.

#### **46.04 Totaranui**

Highly distinctive granite hill country (to c.700m a.s.l.), indented coastline; sunny, warm, drier than most of region, strongly leached low fertility hill and steepland soils originally forested some Polynesian, much European clearance, now largely secondary or original forest, some areas of woody, adventive species.

#### **46.05 Heaphy**

Granite downlands and hills of gentle relief, mostly below 900m, a.s.l., some sedimentary rocks; warm, wet, exposed to westerlies; a range of very strongly leached to podzolised low fertility soils related to topographic position; vegetation largely unmodified forest, some tussockland.

#### **46.06 Wangapeka**

Complex mountainous hinterland, mostly above 900m a.s.l., highest point 1775m; complex geology including granite, schists, volcanic and sedimentary rocks; warm summers; cold winters, high rainfall; mainly shallow, low fertility, very strongly leached and podzolised steepland soils; mostly indigenous vegetation: complex patterns, forests, scrub, tussockland, herbfields; some scrub following clearance, small exotic forest areas.

#### **46.07 Arthur**

Mountains and hills to 1875m a.s.l.; complex geology including Paleozoic marble etc.; summers warm, winters cold; range of moderately leached to podzolised soils related to rainfall, altitude and parent rock; mostly indigenous vegetation with sequence related to altitude and site, forest, subalpine scrub, tussockland, alpine herbfield.

#### **46.08 Karamea**

Coastal plain, rugged hills to 1000m a.s.l., cliffed coast in the S, dunes, estuaries in the N; geology includes gravels, alluvial and marine terraces, granite outcrops; warm, wet; mainly low fertility, strongly leached and podzolised soils related to parent rock and topographic position; originally forested; now modified, coastal plain forest remnants, some pakihi vegetation, dune vegetation and wetlands, largely farmed.

#### **46.09 Matiri**

Flat topped mountains, steep sided valleys, 900-1500 a.s.l.; varied geology: granite, limestone, mudstone, siltstone, sandstone; high rainfall; mainly low fertility, shallow very strongly leached to podzolised steepland soils; indigenous vegetation reflects diversity of soil age, drainage, altitude: forests to about 1280m, scrub and tussocklands on plateaux; several lakes, wetlands.

## **47 NELSON**

### **47.01 Motueka**

Low alluvial plains and Moutere Gravel terraces; sunny, warm, rather sheltered; clay textured soils with impeded drainage on rolling and hilly land, shallow, stony soils on terraces, alluvial soils on river flats, sand soils on dunes; originally mostly forested, some Polynesian clearance; formerly grassland, scrub, fernland, wetlands plus podocarp forest in NW; now mainly modified: farming, horticulture, exotic forests.

### **47.02 Moutere**

Rollin Moutere Gravel hill country rising to about 800m a.s.l. in the S; sheltered warm summers, mild winters, cooler inland; dominantly moderate to low fertility soils from weathered gravels, leaching increasing with altitude and rainfall; originally forested throughout; lower part largely modified: farming, horticulture, exotic forests.

### **47.03 Bryant**

Steep hill country to 1664m a.s.l.; complex geology: various sedimentary rocks, important areas of ultramafic rocks (especially Dun Mountain); climate varies: sunny, sheltered in NW, cooler, wetter at higher altitudes; dominantly steepland soils from a wide range of parent rocks; indigenous vegetation restricted to higher hills: forest, scrub, shrubland, open tussockland on Dun Mountain, special species on ultramafics; lower parts farmed or in exotic forest.

### **47.04 Red Hills**

Elevated zone of ultramafic rock (to 1790m a.s.l.); warm dry summers, substantial winter snow; shallow, stony steepland soils from ultramafic rocks, stony, strongly leached soils on terraces and fans, magnesium rich, waterlogged in places; red tussockland, limited beech forest; local edaphic endemics; parts formerly grazed, now shrubland regeneration.

## **48 NORTH WESTLAND**

### **48.01 Ngakawau**

Coastal hills, low mountains to 1400m a.s.l., dissected plateaux, deep gorges; includes sandstone, grit and conglomerate with coal seams, siltstone, ancient gneiss, granite, greywacke and argillite; wet, mild near coast; very strongly leached to podzolised, very low fertility soils; many on easier slopes with poor drainage; mostly in indigenous vegetation: forests, tussock-scrub-low forest mosaic on coal plateaux; gully vegetation; modified by mining, burning, farms and exotic forests in the N.

### **48.02 Foulwind**

Low coastal plains and marine terraces of gravel and sand; small area ancient Constant gneiss and Tertiary sedimentaries at Cape Foulwind; mild, humid, high rainfall, SW winds; very strongly leached and podzolised soils on terraces, sand soils on dunes, mainly poorly drained alluvial soils on river flats, podzolised soils on hills; originally forested, pakihi bogs, some cutover forest remains; largely farmed.

### **48:03 Buller**

Very steep ridges reaching 1450m a.s.l., narrow valley floors below 300m; complex geology: gneiss, granite, braccia, greywacke, argillite, Tertiary sedimentaries with limestone outcrops and bluffs; very high rainfall; very strongly leached, shallow, low fertility steepland soils, less leached moderately fertile soils- from limestone, mostly in indigenous forest.

#### **48.04 Reefton**

Steep inland mountains reaching 1600m a.s.l., deep valleys (300m); complex geology includes: granite, gneiss ranges, greywacke, argillite western flanks, also coal measures, breccia, glacial outwash terraces, narrow alluvial plains; climate varies: sunny summers, winter valley fogs, high rainfall on ranges; mostly very strongly leached to podzolised or gleyed soils, many with impeded drainage, better drained stony soils on lower terraces, alluvial soils on river flats; originally forested, pakihī bogs; valleys now cleared for farming.

#### **48.05 Punakaiki**

A very complex geological structure of very old and young rocks; warm humid climate; mainly strongly leached to podzolised steepland soils on range, more fertile soils on hilly and steep land from limestone in NE, some alluvial soils along coast in the S; an atypical pattern of resource exploitation; largely unmodified, uniquely diverse mosaic of landforms, forest vegetation and forest birds, notably on warm fertile sites; high conservation value for the forested lowland karst and the ecological diversity of lowland forests.

#### **48.06 Maimai**

South-eastern range flank from less than 300m to 1500m a.s.l.; mainly gneiss and granite, belt of aggradation terraces in E; very high rainfall over range; strongly leached and podzolised soils, many with poor drainage; original forest remains on steep country, best low ground cleared for farming, pakihī bogs on high terraces.

#### **48.07 Totara Flat**

Western flank of granite range from c.350m to 463m a.s.l., low greywacke, argillite hills with Old Man Gravels in N, glacial outwash terraces plus moraine near Grey R.; high rainfall over mountains, rain shadow in valleys; mainly strongly leached and podzolised soils, many with poor to very poor drainage, with more fertile soils in valleys; original forest remains on steep country, to terraces widely cleared for farming.

#### **48.08 Blackball**

Steep broken ranges to c.1000m a.s.l., greywacke and argillite in N, coal measures and Tertiary sedimentaries in S, river terraces; high rainfall, small temperature range near coast, greater inland with winter frosts; very infertile soils: strongly leached and podzolised, many with poor drainage; largely forested, lowered treeline, dense montane shrubland, frequently burnt, on coal measures; terrace forests widely logged, partly cleared; includes part of "podocarp-beech interface".

#### **48.09 Hochstetter**

Glacial outwash terraces, moraines, lakes, wetlands, small areas well dissected Tertiary sedimentary hills, greywacke and granite rounded hills in SE to 1200m a.s.l.; high rainfall, small temperature range in the W, greater in the E; strongly leached and podzolised, infertile soils, many with poor to very poor drainage, more fertile better drained soils on lower terraces and river flats; original forests widely logged, part cleared for farming; decrease in beech southwards.

#### **48.10 Greymouth**

Lon steep-sided limestone, mudstone ridges, sandstone-siltstone hills to 400m a.s.l., low areas of alluvial flats, glacial outwash terraces; mild, high rainfall; mainly moderately to strongly leached and podzolised soils, many with poor or very poor drainage, some areas of more fertile alluvial and sand soils; originally forested: beech almost absent, occurring only on inland edge of district, valley floors mostly cleared, ridges and hills forested, other areas logged; some farming, some exotic forest.

#### **48.11 Brunner**

Dome-like granite mountains in the E with wide flat-floored valleys, recent colluvial, alluvial fans in W, river floodplains; large lake; mild, very high rainfall infertile, very strongly leached and podzolised soils, many with poor drainage, more fertile alluvial soils on river flats; originally forested: rare beech outliers at southern limit in north Westland plains and most low country cleared, farms, some exotic forests.

## **49 SPENSER**

### **49.01 Rotoroa**

Hill country, some high peaks, glacial lakes; complex geology; moist climate, summer dry spells, occasional wind storms; mainly shallow, stony strongly leached and podzolised steepland soils from indurated rocks, deeper soils from Pleistocene gravels and Tertiary rocks on hills, stony soil on terraces; mostly beech forest; farms near Murchison.

### **49.02 Travers**

Glaciated greywacke ranges, 900-2100m a.s.l.; high rainfall; mainly stony, shallow alpine soils, large areas of bare rock, scree; beech forests, subalpine scrub, alpine grassland, herbfield.

### **49.03 Ella**

Glaciated, steep schist mountains to 2301m a.s.l., some greywacke S and E, alluvium in valley floors; high rainfall, severe alpine climate; mainly shallow, stony, very strongly leached and podzolised steepland soils; beech forests, subalpine tussockland.

### **49.04 Lewis**

Greywacke and argillite mountains, 600-2300m a.s.l., glacial outwash gravel and alluvium in valleys; cool, moist, rainfall gradient W-E; stony, strongly leached steepland soils grading to alpine soils, stony soils on terraces, sandy, gravelly alluvial soils on river flats; beech forests in upper valleys; scrub, carpet grass above; forest becomes patchy towards the E; open grasslands in valley floors, grazed.

### **49.05 Hope**

Low mountains to c.1500m a.s.l.; greywacke, argillite, schists in the W; semi-continental cool, moist climate; stony; strongly leached steepland soils, stony soils on terraces, sandy, gravelly alluvial soils on river flats; extensive forests, mostly beech, subalpine scrub, alpine grasslands; valley bottoms grazed.

## **50 WHATAROA**

### **50.01 Hokitika**

Alluvial valleys, lakes, moraine hills, terraces, plateaux; some greywacke; granite, limestone outcrops; mild, high rainfall; a range of soils related to different parent material and topographic position, mostly strongly leached and podzolised with low fertility; originally forested: beech absent; most lower forest logged, flats cleared, farmed; some exotic forests.

### **50.02 Whitcombe**

Heavily glaciated mountains to 2600m a.s.l.; greywacke in E, schist in W; high rainfall; dominantly stony, strongly leached steepland soils with many screes and bare rock outcrops, grading to alpine soils, also alluvial soils on river flats; indigenous vegetation: altitudinal sequence; some beech in N.

## **52 LOWRY**

### **52.01 Hundalee**

Coastal steep sided greywacke and argillite hills to 900m a.s.l. with some Tertiary sediments and glacial outwash gravels; subhumid; mainly moderately leached steepland soils on steeper hills, droughty soils on drier hill, rolling and terrace country; originally beech forest in the S, other forests, scrub, tussockland elsewhere; now mostly farmed.

### **52.02 Leslie**

Inland greywacke and argillite hills to 900m a.s.l., some Tertiary sediments and glacial outwash gravels; subhumid; stony steepland soils, lower altitude droughty in summer; originally mostly forest, including beech, snow tussock and mixed subalpine scrub at higher altitudes; now extensive short tussock grassland, mostly farmed.

### **52.03 Culverden**

Inland basin below 300m a.s.l.; mostly glacial outwash gravel, river gravel, silt, some greywacke, argillite, Tertiary sediments; subhumid; droughty shallow, stony soils on terraces, loess derived soils on rolling land; formerly short tussock grassland, mixed scrub, riparian treeland; now mostly farmed intensively, large exotic forest.

### **52.04 Waiau**

Low greywacke and argillite range to 600m a.s.l., with some Tertiary sediments, outwash gravels, minor volcanics; subhumid; mainly stony steepland soils; originally mostly forested, some beech; tussocklands; formerly short tussock grassland, some snow tussock on tops, scrub; now mostly farmed, severe weed infestations.

### **52.05 Cheviot**

Coastal greywacke and argillite hills to 600m a.s.l., plains of Tertiary sediments, glacial outwash and river gravels; subhumid; loess derived soils on flattish rolling land, stony more friable soils on steep slopes; formerly short tussock grassland with some snow tussock on tops, forest patches on coastal ranges, beech in gullies; now mostly farmed, forest remnants.

### **52.06 Motunau**

Coastal greywacke and argillite hills below 600m a.s.l. and plain of Tertiary sediments with some glacial outwash gravels, coastal marine gravels, sands; subhumid; stony steepland soils on steep slopes, more fertile, droughty soils elsewhere; formerly short tussock grasslands, treelands, mixed shrublands, coastal; kanuka, beech and upland forests; now mostly farmed but extensive remnant forest and shrublands.

### **52.07 Waikari**

Dry greywacke and argillite hills below 600m a.s.l., flat-bottomed valleys of Tertiary sediments; extensive glacial outwash gravels; low rainfall; mainly droughty, clayey textured soils on rolling, hilly slopes, with steepland soils on steep slopes; formerly mostly short tussock grassland, mixed scrub, small gully forest remnants; now intensively farmed.

## **53 HAWDON**

### **53.01 Minchin**

Glaciated greywacke and argillite mountains to 1820m a.s.l.; rainfall decreases eastward; mainly strongly leached stony steepland soils and alpine soils, poorly drained soils with peat on flattish basins; mainly beech forests, subalpine scrub, alpine vegetation including tussockland, valley floor grassland; latter grazed.

### **53.02 Arthur's Pass**

Glaciated greywacke and argillite mountains to 2400m a.s.l.; high rainfall; mainly strongly leached, podzolised stony steepland soils, those on easier slopes with peaty topsoils; mainly alpine vegetation including tussockland, subalpine scrub, some beech forest, patches of montane conifer forest, some manuka scrub in valleys where forest burnt.

## **54 PUKETERAKI**

### **54.01 Sumner**

Moderately glaciated jagged mountains to 1898m a.s.l., intermontane basins, valleys, Lake Sumner plus several smaller lakes; mostly greywacke and argillite, some glacial outwash and recent river deposits in valleys; subhumid mountain climate; leached stepland soils from greywacke and related slope deposits; extensive beech forests, tussockland, mixed scrub, alpine vegetation, tarn and lake communities.

### **54.02 Poulter**

Moderately glaciated, mostly greywacke and argillite mountains to 1986m a.s.l., some Tertiary sediments, alluvium in valleys; moderate to high rainfall; leached stepland soils with altitudinal and E-W gradients, areas of bare rock, scree; originally unbroken forest below treeline, now beech forests, mixed scrub, alpine and valley floors grasslands, riverbed vegetation; valley floors grazed, formerly tops also.

### **54.03 Cass**

Glaciated valleys, intermontane basins, rounded hills, 600-1895m a.s.l.; greywacke and argillite with moraines, glacial outwash and river deposits in valleys, some sediments including limestone near Castle Hill; subhumid hill climate, now lies on tops several months; leached soils on flattish or rolling slopes, some podzolised soils at higher altitudes, large areas of scree, bare rock, some alluvial soils and rendzinas; short tussockland-induced grassland in basins and valleys, discontinuous beech forest and mixed scrub on slopes, subalpine, alpine vegetation on hill top; type localities of many plant species, several endemic species; most of district grazed.

### **54.04 Torlesse**

Moderately glaciated greywacke and argillite ranges to 1996m a.s.l.; some glacial outwash, Tertiary deposits, bare rock, debris; moist hill climate; mainly strongly leached stepland soils, large areas of bare rock, scree; valley tussocklands, patchy beech forest on slopes, scrub, patchy subalpine and alpine vegetation including tussockland, scree, rock, fellfield vegetation, grazed in part.

### **54.05 Craigieburn**

Moderately glaciated greywacke and argillite range to 2195m a.s.l.; some Tertiary deposits, glacial outwash and alluvium; wet mountain climate; mainly leached, stony stepland soils, much erosion: bare rock, scree, debris; beech forest, band of subalpine scrub, subalpine tussockland; alpine vegetation (including scree, rock, fellfield flora); fire-induced tussockland in valleys, grazed in part.

### **54.06 Coleridge**

Relatively low glaciated area of moraines and other deposits, some greywacke and argillite hills; deep clear lake, wetlands; some sandstone, basalts, coal measures; cold winters, warm summers, relatively dry; mainly shallow to moderately deep soils, weakly leached to podzolised depending on rainfall, some alluvial soils; fire induced tussock, mixed scrub, small patches of forest, swamp species; most of district grazed; hydro-electricity development and introduced trout, salmon modify lake.

## **55 CANTERBURY FOOTHILLS**

### **55.01 Ashley**

Non-glaciated hills mostly below 900m a.s.l.; mostly greywacke and argillite, complex Tertiary deposits near Heathstock, some glacial outwash gravels; warm summers, cool winters; mainly shallow, stony stepland soils, some rendzinas and loess derived soils with compact subsoils, soils show leaching sequence with increasing rainfall; former vegetation forest and tussockland, extensive forest remains in the E, scrub on Tertiary deposits; elsewhere farms, exotic forests in the SE.

## **55.02 Oxford**

Moderately glaciated hills to 1141m a.s.l., river flats; mostly greywacke and argillite, with glacial outwash gravels and recent river deposits; warm summers, cool winters; mainly moderately leached hill and steep land soils, some loess derived soils; former vegetation tussockland and forest, extensive forest remains, also extensive scrub, some short and tall tussockland; elsewhere farms, exotic forests in the N and S.

## **55.03 Whitecliffs**

Hills and plains, 300-900m a.s.l.; varied geology; warm summers, cool winters, moderate rainfall; mainly hill and steep land soils with variable loess cover; formerly short tussockland, forest, scrub; now patches of indigenous vegetation; mostly farmed, extensive exotic forests.

## **56 CANTERBURY PLAINS**

### **56.01 High Plains**

Coalesced fans of outwash gravels and alluvial deposits, 150-600m a.s.l.; minor emergent volcanic hills; low rainfall; mainly droughty shallow, stony soils on terraces and low angle fans, alluvial soils on river-flats, deep clayey soils from loess on higher terraces; originally largely forested; formerly short tussockland and scrub; now mostly farmed, small areas of tussock, scrub, riparian scrub, woodland.

### **56.02 Low Plains**

Large area of coalesced fans of glacial outwash gravels and alluvial deposits, 0-300m a.s.l.; some beech gravels, swamp deposits; dunes; very low rainfall; shallow, stony droughty soils on lower terraces, deep, clayey loess soils on higher terraces, alluvial soils on river flats, some peaty soils, saline soil (near Ellesmere) etc.; former vegetation mainly short tussockland and scrub, some floodplain forest, swamplands, riparian woodland; now mostly farmed with small remnants of indigenous vegetation types.

### **56.03 Ellesmere**

Shallow, brackish lake, approx. 20,000 ha, surrounding swamp now mostly drained, separated from sea by stone and sand bank Kaitorete Spit; cool winters, fogs, very dry, windswept; salt spray, saline soils border lake, sandy, stony soils on Spit; lake ecosystem, saltmarsh, swampland, stony beach ridge, dune and sandflat communities; endemic plants and insects; numerous waterfowl.

## **57 BANKS**

### **57.01 Port Hills**

Narrow belt of volcanic hills to 573m a.s.l., fringed with deep coarse textured loess; very dry; droughty loess derived soils on lower slopes, soils from basalt or loess or mixtures on higher slopes; formerly tussockland, forest remnants; endemic plants; mostly grazed or settled.

### **57.02 Herbert**

Volcanic hills to 919m a.s.l., valleys, deep bays, harbours, loess on lower slopes and in valleys; moist, mild; complex of soils from variable thicknesses of loess over basaltic rocks; formerly forest and tussockland; some remnants; endemic plants; mostly grazed.

### **57.03 Akaroa**

Volcanic hills to 841m a.s.l., long harbour, large lake, indented coastline; moist, cool; complex of soils from variable thicknesses of loess over basaltic rocks; formerly mainly forests and tussockland; small remnant beech and other forests, kaikawaka, tussocklands (snowgrass); endemic plants; mostly grazed.