Spatial pattern in macroinvertebrate communities in headwater streams of New Zealand and a multivariate river classification system

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 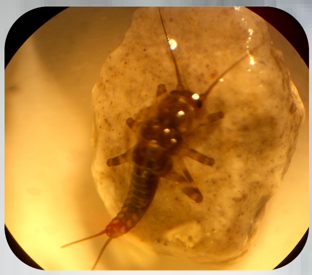  

ABSTRACT

Macroinvertebrate data collected from 120 headwater streams in New Zealand were used to test the ability of the Freshwater Environments of New Zealand River Classification (FWENZ) to explain spatial variation in unimpacted stream invertebrate communities. FWENZ is a GIS based multivariate river environment classification of the sections of national river network. The classification performance of the FWENZ was examined to determine the optimum classification level which could be used for the purpose of conservation and biomonitoring of New Zealand rivers and streams. The classification performance of the FWENZ was also compared to those of two other river classification systems, the ecoregions and the River Environment Classification (REC). Results of the analysis of similarity (ANOSIM) test showed that discrimination of the study sites based on interclass differences in macroinvertebrate community composition was optimal at FWENZ 100 class level which classifies the New Zealand rivers and streams into 100 different groups. The FWENZ 100 class level distinguished the biological variation of the study sites at a finer spatial scale than the REC Geology level. Although performance of the ecoregions classification was stronger than both the river environmental classifications, the REC and the FWENZ, but it was unable to explain the variation in local assemblage structures. Multivariate analyses of the macroinvertebrate abundance data and the associated environmental variables at three different spatial scales (upstream catchment, segment, and reach) were used to identify environmental predictors of assemblage patterns. Catchment-scale measures of climatic, topographic and landcover factors were more strongly correlated with macroinvertebrate community structures than segment scale measures, whereas reach-scale measures of instream physicochemical factors and riparian characteristics had the least association with assemblage patterns. Despite the strong influences of cathment-scale factors on macroinvertebrate communities, local factors like water temperature, stream velocity, reach elevation, percent canopy cover and percent moss cover were also involved in explaining the within-region variation in assemblage patterns, which indicates the importance of considering regional as well as local factors as surrogates of stream invertebrate communities to provide a base for stream bioassessment programmes at multiple scales.

DEDICATION

To my parents

Sibangsu Bimal Chakraborty and Namita Chakraborty

who waited so long for this

And to my fiancé

Esther Emmanuelle

who was always beside me during this journey

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CONTENTS

GENERAL INTRODUCTION

Benthic invertebrates account for much of the biodiversity and ecosystem functioning in running-waters. Stream invertebrates serve as important contributors to river ecosystem processes including detritus (allochthonous and autochthonous carbon) processing, animal-microbial interactions, herbivory, and energy transfer to the consumers at higher trophic levels (Allan 1995, Wallace and Webster 1996). Because of their strong functional relationship to running-water ecosystem processes, invertebrates respond sensitively to habitat modification at different levels of organisation, starting from individual taxa, to community composition (Hodkinson and Jackson 2005). Therefore, knowledge of the spatial pattern in natural variability of macroinvertbrate assemblages and the factors influencing this variation in macroinvertebrate diversity is not only important for biodiversity conservation, but also for environmental management (Heino et al. 2002). Information on unimpacted macroinvertbrate diversity can be gathered from near-pristine headwater streams which support highly diverse macroinvertebrate fauna that contrast with those of the larger rivers downstream. Although size related physical properties combined with anthropogenic factors often contribute to this contrast between diversity in headwaters and that in larger rivers downstream, the headwater streams might sometimes serve as a benchmark for what might be attainable in pristine condition throughout the region.

When knowledge of the distributional data for many taxonomic groups are lacking in most parts of the world, environmental classifications have been used as the surrogates for biotic information with the aim of developing systematic methods for conservation planning and bioassessment (Belbin 1993). Landscape classifications, such as ecoregions (Omernik 1995) have been used extensively in river ecosystem management with the assumption that regions with homogeneous landscape-scale attributes (e.g. climate, geomorphology, landcover) are able to explain the similar ecological pattern (Hawkins and Norris 2000, Harding and Winterbourn 1997). The River Environment Classification (REC) (Snelder and Biggs 2002) is an alternative approach to landscape classifications, where the classes have been defined by a hierarchy of controlling factors (e.g. in descending order watershed climate, topography, geology, land cover) which were assumed to be the dominant causes of spatial variation in ecological characteristics of rivers and streams (Snelder et al. 2004). More recently, multivariate classification techniques have been used to generate such river environment classifications based on direct environmental predictors (e.g. temperature, flow) of biological variation. In this approach a classification of the spatial units (river segments) have been performed, based on a suite of biologically environmental data, by clustering units that have similar environmental characters, the assumption being that these are also likely to have similar ecological character (Snelder et al. 2006). Although multivariate environmental classifications have been used for some time, the classification performance (i.e. discrimination of biological variation) of such habitat prediction models need to be examined before they can be used for conservation or bioassessment (Guisan & Zimmermann 2000).

In this study I have examined whether the Freshwater Environments of New Zealand River Classification (FWENZ) (Snelder et al. 2005) can explain the spatial pattern in macroinvertebrate communities of headwater streams in New Zealand. FWENZ is a multivariate environmental classification of the national river network (originally developed for the REC) that has been designed to maximise the discrimination of spatial variation in unimpacted biological pattern of New Zealand rivers and streams. I have also looked at the environmental predictors of spatial variation in benthic macroinvertbrate assemblage structures in headwater streams of New Zealand.

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Linking stream invertebrate communities and a GIS based multivariate river environment classification

Mangatarere Stream, Tararua **Photo by Riku Paavola**

1 INTRODUCTION

Knowledge of the geographic distributions of species and ecosystems is a prerequisite for systematic conservation planning, but in most parts of the world distributional data for many taxonomic groups are sparse or lacking completely (Belbin 1993). One solution to this problem is to use environmental classifications as surrogates for biotic information where geographic locations with similar environmental attributes are likely to explain similar ecological characteristics. Several statistical techniques and geographical information system (GIS) tools have been used to produce these habitat distribution models which have recently established their importance in ecology. However such species-environment models need testing to assess their ability to reflect ecological significance before they can be used for conservation or biomonitoring purposes (Guisan & Zimmermann 2000).

Existing river classifications which have so far been used for conservation of freshwater ecosystems in New Zealand are ecoregions (Harding and Winterbourn 1997) and the River Environment Classification (REC) (Snelder and Biggs 2002). Ecoregions are classified by mapping geographical regions within which landscape-scale attributes (e.g. climate, topography, geology, landcover) are homogeneous and distinctive compared to other regions. The resultant classes are expected to explain variation in ecological characteristics (community assemblage structures) and to be predictive of the ecological attributes of those areas (Harding and Winterbourn 1997). According to Hawkins et al. (2000), ecoregion classifications perform poorly in their ability to explain the variation in assemblage structure as the longitudinal zonation of rivers (subdivision of rivers at various spatial scales and its contribution to biological variation, Vanotte et al. 1980) remains unaccounted in this classification system. The REC is an alternative approach to landscape classifications, where the classes are defined by a hierarchy of controlling factors (e.g. in descending order watershed climate, topography, geology, landcover) that are assumed to be the dominant causes of spatial variation in ecological characteristics of rivers and streams at different spatial scales (Snelder et al. 2004).

Here, I examined the classification performance of the Freshwater Environments of New Zealand River Classification (FWENZ) (Snelder et al. 2005). FWENZ is a multivariate environmental classification of the national river network (originally developed for the REC) that has been designed to maximise the discrimination of spatial variation in biological pattern of unimpacted New Zealand rivers and streams. It has been developed by identifying the predictors of biotic pattern in river ecosystems from a suite of a large number of environmental variables. A hierarchy of classes is defined such that a small number of high-level classes differentiate river sections that are broadly similar and lower hierarchical levels differentiate more classes with increasing levels of within-class environmental similarity. The classes can be mapped to show their distribution in geographic space (see Snelder et al. 2005 for details). The FWENZ differs from the ecoregion approach of river classification in which geographic location is used explicitly in the definition of individual regions. In contrast, FWENZ classes are defined in environmental space and so the classes may be spatially non-contiguous and show wide range geographic dispersion. The FWENZ differs from the REC in two major ways. Firstly, the FWENZ has been defined numerically (i.e. by using multivariate clustering procedure) based on variables with continuous numeric values unlike the REC which is based on categorical subdivision of individual environmental factors. Secondly, FWENZ variables are based on consideration of the variables that are direct or ‘proximate’ influences (e.g. temperature, flow) of biotic pattern unlike the indirect environmental gradients (such as topography) used in REC classification.

Hawkins et al. (2000) pointed to the need to test classifications that are based on hierarchical frameworks that account for longitudinal zonation in river ecosystems. The aims of my study were to: 1) examine the ability of the FWENZ to explain the spatial variation in unimpacted biological characteristics of New Zealand’s rivers and streams, 2) identify the optimum classification level of the FWENZ which can maximise the discrimination of spatial variation in biotic pattern of New Zealand’s rivers and streams, and 3) compare the classification strength of the FWENZ with those of the REC and ecoregions. Here, a geographically extensive macroinvertebrate dataset was collected to represent the biological characteristics of the stream ecosystem.

2 MATERIALS AND METHODS

2.1 Study sites

My study sites fell within 4 North Island ecoregions (Harding & Winterbourn 1997): Northern Hill Country, Mt Taranaki Forest, Taupo Plateau, and Central Mountains, and 4 South Island ecoregions: North-West Nelson Forest, High Country, Westland Forest, and Southern Alps. Fifteen streams (hundred and thirteen streams were of order 1-3, whereas only seven streams were of order 4) in each of eight ecoregions were sampled to cover the length and breadth of New Zealand (Figure 2.1). Hundred and four streams of all the study streams had a width less than 5 m. The study streams were selected as randomly as possible in first instance. However, streams with obvious signs of human impact were excluded. The eight ecoregions sampled were as follows:

North Island

A. Northern Hill Country – located to the north of the Auckland region. This relatively narrow peninsula is New Zealand's northern-most region. Study sites in this region were between latitude 35º and 36ºS. Altitudes of the study reaches ranged from sea level to ~ 320m above the sea level.

B. Mt Taranaki Forest – the study streams were distributed around the volcanic cone of Mt Taranaki between latitude 39º and 40º S. Altitudes of the study reaches ranged from sea level to ~ 530m above the sea level.

C. Taupo Plateau – study sites were located in Te Urewera National Park to the eastern part of North Island between latitude 38º and 39º S. Te Urewera National Park lies between Bay Plenty and Hawke's Bay in the North Island. Altitudes of the study reaches ranged from 124m – 797m above the sea level.

D. Central Mountains – study streams were distributed along the Tararua range which is situated in the southern part of North Island between latitude 40º and 41º S. Altitudes of the study reaches ranged from 120m ~ 360m above the sea level.

South Island

E. North-West Nelson Forest – study streams were situated in Kahurangi National Park to the northeast of the South Island between latitude 40º30' and 41º30' S. Altitudes of the study streams ranged from the sea level to ~ 830m above the sea level.

F. High Country – study sites were located along the Arthurs Pass in Canterbury region, South Island between latitude 42º30' and 43º30' S. Altitudes of the study reaches ranged from 600m ~ 840m above the sea level.

G. Westland Forest – here the study streams were distributed along the west coast of the South Island between latitude 43º to 44º S. The West Coast generally refers to the narrow strip of land between South Island's Southern Alps and Tasman Sea. Altitudes of the study streams ranged from 60 m to ~ 340 m above the sea level.

H. Southern Alps – it mainly comprises the rugged, glaciated country and fiords in the south-west corner of the South Island. In this region study sites were located between lat 44º30' and 45º30' S. Altitudes of the study reaches ranged from 160 m to ~ 700 m above the sea level.

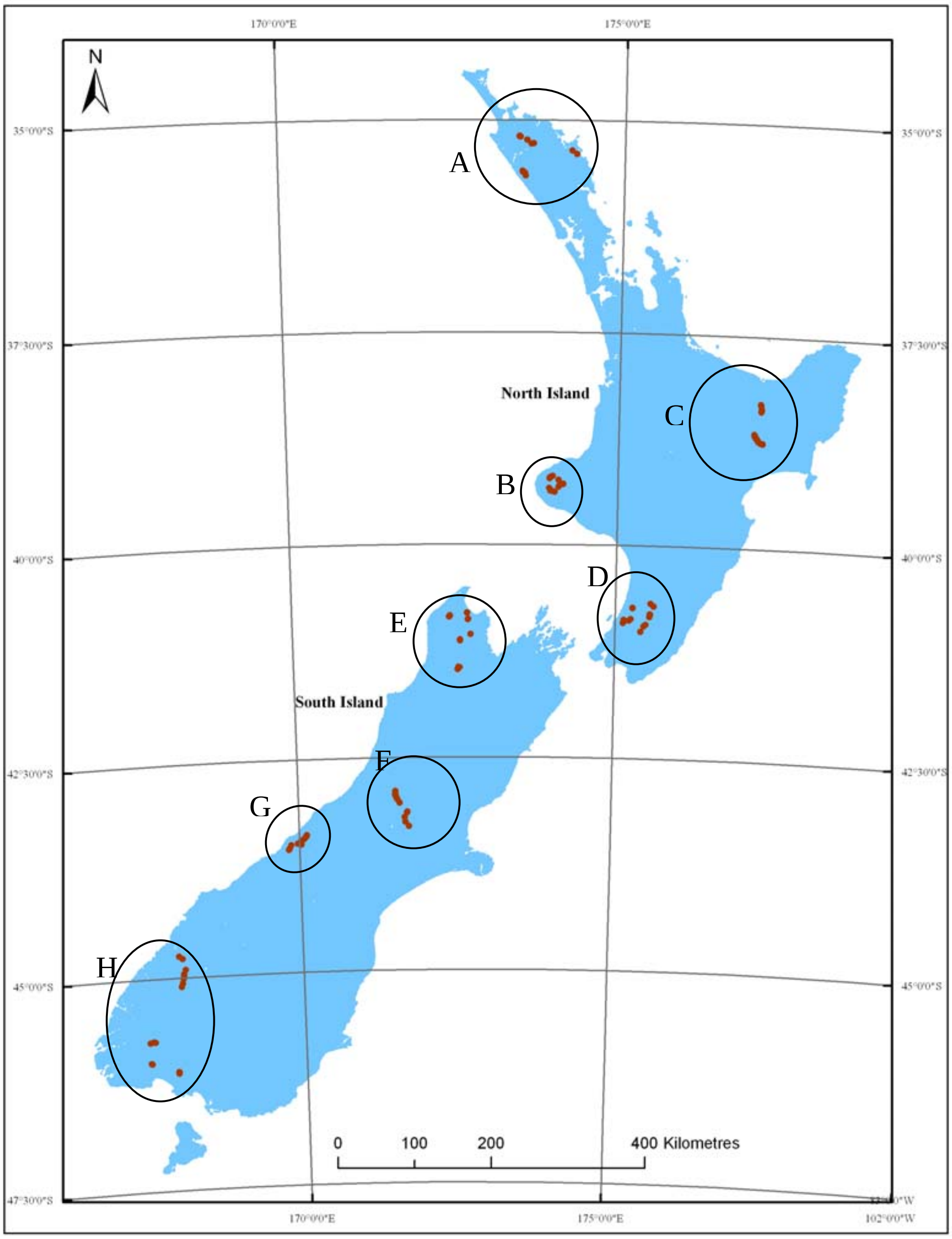


Figure 1.1. Map of New Zealand showing the location of the study sites. A = Northern Hill Country; B = Mt Taranaki Forest; C = Taupo Plateau; D = Central Mountains; E = North-West Nelson Forest; F = High Country; G = Westland Forest; H = Southern Alps. ● = Study sites

2.2 Habitat characteristics

Several riparian and in-stream variables were measured on site (see Table 1.1 for summary). The integrity (percent of riparian zone without obvious human impact) of the riparian zone was assessed visually in a 50 m section along both banks directly upstream of the sampling site. Shading by overhanging vegetation (percent canopy cover) was measured at 20 locations in evenly spaced cross-channel transects along the 20-25 m sampling length. Embeddedness of the substratum was assessed visually and was classified into four groups (embedded, partly embedded, loose, and partly loose) according to the degree of embeddedness of the substrates into the stream bed. Percentage of moss cover (bryophytes) was measured in 10 50cm x 50cm quadrats placed randomly along the sampling reach. Size distribution of surface bed material was assessed using Wolman's (1954) method by sampling at least 50 particles along the sampling reach. The following classification of particle sizes was used (modified Wentworth scale, Minshall et al., 1984): 1) coarse gravel (8 mm-16 mm); 2) small pebble (16 mm-32 mm); 3) large pebble (32 mm-64 mm); 4) small cobble (62 mm-128 mm); 5) large cobble (128 mm-256mm); 6) small boulder (300 mm); and 7) large boulder and bedrock (>300 mm). The proportion of each size class was estimated for each site and these estimates were subsequently multiplied to the respective midpoint value for each size class to get the mean substratum particle size for a site (Quinn and Hickey 1990). Temperature and conductivity were measured at each site using a ECScan pocket meter (Eutech Instruments), while pH was measured using pHTestr^{TM} 2 (Eutech Instruments). Depth and stream velocity were measured at 40 random locations in cross channel transects along the sampling reach using a Marsh-McBirney flow meter, Flo-Mate^{TM} 2000. Mean stream width was also measured at each sampling site. Slope was estimated by measuring the vertical difference in the water surface level with a surveyor's level over a 10m reach. Periphyton biomass was estimated by extracting photosynthetic pigments (chlorophyll-α and phaeophytin) with 90% acetone at 5 ºC

Table1.1. Means and ranges of major environmental variables for each of the 8 ecoregions sampled.

	Ecoregions							
Variables	Northern Hill Country	Mt Taranaki Forest	Taupo Plateau	Central Mountains	North-West Nelson Forest	High Country	Westland Forest	Southern Alps
Altitude (m)	123	500	505	236	269	754	220	412
	20 - 320	326 - 860	124 - 797	120 - 360	78 - 847	628 – 879	40 – 340	150 – 950
Slope (m)	0.20	0.05	0.04	0.04	0.07	4.83	6.21	0.05
	0 - 2.70	0.02 - 0.08	0.01 - 0.17	0 - 0.28	0.01 - 0.21	0.01 – 18.30	0.01 – 21	0.01 – 0.17
Sampling length (m)	23	23	23	21	20	21	20	24
	14 - 41	15 - 33	14 - 38	13 - 29	12 - 26	16 – 31	15 - 25	16 – 30
Stream width (m)	2.69	3.29	2.86	4.29	3.00	2.93	2.79	3.01
	1 - 5.90	0.80 - 8.5	1.60 - 7.25	1.20 - 9.95	0.85 - 6	1 – 6	0.8 – 5	0.9 – 6.8
Depth (cm)	13.97	21.20	16.89	18.43	17.77	19.21	17.40	17.35
	6.98 - 24.80	6.40 - 30.10	10.10 - 30.30	10.35 - 28.23	8.70 - 25.43	5.70 – 32.38	9.65 – 25.93	8 – 30.75
Velocity (m/sec)	0.20	0.29	0.34	0.36	0.37	1.40	1.47	0.45
	0.07 - 0.47	0.11 - 0.46	0.17 - 0.67	0.20 - 0.53	0.09 - 0.80	0.30 – 2.15	0.25 – 3.28	0.22 – 0.7
pH	7.72	7.67	7.82	7.51	8.08	7.85	7.37	7.66
	6.80 - 8.40	7 - 8.20	7.38 - 8.44	7.23 - 7.86	7.30 - 8.70	7.30 – 8.30	5 – 7.9	5.70 – 8.40
Temp (ºC)	15.93	10.30	13.49	13.98	11.28	7.03	10.37	7.39
	14 - 18.10	8.10 - 12.30	10.62 - 17.57	11.59 - 17	7.80 - 14	5.10 – 11.10	7 – 12.9	4.9 – 9.4
Conductivity (µS/cm)	139.13	63.13	102.93	69.00	118.13	56.45	62.33	59.93
	95 - 275	31 - 105	65 - 185	47 - 88	28 - 247	7.8 - 105	6 – 151	5 – 148
Chl a (µg/cm2)	1.74	1.93	9.51	1.17	2.47	0.61	0.75	0.42
	0.15 - 4.56	0.20 - 4.28	0.28 - 78.66	0.26 - 1.82	0.68 - 8.70	-0.01 – 4.23	0.02 – 3.20	-0.07 – 1.26
Moss cover (%)	3.85	13.03	1.50	0.58	10.18	1.78	12.48	3.98
	0 - 20	0.50 - 60	0 - 10	0 - 2	0.25 - 85	0 – 10	0.25 – 65	0 – 10
Substrate size index	116.41	186.08	130.31	131.84	172.39	160.61	159.84	142.84
	30.90 - 306.54	113.75 - 243.40	43.93 - 215.16	57.71 - 189.49	57.90 - 252.41	65.46 – 237.30	74.51 – 307.76	19.77 – 362.85
Riparian Integrity (%)	93.67	98.00	93.00	89.67	100.00	99.87	99	100
	65 - 100	75 - 100	50 - 100	50 - 100	100	98 – 100	90 – 100	100
% Canopy cover	67.33	74.92	65.32	62.27	59.67	31.33	50.35	48.25
	12.25 - 95.75	18.25 - 97.25	4.25 - 95.75	7.50 - 95.75	2.50 - 95.50	0 - 95	0 – 93.25	0 - 99

for 24h in the dark from 5 randomly selected stones collected along the sampling length of each site. Absorbance was read at 750, 665 and 664nm on a Varian Cary 50 Conc. UV-Visible spectrophotometer™ before and after 0.1 M HCL was added. Pigment concentration (μg cm^2) was calculated following Steinman & Lamberti (1996). Three stone dimensions were measured to approximate the surface area and then halved to correct for the stone surface area available for periphyton growth following the approach described by Graham et al. (1988).

2.3 Invertebrate data

All invertebrate samples were collected during the Austral summer between early February and mid April of 2006. At each site a 2-min kick-net sample (250-μm mesh) was taken to cover most of benthic microhabitats in a riffle section of approximately 100 m^2. Samples were collected by disturbing the substrate upstream of the net while moving across the width of the channel. Macroinvertebrates and associated materials were preserved in 70% isopropyl alcohol. Invertebrate samples were rinsed through 500-μm sieve in the laboratory to process thoroughly (without subsampling) and all the invertebrates were identified to the lowest possible taxonomic level (usually to species or genus level) by using existing keys (e.g. Winterbourn et al. 2006, Towns and Peters 1996, McFarlane 1990, Cowley 1978).

2.4 GIS data extraction

The FWENZ (Snelder et al. 2005) and REC (Snelder and Biggs 2002) class memberships for each river segment associated to my study sites were obtained from the GIS layers underlying the FWENZ and REC classes at different classification levels. The FWENZ dataset has been derived by using the New Zealand river network model that was originally developed for the REC from a 30m pixel digital elevation model (DEM) (Snelder and Biggs 2002) using ArcINFO (ESRI, California, USA) hydrological processing routines. Each river segment (uniquely identified by an attribute called NZReach number) in the FWENZ dataset is defined by its confluence with an upstream and downstream river section (Snelder & Biggs 2002). In FWENZ a suite of environmental variables, which characterise the upstream catchment environment of each network segment, the local environment of the segment itself, and the downstream network between the segment and the river mouth, were used to classify the national river network at the following levels of the classification hierarchy: 2, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 100, 150, 200, 250, 300. The study sites fell within 10, 20, 27, 33, and 47 FWENZ classes at the 20, 50, 100, 150, 200, and 300 class level of the FWENZ classification respectively (see Table 1.3). According to the REC classification the study sites fell within 4 REC Climate, 9 REC Source-Of-Flow, 27 REC Geology, 37 REC Land-Cover, and 51 REC Network-Position categories (see Table 1.2 & 1.3).

Table 1.2. River Environment Classification (REC) levels, categories and notation. See Snelder and Biggs (2002) for the full list of categories developed for classification of New Zealand rivers.

Classification level	Categories	Notation
Climate	Cool-Extremely Wet	CX
	Cool-Wet	CW
	Warm-Extremely-Wet	WX
	Warm-Wet	WW
Source-of-Flow	Glacial-Mountain	GM
	Mountain	M
	Hill	H
	Low-Elevation	L
Geology	Hard-Sedimentary	HS
	Soft-Sedimentary	SS
	Volcanic-Acidic	VA
	Volcanic-Basic	VB
	Alluvium	AL
	Plutonic	PL
Land-Cover	Indigenous-Forest	IF
	Pastoral	P
	Scrub	S
	Bareground	B
Network Position	Low Order	LO
	Medium Order	MO
Valley-Land-Form	High-Gradient	HG
	Medium-Gradient	MG
	Low-Gradient	LG

Table 1.4. Number of sampling sites classified by Ecoregions and by the first 5 levels of River Environment Classification (REC). See Table 1.2 for REC notation. For detailed classification of the sites see the Appendix 1.

Ecoregions	Sampling areas	Number of sites	REC classes at the first 4 levels					Number of sites
			Climate	Source of Flow	Geology	Land-Cover	Network Position	
Northern Hill Contry	Northland	15	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	14
Mt Taranaki Forest	Taranaki	15					CX/H/HS/IF/MO	7
Taupo Plateau	Urewera	15				CX/H/HS/P	CX/H/HS/P/LO	1
Central Mountains	Wellington	15					CX/H/HS/P/MO	1
North-West Nelson Forest	Nelson	15			CX/H/SS	CX/H/SS/IF	CX/H/SS/IF/LO	3
High Country	Canterbury	15				CX/H/SS/S	CX/H/SS/S/MO	1
Westland Forest	West Coast	15			CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	13
Southern Alps	Firodland	15					CX/H/VA/IF/MO	5
						CX/H/VA/P	CX/H/VA/P/LO	2
					CX/H/AI	CX/H/AI/IF	CX/H/Al/IF/LO	2
					CX/H/PI	CX/H/PI/T	CX/H/Pl/T/LO	1
					CX/H/VB	CX/H/VB/IF	CX/H/VB/IF/LO	1
				CX/M	CX/M/HS	CX/M/HS/IF	CX/M/HS/IF/LO	3
							CX/M/HS/IF/MO	1
						CX/M/HS/B	CX/M/HS/B/LO	2
							CX/M/HS/B/MO	1
						CX/M/HS/T	CX/M/HS/T/LO	4
							CX/M/HS/T/MO	1
					CX/M/SS	CX/M/SS/IF	CX/M/SS/IF/MO	3
					CX/M/VA	CX/M/VA/B	CX/M/VA/B/LO	1
					CX/M/VB	CX/M/VB/T	CX/M/VB/T/LO	1
						CX/M/VB/IF	CX/M/VB/IF/LO	2
							CX/M/VB/IF/MO	1
					CX/M/PI	CX/M/PI/T	CX/M/Pl/T/LO	1
				CX/L	CX/L/HS	CX/L/HS/S	CX/L/HS/S/LO	1
						CX/L/HS/IF	CX/L/HS/IF/LO	3
					CX/L/AI	CX/L/AI/IF	CX/L/Al/IF/LO	1
							CX/L/Al/IF/MO	1
					CX/L/VA	CX/L/VA/IF	CX/L/VA/IF/LO	1
				CX/GM	CX/GM/PI	CX/GM/PI/B	CX/GM/Pl/B/MO	1
			CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/LO	4
							CW/H/HS/IF/MO	5
					CW/H/SS	CW/H/SS/T	CW/H/SS/T/LO	1
					CW/H/AI	CW/H/AI/T	CW/H/Al/T/MO	1
					CW/H/PI	CW/H/PI/IF	CW/H/Pl/IF/LO	1
							CW/H/Pl/IF/MO	2
						CW/H/PI/T	CW/H/Pl/T/LO	1
				CW/M	CW/M/HS	CW/M/HS/T	CW/M/HS/T/LO	1
						CW/M/HS/B	CW/M/HS/B/LO	2
							CW/M/HS/B/MO	1
					CW/M/PI	CW/M/PI/T	CW/M/Pl/T/LO	1
					CW/L/HS	CW/L/HS/P	CW/L/HS/P/LO	1
						CW/L/HS/IF	CW/L/HS/IF/MO	1
				CW/L	CW/L/SS	CW/L/SS/IF	CW/L/SS/IF/LO	2
					CW/L/VA	CW/L/VA/IF	CW/L/VA/IF/LO	1
			WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/LO	2
							WW/L/HS/IF/MO	4
					WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	5
							WW/L/VA/IF/MO	2
			WX	WX/L	WX/L/VA	WX/L/VA/IF	WX/L/VA/IF/LO	1
Total number of classes							WX/L/VA/IF/MO	1
8			4	9	27	37	51	

Table 1.3. Number of study sites within each of the Freshwater Environments of New Zealand River Classification (FWENZ) classes at 6 different hierarchical class levels. For detailed classification of the sites see the Appendix 1.

FWENZ 20 level class	Number of sites	FWENZ 50 level class	Number of sites	FWENZ 100 level class	Number of sites	FWENZ 150 level class	Number of sites	FWENZ 200 level class	Number of sites	FWENZ 300 level class	Number of sites
1	42	1	9	1	5	1	5	2	4	4	2
2	4	3	6	3	4	3	4	3	1	17	4
3	3	4	8	5	2	6	2	7	4	22	2
5	5	6	2	7	4	9	2	12	2	23	1
7	1	7	3	9	8	10	2	15	1	35	1
8	26	8	3	15	2	13	8	17	1	41	2
9	2	9	11	16	3	23	2	18	2	47	12
10	16	10	4	18	3	24	3	22	8	55	2
11	20	13	2	19	11	27	3	41	2	73	5
12	1	14	1	22	4	29	6	42	2	74	8
		20	5	30	2	30	5	43	1	79	2
		23	1	31	1	34	4	49	2	107	4
		25	21	42	5	49	2	50	1	111	3
		27	5	50	1	50	1	54	6	112	1
		28	2	53	12	71	5	57	1	115	1
		29	5	54	5	81	1	58	4	116	5
		30	11	55	4	84	12	65	4	118	2
		31	17	58	5	86	3	91	2	135	3
		32	3	62	2	87	2	94	1	138	2
		36	1	64	5	88	4	126	5	139	6
				65	10	92	5	148	1	142	4
				66	1	98	2	153	12	143	1
				67	11	103	1	156	3	144	5
				68	6	104	4	157	1	147	1
				69	2	105	9	159	1	152	1
				71	1	106	1	160	3	155	1
				77	1	107	1	161	1	158	4
						108	8	167	5	167	2
						109	3	176	2	184	4
						110	6	182	1	190	1
						112	2	183	4	191	2
						116	1	185	4	194	1
						124	1	186	1	205	2
								187	4	206	1
								190	1	216	1
								193	1	222	3
								194	5	242	1
								195	3	248	4
								196	3	260	1
								197	4	264	1
								198	2	269	1
								201	2	270	1
								207	1	272	3
								217	1	280	2
										287	1
										290	2
Total no. of classes										297	1
10		20		27		33		44		47	

2.5 Data analysis

In order to examine the patterns in community composition Nonmetric Multidimensional Scaling (NMDS) (Kruskal and Wish 1978) ordination procedure was performed in PRIMER 6 software (PRIMER E Ltd., U.K.) (Clark and Warwick 2001), using Bray-Curtis (BC) distance measure. NMDS was chosen because it is well suited to data that are non-normal or are on discontinuous scales, and because of its robustness with regard to the "zero truncation problem" (Beals 1984) which occurs in an ordination of heterogeneous data sets with large number of zeros (De Cacère and Legendre 2008). An important attribute of the Bray-Curtis measure of compositional distance is that sites are grouped on the basis of the species they have in common and the species that are absent at both sites have no influence on biological distance measures (Clarke & Warwick 2001). Prior to calculating biological distances $\sqrt[4]{}$-transformations was applied to the abundance data to down-weight dominant taxa and place greater emphasis on taxonomic diversity. After transformation, the abundance data was also standardised for each species by the total number of individuals to ensure equal contribution of all species to the final distance estimate.

In order to test the strength of the FWENZ classification at a range of hierarchical levels (20, 50, 100, 150, 200 and 300 class levels) and also to compare the classification strength of the FWENZ with that of the REC and ecoregions one-way analysis of similarity (ANOSIM) was carried out using PRIMER (Clarke and Warwick 2001). ANOSIM can be used to calculate either the global (i.e. overall) average difference in compositional similarity taken across all classes (global *R*) or the average difference in compositional similarity between particular pairs of classes (pairwise *r*) (Clarke and Warwick 1994). The global *R* statistic measures the average difference between biological distances of sites located in different classes and the biological distances of sites occurring within the same classes (Clarke and Warwick 2001). Therefore, global *R* indicates the strength of the classification by comparing the degree to which the sites within the class are biologically more similar to each other than the average levels of similarity occurring across the wider datasets. The global *R* has a value of 1 if sites within classes are more similar to each other than to any site from different classes. It is 0 when there is no difference between the biological distances of sites within classes and those of sites in contrasting classes. The pairwise *r* statistic was also calculated to test the percentage of significant interclass differences at each classification level. In order to determine the optimal classification level a combined classification strength index was created by multiplying the global *R* value with the percentage of significant between-class differences (*r* statistics derived from pairwise ANOSIM test) at each classification level. Taxa contributing to the differentiation among the sites were determined by using the similarity percentages (SIMPER) routine (Clarke 1993), in PRIMER (Clarke and Warwick 2001).

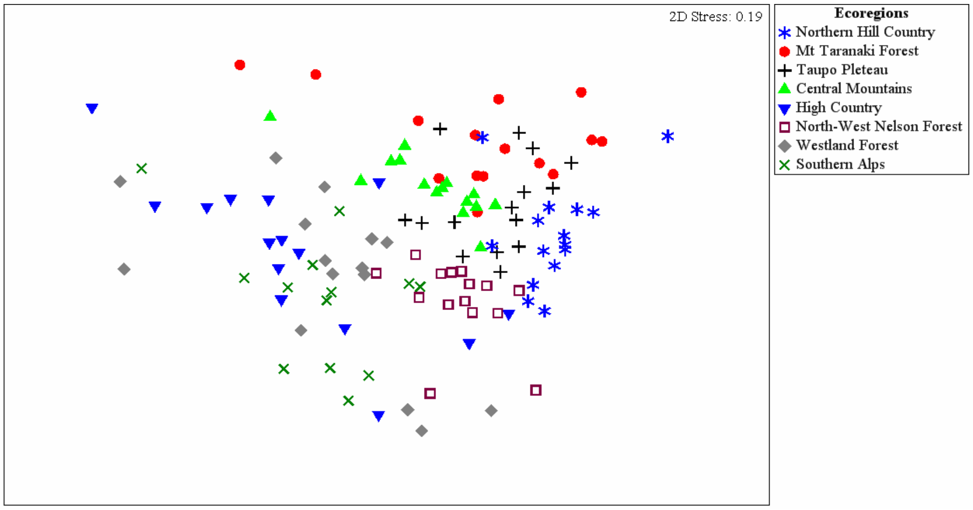
3 RESULTS

3.1 Macroinvertebrate communities

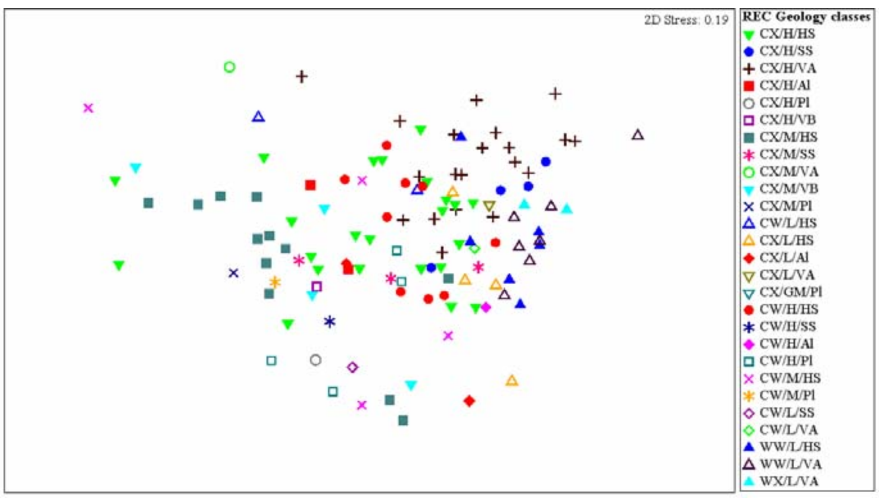
One hundred and thirty eight taxa were recorded from the 120 sites, all of which were kept intact in the dataset for ordination and similarity analysis. Taxonomic richness per site ranged from 8 to 50 (mean = 30.93, SD = 8.64). The early instars of a caddisfly family Hydrobiosidae could not be identified beyond their family level and so grouped together as Hydrobiosidae early instar. These early instars of Hydrobiosidae might have overlapped with other Hydrobiosidae species. Also the dipteran pupas could not be identified to their genus level, which might have overlapped with other dipteran species. Two mayfly (*Deleatidium* spp. and *Nesameletus* spp.) and one stonefly taxon (*Zelandoperla* spp.), early instar larval stage of one caddisfly family (Hydrobiosidae), two beetle family (larval stage of Elmidae and adult stage of Hydraenidae) and one chironomidae taxa (*Cricotopus* spp.) were found at 80 to 90% of all sites. Among them *Deleatidium* spp. and Elmidae were the most abundant taxa, occurring with a relative abundance of 45.83% on an average taken across all the sites ranging from 0 to 94% of the macroinvertebrate community at each site. Eight taxa (*Coloburiscus humeralis*, *Stenoperla prasina*, *Austroperla cyrene*, *Olinga* spp., *Psilochorema* spp., *Aphrophila neozelandica*, *Eriopterini* spp., and Chironominae) were collected at 60 to 80% of the sites. Twenty one taxa were found at more than 50% of the sites whereas seventeen taxa were found at 5 to 10% of the sites and the rest of the 138 taxa were recorded at 10 to 50% of the sites.

3.2 Ordination

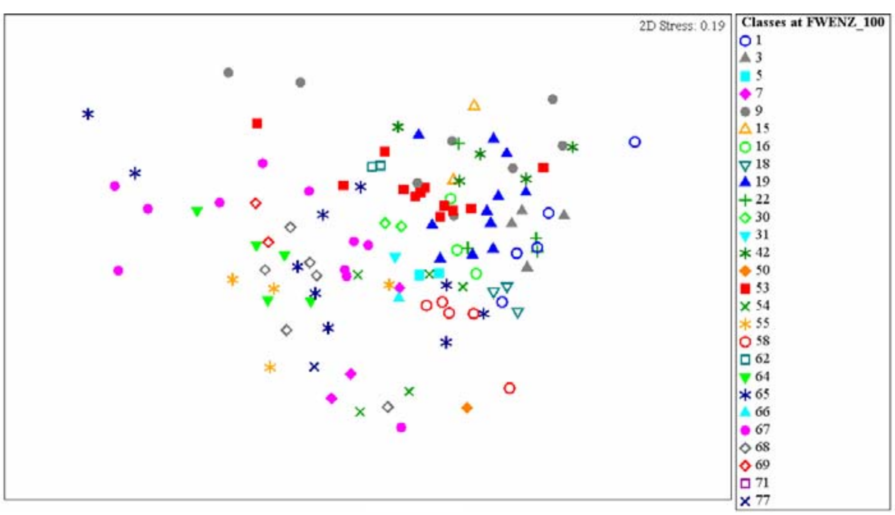
An optimal NMDS ordination (2-dimensional) with the lowest stress value (stress value = 0.19) was obtained by using the fourth root transformed abundance data standardised by the total number of individuals. Though ecoregions did not form separate clusters on the NMDS ordination plot, most of the sites within each ecoregion grouped together (Fig.1.2a). Out of 27 REC Geology classes represented by all the study sites, only five classes, CX/H/VA, CW/H/HS, CX/M/HS, WW/L/VA and WW/L/HS were relatively separated on the ordination (Fig. 1.2b). Discrete clusters were not present on NMDS ordination when sites were coded by groups at FWENZ 100 class level (Fig. 1.2c).



(a)



(b)



(c)

Fig.1.2. Nonmetric Multidimensional Scaling ordination based on Bray-Curtis similarity measure among the 120 study sites classified by (a) ecoregions (b) River Environment Classification (REC), and (c) Freshwater Environments of New Zealand River Classification (FWENZ). Bray-Curtis similarity measure was based on standardised $^4\sqrt{}$-transformed abundance data. See Table 1.2 for REC class notation in legend.

3.3 Similarity analysis

One way ANOSIM test on standardised $^4\sqrt{}$-transformed abundance data revealed that all the six hierarchical class levels (20, 50, 100, 150, 200 and 300 class levels) of FWENZ classification were able to differentiate (*P* < 0.05) the study sites based on their distinctive macroinvertebrate assemblage patterns (Table 1.5). Although the global ANOSIM *R* values were significant at all six levels of the FWENZ classification, they increased gradually with the increasing levels of classification, indicating that finer levels of classifications were able to interpret more the distinctive community assemblages. The increase in global *R* value was steep from the 50 to 100 class level, but was more gradual as the classification level was further increased up to 200 class level after which the rise in global *R* value reached a plateau (Fig.1.3a). Examination of pairwise tests revealed that at the 100 class level of FWENZ (global *R* = 0.43, P = 0.001) 35% of all the possible pairwise comparisons between groups were significant whereas it was 29% and 17% at 150 class (global *R* = 0.47, P = 0.001) and 200 class levels (global *R* = 0.57, P = 0.001) respectively (see Table 1.5 & Fig. 1.3c). Also of all the six FWENZ class levels tested, FWENZ 100 class level had the highest classification strength index (Table 1.5).

One way ANOSIM test performed on standardised $^4\sqrt{}$-transformed abundance data revealed, that REC classes at Climate level were unable (global *R* = 0.08, P = 0.078) to demonstrate the between class differences in biological characteristics (macroinvertebrate community). However there was a steep and significant rise in global *R* statistic from Climate to Source-of-Flow and then to Geology level (Fig. 1.3b). Further increasing of REC classification detail from Landcover (of streams) to Network-Position and Valley-Landform level resulted into much slower increase, and then a fall in global *R* statistic. Although the

Source-of-Flow level had a higher percentage of significant between-class differences and a higher classification strength index than the Geology level, the later considered being the optimal REC class level as the global *R* statistic was much higher (global *R* = 0.40, P = 0.001) at this level than the Source-of-Flow level (global *R* = 0.29, P = 0.001). It is to be noted that the combined classification strength index was second highest at the REC Geology level among all the six REC class levels tested (Table 1.5). Although the global *R* statistic at FWENZ 100 class level was almost equal to that obtained at the REC Geology level, the percentage of significant pairwise comparisons and the combined classification strength index (35% and 15 respectively) were higher at FWENZ 100 class level than those (20% and 8 respectively) obtained at REC Geology level (Fig. 1.3d). So FWENZ 100 class level performed better than the REC Geology level in terms of the number of individual classes that significantly differed from each other within a particular classification level.

Table 1.5. Results of the one-way analysis of similarity (ANOSIM) analyses performed on 6 class levels of Freshwater Environments of New Zealand River Classification (FWENZ), 6 class levels of River Environment Classification (REC) and ecoregions. Results of the ANOSIM are based on $^{4}\surd$-transformed abundance data which was standardised by the total number of individuals for each species.

Classification level	**No. of Classes**	**Global *R* value**	**Significance level (P)**	**% of significant pairwise comparisons (pairwise ANOSIM test)**	**Classification Strength Index (*R* x % of significant pairwise comparisons)**
FWENZ 20	10	0.23	0.001	30	6.9
FWENZ 50	20	0.29	0.001	35	10.2
FWENZ 100	27	0.43	0.001	35	15
FWENZ 150	33	0.47	0.001	29	13.6
FWENZ 200	44	0.57	0.001	17	9.7
FWENZ 300	47	0.58	0.001	14	8.1
REC Climate	4	0.08	0.078	17	1.4
REC Source-of-Flow	9	0.29	0.001	47	13.6
REC Geology	27	0.40	0.001	20	8
REC Landcover	37	0.42	0.001	12	5.0
REC Network-position	51	0.43	0.001	8	3.4
REC Valley-Landform	65	0.39	0.001	2	0.8
Ecoregion	8	0.49	0.001	100	49

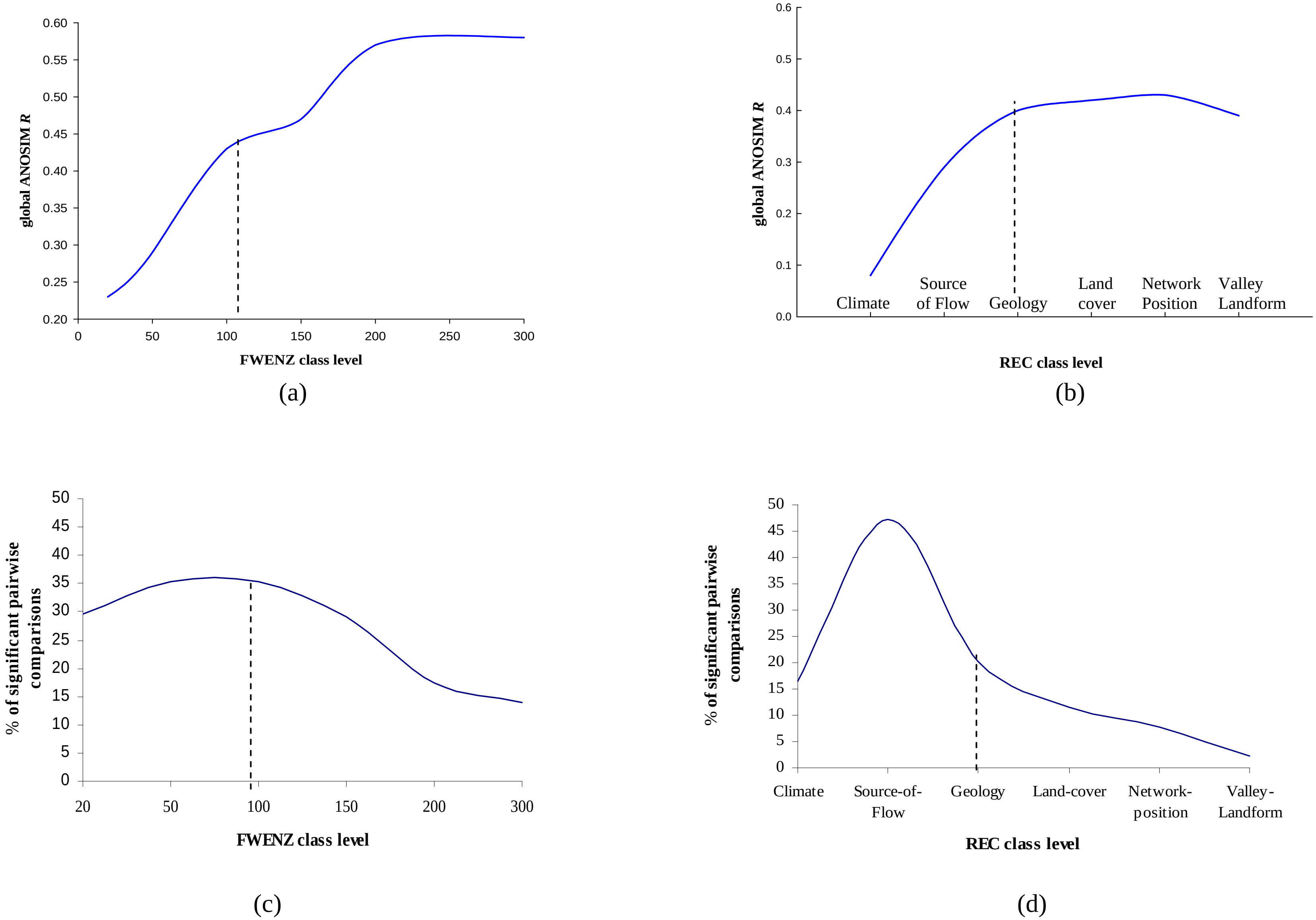


Fig. 1.3. Results of global analysis of similarity (ANOSIM) tests and pairwise ANOSIM on (a) & (c) Freshwater Environments of New Zealand River Classification (FWENZ), and (b) & (d) River Environment Cassification (REC). See Table 1.5 for the summary of ANOSIM test. Dashed lines show the optimum class levels.

ANOSIM test performed on standardised $^4\sqrt{}$-transformed abundance data showed that ecoregion classification performed much better (global $R \approx 0.50$, $P < 0.05$) than the other two optimal class levels of the REC (Geology level) and FWENZ (100 class level) classifications. The pairwise ANOSIM test revealed that all the possible pairwise combinations between ecoregions represented by the study sites were significant, demonstrating the distinctiveness of community compositions among the ecoregion groups (Table 1.6). Also the ecoregion classification scored a much higher classification strength index than the REC Geology and the FWENZ 100 class levels (Table 1.5).

3.4 Species contribution to similarity analysis

3.4.1 Ecoregions

From the pair-wise ANOSIM test performed on ecoregion classification using standardised $^4\sqrt{}$-transformed abundance data, I found that among the eight ecoregion groups all the for ecoregions in the North Island and North-West-Nelson Forest in the South Island were significantly different from each other based on their average within class similarities in macroinvertebrate community structure (see Table 1.6 for the summary of pair-wise ANOSIM test on ecoregions). Between-class differences in community structure were very marginal among High Country, Westland Forest, and Southern Alps. However, the invertebrate community structures of these three ecoregions in the South Island were significantly different to those of the for ecoregions in North Island and also to that of North-West-Nelson Forest (see Table 1.6 for the summary of pair-wise ANOSIM test on ecoregions).

Table 1.6. Results of pairwise analysis of similarity (ANOSIM) test performed on 8 classes of Ecoregion classification system.

	Northern Hill Country	Mt Taranaki Forest	Taupo Plateau	Central Mountains	North-West Nelson Forest	High Country	Westland Forest	Southern Alps
Northern Hill Country		0.533	0.344	0.483	0.537	0.719	0.727	0.706
Mt Taranaki Forest	0.533		0.377	0.519	0.645	0.657	0.576	0.65
Taupo Plateau	0.344	0.377		0.445	0.472	0.618	0.567	0.587
Central Mountains	0.483	0.519	0.445		0.568	0.571	0.52	0.616
North-West Nelson Forest	0.537	0.645	0.472	0.568		0.489	0.481	0.472
High Country	0.719	0.657	0.618	0.571	0.489		0.168	0.128
Westland Forest	0.727	0.576	0.567	0.52	0.481	0.168		0.103
Southern Alps	0.706	0.65	0.587	0.615	0.472	0.128	0.103	

Note: Pairwise *r* statistics calculated for each pair of classes are shown. Significance level % (P value) for pairwise *r* statistic calculated for each pair of classes is 0.001except for the pairs High Country & Westland Forest and High Country & Southern Alps where the P values are 0.007 and 0.006 respectively.Here ANOSIM is based on standardised $^{4}\sqrt{}$-transformed abundance data which was then standardised by the total number of individuals for each species.

Results of the pair-wise ANOSIM test was supported by the SIMPER analysis performed among the ecoregion groups, which revealed significant differences in the suites of species explaining greatest dissimilarity among the ecoregion classes. Of the invertebrate taxa which contributed most to significant differences in community structure among the ecoregions, *Deleatidium* spp., *Nesameletus* spp., Elmidae, *Olinga* spp., and *Zelandoperla* spp. were found to be responsible for between-class difference in community composition for almost every pair of ecoregions (see Appendix 3 for summary of the SIMPER analysis among ecoregions). Besides *Deleatidium* spp., none of the taxa individually contributed more than 10% to the overall within class similarity. However, the average abundance of and the percentage of contribution by *Deleatidium* spp. to average within class similarity varied from class to class (Appendix 3). Besides the above mentioned five core taxa, there were few taxa (e.g. *Costachorema brachypterum*, *Zelandobius* 'x', *Neozephlebia scita*, *Austroclima jollyae*, *Orthopsyche* spp.) which contributed uniquely to the average within class similarities of specific ecoregions.

3.4.2 River Environment Classification (REC)

Examination of the pairwise ANOSIM test performed on the REC Geology classes revealed that 20% (n = 27) of all the possible pairwise combinations were significant (see Table 1.7 for the summary of pair-wise ANOSIM test on REC Geology level). Out of these 13 REC Geology classes, which were represented by 84% of the study sites, only five classes (CX/H/VA, CX/M/HS, CW/H/HS, WW/L/VA, and WW/L/HS) were found to have the assemblage structures significantly (see Table 1.7 for the summary of pair-wise ANOSIM test on REC Geology level) distinct to most of these 13 classes. However, only 45% of the study sites were classified into these five REC Geology categories. *Deleatidium* spp., *Nesameletus* spp., *Coloburiscus humeralis*, *Zelandoperla* spp., *Austroperla cyrene*, *Olinga* spp., and Elmidae were the key invertebrate taxa which explained most the significant differences in community structure among these 13 REC Geology categories (see Appendix 3 for summary of the SIMPER analysis among the REC Geology categories). None of the taxa except *Deleatidium* contributed individually more than 10% to the overall within class compositional similarity for most of the classes. For other taxa (*Coloburiscus humeralis*, *Zelandobius confusus*, *Zelandoperla* spp., and Elmidae) were found to contribute individually more than 7% to the overall within class similarity of some classes.

The results of the pairwise ANOSIM test and the SIMPER analyses among the REC Geology categories showed that there was an obvious difference in community structure between the sites in Hard-Sedimentary (CX/H/HS, CW/H/HS, CX/M/HS, CW/M/HS, CX/L/HS and

WW/L/HS) and the sites in Volcanic-Acidic (CX/H/VA, WW/L/VA) categories. For example, there was a difference (pairwise r = 0.262, P = 0.012) in community composition between the sites in Volcanic-Acidic (VA) and Hard-Sedimentary (HS) categories nested within WW/L Source-Of-Flow class, though the majority of sites fell within the same ecoregion (Northern Hill Country). The relative abundance of *Deleatidium*, *Neozephlebia scita*, *Olinga*, Elmidae, Oligochaeta, and *Helicopsyche* were higher in the Hard-Sedimentary (HS) category than in the Volcanic-Acidic (VA) category nested within WW/L Source-Of-Flow class. Similarly, the average abundance of, and the percent contribution, to average within class similarity by *Deleatidium*, *Zelandoperla*, and *Olinga* were higher within the Hard-Sedimentary categories CX/H/HS, CX/M/HS and CW/M/HS than those in Volcanic-Acidic category CX/H/VA.

Though community compositions differed among different REC Geology categories, the same Geology category had different community structures while nested within different Source-Of-Flow categories. For example, Volcanic-Acidic (VA) category nested within WW/L Source-Of-Flow class differed significantly (pairwise r = 0.292, P = 0.015) from the VA Geology category nested within CX/H Source-Of-Flow. This difference was represented by the presence of *Baraeoptera*, *Olinga*, *Aoteapsyche*, and *Neozephlebia scita* in higher abundance, and *Deleatidium* and *Orthopsyche* in lower abundance. This reflected the influence of climate and topology on geology of the sites while explaining the differences in assemblage structure.

Table 1.7. Results of pairwise analysis of similarity (ANOSIM) test performed on Geology level of River Environment Classification (REC)

	CX/H/HS	CX/H/SS	CX/H/VA	CX/H/AL	CX/M/VB	CX/M/HS	CX/L/HS	CX/L/AL	CW/H/HS	CW/M/HS	CW/H/PL	WW/LVA	WW/L/HS
CX/H/HS			0.273 (0.001)			0.312 (0.001)				0.418 (0.013)		0.244 (0.03)	
CX/H/SS						0.55 (0.004)			0.361 (0.021)	0.427 (0.029)	0.552 (0.029)		0.766 (0.005)
CX/H/VA	0.273 (0.001)			0.617 (0.017)	0.8 (0.001)	0.761 (0.001)	0.432 (0.025)	0.755 (0.013)	0.378 (0.001)	0.826 (0.001)	0.697 (0.001)	0.484 (0.001)	0.56 (0.001)
CX/H/AL			0.617 (0.017)										1 (0.036)
CX/M/VB			0.396 (0.02)						0.306 (0.045)			0.812 (0.003)	0.798 (0.005)
CX/M/HS	0.312 (0.001)	0.55 (0.005)	0.761 (0.001)				0.525 (0.003)		0.466 (0.002)	0.376 (0.025)		0.74 (0.001)	0.683 (0.001)
CX/L/HS			0.432 (0.025)			0.532 (0.008)							0.679 (0.005)
CX/L/AL			0.755 (0.013)									0.89 (0.028)	1 (0.036)
CW/H/HS		0.361 (0.021)	0.378 (0.001)		0.455 (0.01)	0.466 (0.002)		0.76 (0.018)		0.407 (0.014)	0.331 (0.034)	0.3 (0.002)	0.397 (0.005)
CW/M/HS	0.418 (0.013)	0.427 (0.029)	0.707 (0.002)			0.376 (0.025)			0.407 (0.014)			0.556 (0.006)	0.643 (0.005)
CW/H/PL		0.552 (0.029)	0.564 (0.005)						0.331 (0.034)			0.672 (0.006)	0.825 (0.005)
WW/L/VA	0.244 (0.03)		0.292 (0.015)	0.838 (0.028)	0.812 (0.003)	0.74 (0.001)		0.89 (0.028)	0.3 (0.002)	0.556 (0.006)	0.672 (0.006)		0.262 (0.012)
WW/L/HS		0.766 (0.005)	0.361 (0.005)	1 (0.036)	0.798 (0.005)	0.683 (0.001)	0.679 (0.005)	1 (0.036)	0.397 (0.005)	0.313 (0.033)	0.825 (0.005)	0.262 (0.012)	

Note: Only those classes which were represented by the majority of the study sites and those involved in significant pairwise comparisons (pairwise *r* statistics) are shown here. Significance level % (P value) for pairwise *r* statistic calculated for each pair of classes is presented in parentheses. Here ANOSIM is based on $\sqrt[4]{}$-transformed abundance data which was then standardised by the total number of individuals for each species.

3.4.3 Freshwater Environments of New Zealand (FWENZ) river classification

The pair-wise ANOSIM test performed on the FWENZ classes at 100 class level showed that 35% (n = 27) of all the possible pairwise comparisons were significant (see Table 1.7 for the summary of pair-wise ANOSIM test on REC Geology level). Each these 15 classes at FWENZ 100 class level (represented by 82% of the study sites) except 5 classes (22, 54, 55, 65, and 67) was found to be significantly different from each other (see Table 1.8 for the summary of pair-wise ANOSIM test on FWENZ 100 level). The SIMPER analyses among the FWENZ classes at 100 class level revealed, that *Deleatidium* spp., *Coloburiscus humeralis*, *Nesameletus* spp., *Zelandoperla* spp., Elmidae, *Aphrophila* spp., *Chironominae* spp., and *Cricotopus* spp. contributed the most to the significant differences in community composition between almost every pair of classes at FWENZ 100 level (see Appendix 4 for summary of the SIMPER analysis among the FWENZ 100 level classes). *Deleatdium* spp. contributed more than 10% to the overall within class similarity for most of the classes. Three other taxa (*Coloburiscus humeralis*, Elmidae and *Cricotopus* spp.) were found to contribute individually more than 7% to the overall compositional similarity of some classes.

Examination of the possible pair-wise tests among the FWENZ classes at 100 class level showed that in most of the cases the pairwise comparisons between classes grouped under the same ecoregion were not significant. For example, there was no significant difference (see Table 1.8 for the summary of pair-wise ANOSIM test on FWENZ 100 level) in faunal composition among class 1, 3 and 22 at FWENZ 100 class level, which were only represented by most of the study sites in Northern Hill Country ecoregion. Similarly there was no significant difference (see Table 1.8 for the summary of pair-wise ANOSIM test on FWENZ 100 level) in

Table 1.8. Results of pairwise analysis of similarity (ANOSIM) test performed on 150 class level of Freshwater Environments of New Zealand River Classification (FWENZ) system.

FWENZ 150 class level	53	42	9	19	22	3	1	58	54	64	65	67	68	7	55
53		0.487 (0.003)	0.374 (0.002)	0.417 (0.001)	0.372 (0.034)	0.502 (0.012)	0.484 (0.008)	0.55 (0.003)	0.581 (0.002)	0.789 (0.001)	0.344 (0.001)	0.428 (0.001)	0.772 (0.001)	0.781 (0.002)	0.794 (0.003)
42	0.487 (0.003)			0.486 (0.003)	0.969 (0.008)	0.725 (0.0080	0.7 (0.008)	0.784 (0.008)	0.708 (0.008)	0.988 (0.008)	0.467 (0.002)	0.501 (0.004)	0.941 (0.002)	0.881 (0.008)	1 (0.008)
9	0.374 (0.002)			0.425 (0.001)			0.258 (0.049)	0.374 (0.011)	0.474 (0.002)	0.617 (0.005)	0.386 (0.001)	0.398 (0.001)	0.593 (0.001)	0.654 (0.002)	0.612 (0.004)
19	0.417 (0.001)	0.486 (0.003)	0.425 (0.001)		0.563 (0.002)	0.513 (0.006)	0.584 (0.001)	0.62 (0.001)	0.676 (0.001)	0.948 (0.001)	0.509 (0.001)	0.619 (0.001)	0.942 (0.001)	0.858 (0.002)	0.851 (0.002)
22	0.372 (0.034)	0.969 (0.008)		0.563 (0.002)				0.494 (0.016)	0.506 (0.016)	0.994 (0.008)		0.472 (0.005)	0.996 (0.005)	0.813 (0.029)	1 (0.029)
3	0.502 (0.012)	0.725 (0.008)		0.513 (0.006)				0.656 (0.008)	0.556 (0.024)	1 (0.008)	0.387 (0.027)	0.507 (0.005)	1 (0.005)	0.75 (0.029)	1 (0.029)
1	0.484 (0.008)	0.7 (0.008)	0.258 (0.049)	0.584 (0.001)				0.344 (0.016)	0.448 (0.008)	0.98 (0.008)	0.277 (0.037)	0.603 (0.003)	0.971 (0.002)	0.85 (0.008)	0.863 (0.008)
58	0.55 (0.003)	0.784 (0.008)	0.374 (0.011)	0.62 (0.001)	0.494 (0.016)	0.656 (0.008)	0.344 (0.016)			0.856 (0.008)		0.306 (0.023)	0.715 (0.002)	0.569 (0.008)	0.644 (0.008)
54	0.581 (0.002)	0.708 (0.008)	0.474 (0.002)	0.676 (0.001)	0.506 (0.016)	0.556 (0.024)	0.448 (0.008)			0.484 (0.016)			0.6 (0.002)	0.438 (0.04)	
64	0.789 (0.001)	0.988 (0.008)	0.617 (0.005)	0.948 (0.001)	0.994 (0.002)	1 (0.008)	0.98 (0.008)	0.856 (0.008)	0.484 (0.016)				0.275 (0.032)	0.713 (0.008)	
65	0.344 (0.001)	0.467 (0.002)	0.386 (0.001)	0.509 (0.001)		0.387 (0.027)	0.277 (0.037)								
67	0.428 (0.001)	0.501 (0.004)	0.398 (0.001)	0.619 (0.001)	0.472 (0.005)	0.507 (0.005)	0.603 (0.003)	0.306 (0.023)			0.021 (0.457)			0.37 (0.014)	
68	0.772 (0.001)	0.941 (0.002)	0.593 (0.001)	0.942 (0.001)	0.996 (0.005)	1 (0.005)	0.971 (0.002)	0.715 (0.002)	0.6 (0.002)	0.275 (0.036)	0.643 (0.005)			0.556 (0.005)	
7	0.78 (0.002)	0.881 (0.008)	0.654 (0.002)	0.858 (0.002)	0.813 (0.029)	0.75 (0.029)	0.85 (0.008)	0.569 (0.008)	0.438 (0.04)	0.713 (0.8)	-0.107 (0.6)	0.37 (0.014)	0.556 (0.005)		0.625 (0.029)
55	0.794 (0.003)	1 (0.008)	0.612 (0.004)	0.851 (0.002)	1 (0.029)	1 (0.029)	0.863 (0.008)	0.644 (0.008)			0.394 (0.008)			0.625 (0.029)	

Note: Only those classes represented by the majority of the study sites and those involved in significant pairwise comparisons (Pairwise *r* statistics) are shown. Significance level % (P value) for pairwise *r* statistic calculated for each pair of classes is presented in parentheses. Here ANOSIM is based on $\sqrt[4]{}$-transformed abundance data which was then standardised by the total number of individuals for each species.

assemblage structure between class 42 and 9, which were only represented by most of the study sites of Mt Taranaki Forest ecoregion. However the fact, that the difference in invertebrate community between class 3 and class 58 (pairwise $r = 0.656$, P = 0.008) was significantly greater than that observed between class 1 and class 58 (pairwise $r = 0.344$, P = 0.016), showed that there was some compositional difference between class 3 and class 1. It was evident from the results of SIMPER analyses among the FWENZ 100 level classes that the average community composition of the class 58 is more similar to that of class 1 than to that of class 3 (see Appendix 4). The SIMPER analyses showed that *Austroclima jollyae*, *Aoteapsyche* spp., *Orthopsyche* spp., *Baraeoptera* spp., *Olinga* spp., and *Aprophila* spp. were among the first few taxa which contributed the most to this difference between class 3 and class 1.

4 DISCUSSION

4.1 Optimal classification level of the FWENZ and its classification strength

The FWENZ was able to explain the variation in macroinvertebrate community at all six classification levels examined for their ability to discriminate rivers and streams in New Zealand based on their unimpacted (natural) biological characteristics. At low levels of classification, performance of the FWENZ was comparatively less robust than the REC. The classification strength of the FWENZ continued to rise between the 50 and 200 class level as the number of classes increased. However for the REC, classification strength reached a plateau as the classification resolution increased beyond the Geology level (Geology categories nested within the Climate and Source-of-Flow level categories). As most of the sites were on forested streams, further nesting of the REC Geology categories into the REC Land-Cover level categories did not produce any additional discrimination of the biological variation of the study sites.

The poor performance of the FWENZ at the lower classification levels was possibly because the FWENZ is based on environmental variables (e.g. mean air temperature in the warmest month, average slope and mean flow of river section) which have a more proximate effect on biological variation (Snelder et al. 2005), whereas the first few classification levels of the REC are based on watershed climate, topography and geology which were postulated by Snelder et al. (2004) to be major drivers for variation in biological community structure at broader scales. A classification based on causal factors with direct effects on organism distribution could also be the reason why the FWENZ performed better than REC at the higher classification levels. Several studies (Power et al. 1988, Poff 1997, Sandin & Johnson 2000, Death & Joy 2004) in the past have shown that local scale abiotic factors could account for a larger part of variance in stream fauna. My analysis demonstrated that for both the river classification systems (REC and FWENZ), after a certain level of classification further increasing of classification resolution yielded no further increase in classification strength. This indicates that certain point is reached where further spatial graining of environmental factors can produce limited or no additional discrimination of biological differences, a result which was also found by Snelder et al. (2005, 2006). I found that the classification performance of the FWENZ attained this plateau at a finer spatial scale than the REC.

Snelder et al. (2006) suggested that the level of a multivariate environmental classification at which the performance tends to plateau, should be established as an optimal classification level for conservation management purpose. While selecting the optimum classification level, I have considered not only the upper limit for overall significant difference (global *R* statistic) across all the classes at different classification levels but also the percentage of significant interclass differences (pairwise *r* statistic) observed within each hierarchical level. The combined classification strength index (a compromise between the global *R* statistic and the percentage of significant pairwise *r* statistic) was higher at the REC Source-of-Flow level than the REC Geology level, as the percentage of significant interclass differences was higher at the Source-of-flow level. The REC Geology level still considered to be the optimal classification level because of its better performance in overall significant difference (global *R* statistic) taken across all the classes at this level than the Source-of-Flow level. The global *R* was given more importance than the percentage of significant pairwise *r* statistics, as the global *R* indicates the strength of the classification by comparing the degree to which the sites within the class are more biologically similar to each other than the average levels of similarity occurring across the wider datasets. Examination of pairwise tests at different classification levels of the FWENZ showed that the percentage of significant pairwise comparisons among FWENZ classes was comparatively high at 100 class (35%) and 150 class (29%) levels, which was also higher than that (20%) observed at REC Geology level. Also, the study streams within a particular REC Geology category were often found to have several FWENZ 100 class memberships, most of which were significantly different to each other. For example, study sites from the two ecoregions Mt Taranaki and Taupo Plateau, which fell within the Volcanic-Acidic category CX/H/VA of REC, were also grouped into class 9, class 19, class 42 and class 15 at the FWENZ 100 level classification, most of which were significantly different to each other based on their invertebrate community composition (Fig. 1.4). Thus the FWENZ classes at 100 class level provided a more optimal separation of the study sites based on average difference in within-class compositional similarity of macroinvertebrate community at a finer spatial grain than the REC Geology categories.

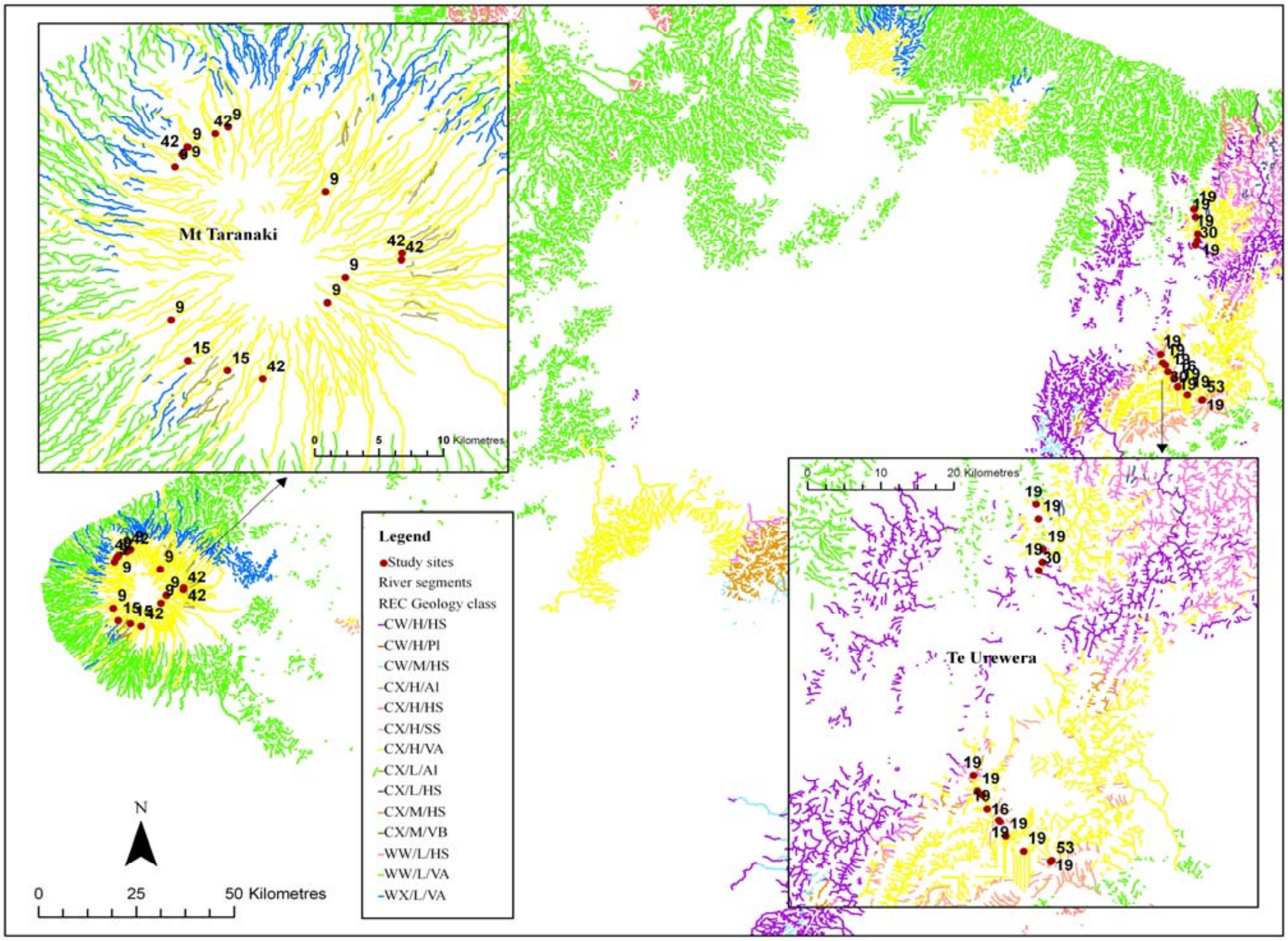


Fig. 1.4. Comparison of spatial graining at FWENZ 100 class level with that at REC Geology level. Study sites were coded by their FWENZ 100 level class memberships. River segments were colour coded to show their class memberships at the REC Geology level. FWENZ = Freshwater Environments of New Zealand River Classification; REC = River Environment Classification.

In none of the classification levels of the FWENZ and REC, was the percentage of significant pairwise comparisons more than 50%. The ANOSIM analysis thus indicated that, although there were some overall differences in the community composition among the classes at different classification levels of the FWENZ and REC, only a few of these individual groups could be considered to have compositions that distinguished them from other groups. However, it was also noticed that a major part of the biological dataset has been explained by these few individual groups which were involved in significant interclass differences at 100 class level of the FWENZ and the REC Geology level. From the decrease in percentage of significant pairwise comparisons with the increasing classification resolution of the FWENZ, it was evident that after the 150 class level between-class differences in community composition became too subtle. This was attributable to the categorisation of the study sites into small groups comprising small number of sites with the increasing number of classes, thus ending up with insufficient biological information and random distribution of invertebrate taxa at this finer special grain. Although, this trend of decrease in significant interclass differences with the increasing classification detail was observed at much lower classification levels (after Source-of-Flow level) for the REC.

The classification strength of the ecoregions was much stronger than that observed for both, the FWENZ and the REC. However, the distinctiveness of ecoregion classes in the South Island was less obvious than that observed in the North Island, possibly because of the high influence of the core group of invertebrate taxa (e.g. *Deleatidium* spp., Elmidae) in the assemblage pattern of most of the study sites in the South Island. Ecoregions in New Zealand were defined on the basis of a range of climatic, geomorphologic and land-cover (vegetation-type) characteristics at regional scale (Harding & Winterbourn 1997). The better performance of ecoregion classification in my study could be explained by the length of the geographical extent sampled and the strong influence of climate, topography and geology on the variation in biological patterns at that broad spatial scale.

Lack of significant difference between the FWENZ 100 level classes grouped under the same ecoregion raises doubt about the ability of the FWENZ 100 level classification to explain the within-region variation in invertebrate community composition. However, a close investigation into the average within-class community compositions and the varied degree to which each of these FWENZ 100 level classes within the same ecoregion significantly differed from those found within the other ecoregions, indicated that FWENZ 100 class level accounts for within-region biological variation, thus local-scale difference in community composition. At the same time interclass differences in average community composition between FWENZ 100 level classes seemed to reflect, to some extent, the regional differences in invertebrate assemblage. For example, difference in community composition among High Country, Westland Forest, and Southern Alps was low which was also reflected by the lack of significant differences between most of the FWENZ 100 level classes (class 67, 68, 64. 65, 7, and 55) which fell within these three ecoregions.

4.2 Effect of rare taxa, regional species diversity and biogeography on classification performance

Invertebrate taxa (e.g. *Deleatidium* spp., *Nesameletus* spp., *Coloburiscus humeralis*, *Zelandoperla* spp., and Elmidae) which contributed most to between-class dissimilarities, were similar for the FWENZ 100 level classes, the REC Geology categories, and the ecoregions represented by the study sites, except a few rare taxa which were unique to few classes in terms of their average distribution. Rounick and Winterbourn (1982) have shown that New Zealand's riverine fauna is dominated by a core assemblage of taxa with wide environmental tolerances. However, the relative abundance of each taxa of this core invertebrate group varied between classes, and this might explain their contribution to interclass differences in assemblage structure despite their presence in almost every class. The fact, that on average, the contribution of this core invertebrate group to within class similarities for each of these three river classification systems tested was less than 40%, indicates the importance of rare taxa alongside the common taxa in explaining the between-class differences in community composition. I found, that at the higher classification level of the FWENZ, importance of the core invertebrate group in reflecting between-class compositional differences was less within the same ecoregion. For example, none of the core group of invertebrate taxa was among the first few species which explained most of the significant difference (paiwise $r = 0.40$, $P = 0.02$) in community structure between class 30 and 29 at FWENZ 150 class level, which were represented by most of the study sites within the Taupo Plateau. This illustrates that rare taxa can be important in reflecting the local difference in community structure at finer spatial scale. This finding of my study supports the argument by Cao et al (2001) that rare taxa may enable recognition of finer community types in multivariate classification analysis, because “many abundant species are likely to be common to all sites within each type”. So the FWENZ classes at higher classification levels (from the 100 to 150 class level) not only explain the spatial distribution of major dominant taxa but also the rare taxa.

Lack of discrete grouping by some of the FWENZ classes at higher classification levels on the NMDS ordination and the high stress value for the optimal ordination showed that some of the study sites could not be grouped easily by their invertebrate assemblages at those finer spatial scales, which was likely the consequence of many taxa varying independently in response to local scale environmental gradients. This was more evident among the FWENZ class memberships of the study sites in the South Island. As a result, the classification strength tests that were based on similarity averaged across all taxa may have blurred distinctive differences in the invertebrate assemblage structure among few classes.

By comparing the results of the SIMPER analyses for the FWENZ 100 class level and the ecoregion classification, it seemed that the community structure of an ecoregion actually mirrors the average community composition found across the FWENZ 100 level classes represented by majority of the study streams within that particular ecoregion. For example, high abundance (7% contribution to average within class similarity) of *Orthopsyche* in Taranaki Forest ecoregion could be better explained by looking at the community composition of class 42 and class 9 at FWENZ 100 level, which were represented only by the study sites within this ecoregion. *Orthopsyche* contributed more than 10% to within class compositional similarity of class 42 whereas it was only 3% for class 9. Although it is often suggested that local diversity is dependent on regional species pool, normally less than half of the regional species pool is found at any sampled site (Allan 1995). This finding of my study concurs with the former studies (Poff 1997, Heino et al. 2002) which showed that environmental filters at the within-region scales eventually influence the probability that certain species of regional species pool are able to colonise in a local assemblage. It was expected that being a classification based on direct causal factors of biological variation FWENZ classes at higher classification levels would address this variation in local species diversity at within-region scale.

In this study, sites were limited to forested streams to gather information on stream biota at unmodified habitats. Therefore, my study sites represented only a proportion of the FWENZ classes at any particular classification level. As the optimum FWENZ classification level was more detailed with increasing number of classes, size of the classes became smaller and unequal in terms of the number of study sites within each class and their spatial distribution became very limited. This might have resulted in regionalisation of most the class memberships of my study sites at higher classification levels of FWENZ, especially in the North Island, because of the long geographical distances among the river catchments sampled in 4 ecoregions. None of the study sites within the North or South Island fell within the same FWENZ classes at 100 class level. So, the FWENZ 100 level class memberships of my study sites, which actually group the sites on the basis of environmental factors alone, were not independent of geographic location at a national scale. I found that at the 100 class level, FWENZ class memberships of the North Island study sites were quite different (with high pairwise ANOSIM r values) in community composition from those in the South Island. It seems, that this difference was not only because of the variation in community structures at local scales, but also because of the biogeographic variation in the macroinvertebrate assemblage structures between the North and South Islands of New Zealand (Boothroyd 2000).

4.3 Implications for use of the FWENZ in conservation management

The results of this study lead me to conclude that the classification performance of the FWENZ was optimum at 100 class level which also performed better than the REC Geology level to distinguish the variation in unimpacted stream invertebrate community structures, while comparing the percentages of significant interclass differences along with the overall difference across all the classes at a particular classification level. From the classification performance of the REC, it was found that the landuse had a very limited additional influence on the variation in natural macroinvertebrate assemblage structures while topography (REC Source-Of-Flow) and geology were the major broad scale determinants of stream invertebrate assemblage pattern in unmodified headwater streams. However, as the New Zealand rivers and streams are grouped at a larger spatial scale (56 classes) by the REC Geology level than the FWENZ 100 class level, the later could better explain the local differences in community composition along with the influence of regional species pool on local species richness.

Macroinvertebrate assemblages in the study streams corresponded relatively well to ecoregion classification in comparison to the other two river environment classifications, but several factors like geographically extensive biological data sets, regional variation in environmental gradients of macroinvertebrate diversity, and the difference in biogeographic histories between the two islands (the North and South Island) of New Zealand may partly account for this strong performance by ecoregions. On the other hand, although classification performance of the 100 class level of FWENZ was, to some extent, influenced by the biogeographic pattern in species distribution between the North and South Island and also by the occurence of a core group of dominant taxa through out the study areas, between class variation in species abundances was obvious at this classification level. This leads me to suggest that FWENZ 100 level should be used as an optimal spatial framework for environmental assessment and conservation management at national scale. However, more rigorous testing of prediction accuracy of the FWENZ classes between the 100 and 200 class levels are recommended at within-ecoregion scales.

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2

Environmental predictors of macroinvertebrate assemblage patterns in headwater streams of New Zealand; local or regional influence

Wesney Creek, Fiordland **Photo by Riku Paavola**

1 INTRODUCTION

Benthic macroinvertebrates have an important ecological role in river ecosystem including their contribution to detritus processing, animal-microbial interactions, herbivory, and energy transfer to the consumers at higher trophic levels (Allan 1995, Wallace & Webster 1996). Such functional versatility and ecological importance of benthic macroinvertebrate communities result from their multitude of adaptations to the heterogeneity (spatial and temporal) of stream habitats. Because of their strong functional relationship to running-water ecosystem processes, macroinvertebrates respond sensitively to habitat modification at different levels of organisation, starting from individual taxa, to invertebrate community composition (Hodkinson & Jackson 2005). Information on factors affecting the natural variability of macroinvertebrate assemblages is, therefore, not only vital for biodiversity conservation, but also for determining reference conditions for biomonitoring, and for restoration of lotic ecosystems (Rosenberg & Resh 1993, Palmer et al. 1997). Knowledge on spatial variation in macroinvertebrate diversity across the region can be gathered from near-pristine headwater streams which support highly diverse macroinvertebrate fauna that contrast with those of the larger rivers downstream. Although size related physical properties combined with anthropogenic factors often contribute to this contrast between diversity in headwaters and that in larger rivers downstream, the headwater streams might sometimes serve as a benchmark for what might be attainable in pristine condition throughout the region.

Interrelationships between catchment characteristics (e.g. catchment geomorphology and vegetation type), water chemistry and macroinvertebrate fauna have been widely demonstrated in previous studies (e.g. Minshall et al. 1983; Corkum 1992; Sponseller et al. 2001; Townsend et al.

2004). The strong influence of catchment scale climatic, geomorphological and land-use parameters on invertebrate assemblages was also noticed in New Zealand rivers (Biggs et al. 1990, Quinn and Hickey 1990). This has lead to the development of aquatic ecoregions comprised of geographical regions with homogeneous landscape-scale attributes (Harding and Winterbourn 1997). The high correspondence between ecoregions and benthic assemblages indicates that local assemblages are predominantly structured by catchment-scale factors (Harding et al. 1997, Sandin and Johnson 2000). On the other hand, Death and Joy (2004) found stronger association of reach-scale measured variables with the macroinvertebrate assemblage structure than the GIS derived catchment-scale factors. Even studies reporting relatively high correspondence between regional delineations of environmental factors and benthic assemblages highlighted that factors at smaller scales also need to be considered in order to explain within-region variation in assemblage structure (e.g. Sandin and Johnson 2000, Heino et al. 2002).

Streams are hierarchical and extremely heterogeneous ecosystems across multiple spatial scales (Griffiths 1999). The hierarchy of stream habitats consists of drainage systems, streams within drainage systems, pool-riffle sequences within stream reaches, and small-scale microhabitats within riffles (Frissell et al. 1986). There is considerable variation in environmental factors at each spatial scale, ranging from differences in climate, geomorphology and landcover among regions and drainage systems to microhabitat configurations at the within-riffle scales. Recent conceptual frameworks have indicated that environmental factors prevailing at hierarchical scales act as filters to select subsets of species from the regional species pool, which are able to persist in the local assemblages (Tonn 1990, Poff 1997, Habersack 2000). The variation in environmental predictors of stream communities as well as in community compositions at different spatial scales has led to acknowledging the importance of multi-scale control of local assemblage structure. In this study, I have used the macroinvertebrate dataset collected from 120 headwater streams throughout New Zealand to identify, (1) the environmental predictors of spatial variation in benthic macroinvertebrate assemblage structures at three different spatial scales; upstream catchment, segment, and reach scale, and (2) the spatial scale with the highest correspondence between environmental predictors and invertebrate communities structure.

2 MATERIALS AND METHODS

2.1 Study sites

My study sites fell within 4 North Island ecoregions: Northern Hill Country, Mt Taranaki Forest, Taupo Plateau, and Central Mountains, and 4 South Island ecoregions: North-West Nelson Forest, High Country, Westland Forest, and Southern Alps. Fifteen streams (hundred and thirteen streams were of order 1-3, whereas only seven streams were of order 4) in each of eight ecoregions were sampled to cover the length and breadth of New Zealand (Figure 2.1). Hundred and four streams of all the study streams had a width less than 5 m. The study streams were selected as randomly as possible in first instance. However, streams with obvious signs of human impact were excluded. The eight ecoregions sampled were as follows:

<u>North Island</u>

E. Northern Hill Country – located to the north of the Auckland region. This relatively narrow peninsula is New Zealand’s northern-most region. Study sites in this region were between latitude 35º and 36ºS. Altitudes of the study reaches ranged from sea level to ~ 320m above the sea level.

F. Mt Taranaki Forest – the study streams were distributed around the volcanic cone of Mt Taranaki between latitude 39º and 40º S. Altitudes of the study reaches ranged from sea level to ~ 530m above the sea level.

G. Taupo Plateau – study sites were located in Te Urewera National Park to the eastern part of North Island between latitude 38º and 39º S. Te Urewera National Park lies between Bay Plenty and Hawke's Bay in the North Island. Altitudes of the study reaches ranged from 124m – 797m above the sea level.

H. Central Hill Country – study streams were distributed along the Tararua range which is situated in the southern part of North Island between latitude 40º and 41º S. Altitudes of the study reaches ranged from 120m ~ 360m above the sea level.

<u>South Island</u>

I. North-West Nelson Forest – study streams were situated in Kahurangi National Park to the northeast of the South Island between latitude 40º30' and 41º30' S. Altitudes of the study streams ranged from the sea level to ~ 830m above the sea level.

J. High Country – study sites were located along the Arthurs Pass in Canterbury region, South Island between latitude 42º30' and 43º30' S. Altitudes of the study reaches ranged from 600m ~ 840m above the sea level.

K. Westland Forest – here the study streams were distributed along the west coast of the South Island between latitude 43º to 44º S. The West Coast generally refers to the narrow strip of land between South Island's Southern Alps and Tasman Sea. Altitudes of the study streams ranged from 60 m to ~ 340 m above the sea level.

L. Southern Alps – it mainly comprises the rugged, glaciated country and fiords in the south-west corner of the South Island. In this region study sites were located between lat 44º30' and 45º30' S. Altitudes of the study reaches ranged from 160 m to ~ 700 m above the sea level.

Here, I have used the ecoregion (Harding and Winterbourn 1997) boundaries for examining regional delineations in the abiotic and biotic dataset collected from my study sites.

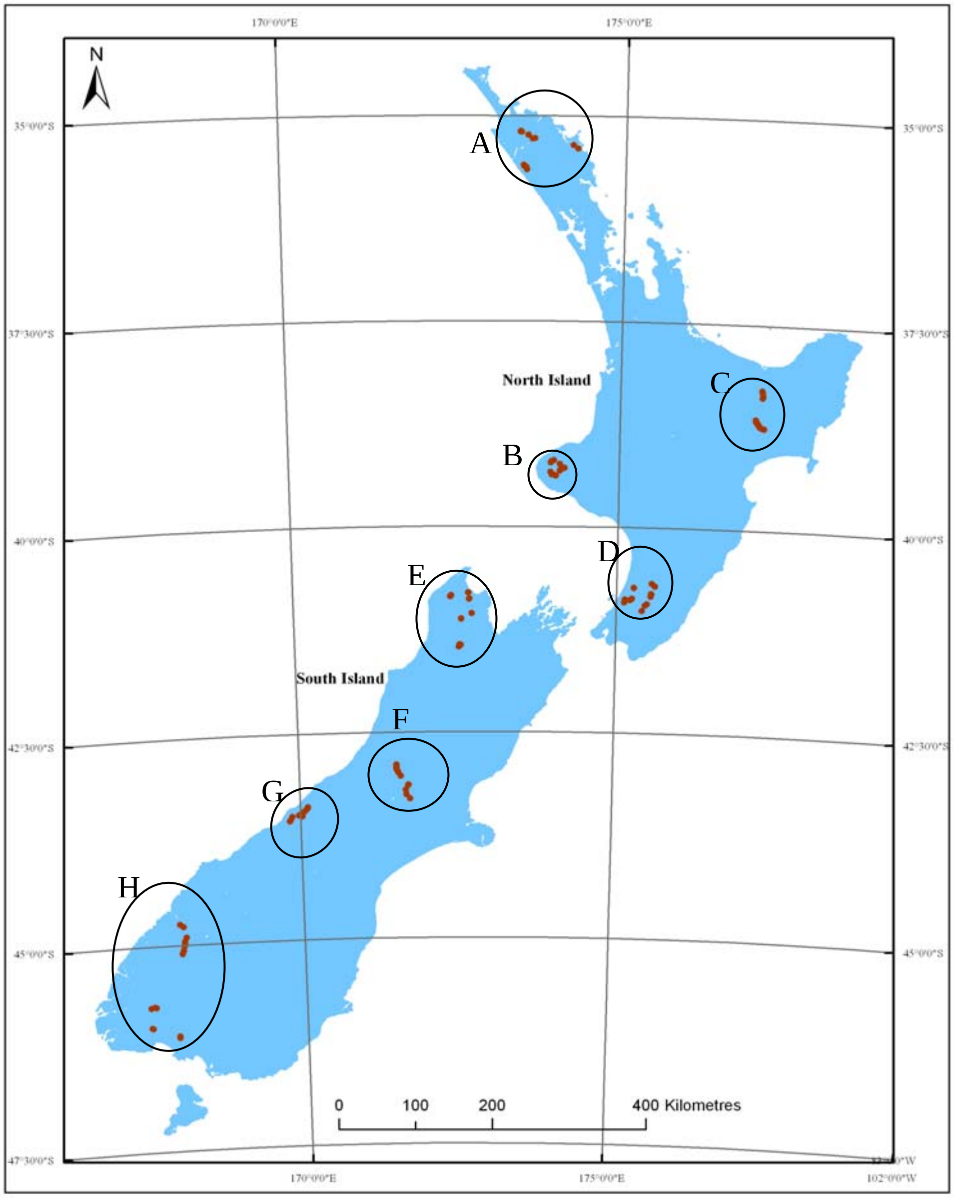


Figure 1.1. Map of New Zealand showing the location of the study sites. A = Northern Hill Country; B = Mt Taranaki Forest; C = Taupo Plateau; D = Central Mountains; E = North-West Nelson Forest; F = High Country; G = Westland Forest; H = Southern Alps. ● = Study sites

2.2 Habitat characteristics

Several riparian and in-stream variables were measured on site (see Table 2.1 for summary). The integrity (percent of riparian zone without obvious human impact) of the riparian zone was assessed visually in a 50 m section along both banks directly upstream of the sampling site. Shading by overhanging vegetation (percent canopy cover) was measured at 20 locations in evenly spaced cross-channel transects along the 20-25 m sampling length. Embeddedness of the substratum was assessed visually and was indexed into four groups (embedded, partly embedded, loose, and partly loose) according to the degree of embeddedness of the substrates into the stream bed. Percentage of moss cover (bryophytes) was measured in 10 50cm x 50cm quadrats placed randomly along the sampling reach. Size distribution of surface bed material was assessed using Wolman's (1954) method by sampling at least 50 particles along the sampling reach. The following classification of particle sizes was used (modified Wentworth scale, Minshall et al 1984): 1) coarse gravel (8 mm-16 mm); 2) small pebble (16 mm-32 mm); 3) large pebble (32 mm-64 mm); 4) small cobble (62 mm-128 mm); 5) large cobble (128 mm-256mm); 6) small boulder (300 mm); and 7) large boulder and bedrock (>300 mm). The proportion of each size class was estimated for each site and these estimates were subsequently multiplied to the respective midpoint value for each size class to get the mean substratum particle size for a site (Quinn and Hickey 1990). Temperature and conductivity were measured at each site using a ECScan pocket meter (Eutech Instruments), while pH was measured using pHTestr™ 2 (Eutech Instruments). Depth and stream velocity were measured at 40 random locations in cross channel transects along the sampling reach using a Marsh-McBirney flow meter, Flo-Mate™ 2000. Mean stream width was also measured at each sampling site. Slope was estimated by measuring the vertical difference in the water surface level with a surveyor's level over a 10m reach. Periphyton

Table 2.1. Means and ranges of major environmental variables for each of the 8 ecoregions sampled.

Variables	Ecoregions Northern Hill Country	Mt Taranaki Forest	Taupo Plateau	Central Hill Country	North-West Nelson Forest	High Country	Westland Forest	Southern Alps
Altitude (m)	123	500	505	236	269	754	220	412
	20 - 320	326 - 860	124 - 797	120 - 360	78 - 847	628 – 879	40 – 340	150 – 950
Slope (m)	0.20	0.05	0.04	0.04	0.07	4.83	6.21	0.05
	0 - 2.70	0.02 - 0.08	0.01 - 0.17	0 - 0.28	0.01 - 0.21	0.01 – 18.30	0.01 – 21	0.01 – 0.17
Sampling length (m)	23	23	23	21	20	21	20	24
	14 - 41	15 - 33	14 - 38	13 - 29	12 - 26	16 – 31	15 - 25	16 – 30
Stream width (m)	2.69	3.29	2.86	4.29	3.00	2.93	2.79	3.01
	1 - 5.90	0.80 - 8.5	1.60 - 7.25	1.20 - 9.95	0.85 - 6	1 – 6	0.8 – 5	0.9 – 6.8
Depth (cm)	13.97	21.20	16.89	18.43	17.77	19.21	17.40	17.35
	6.98 - 24.80	6.40 - 30.10	10.10 - 30.30	10.35 - 28.23	8.70 - 25.43	5.70 – 32.38	9.65 – 25.93	8 – 30.75
Velocity (m/sec)	0.20	0.29	0.34	0.36	0.37	1.40	1.47	0.45
	0.07 - 0.47	0.11 - 0.46	0.17 - 0.67	0.20 - 0.53	0.09 - 0.80	0.30 – 2.15	0.25 – 3.28	0.22 – 0.7
pH	7.72	7.67	7.82	7.51	8.08	7.85	7.37	7.66
	6.80 - 8.40	7 - 8.20	7.38 - 8.44	7.23 - 7.86	7.30 - 8.70	7.30 – 8.30	5 – 7.9	5.70 – 8.40
Temp (ºC)	15.93	10.30	13.49	13.98	11.28	7.03	10.37	7.39
	14 - 18.10	8.10 - 12.30	10.62 - 17.57	11.59 - 17	7.80 - 14	5.10 – 11.10	7 – 12.9	4.9 – 9.4
Conductivity (µS/cm)	139.13	63.13	102.93	69.00	118.13	56.45	62.33	59.93
	95 - 275	31 - 105	65 - 185	47 - 88	28 - 247	7.8 - 105	6 – 151	5 – 148
Chl a (µg/cm2)	1.74	1.93	9.51	1.17	2.47	0.61	0.75	0.42
	0.15 - 4.56	0.20 - 4.28	0.28 - 78.66	0.26 - 1.82	0.68 - 8.70	-0.01 – 4.23	0.02 – 3.20	-0.07 – 1.26
Moss cover (%)	3.85	13.03	1.50	0.58	10.18	1.78	12.48	3.98
	0 - 20	0.50 - 60	0 - 10	0 - 2	0.25 - 85	0 – 10	0.25 – 65	0 – 10
Substrate size index	116.41	186.08	130.31	131.84	172.39	160.61	159.84	142.84
	30.90 - 306.54	113.75 - 243.40	43.93 - 215.16	57.71 - 189.49	57.90 - 252.41	65.46 – 237.30	74.51 – 307.76	19.77 – 362.85
Riparian Integrity (%)	93.67	98.00	93.00	89.67	100.00	99.87	99	100
	65 - 100	75 - 100	50 - 100	50 - 100	100	98 – 100	90 – 100	100
% Canopy cover	67.33	74.92	65.32	62.27	59.67	31.33	50.35	48.25
	12.25 - 95.75	18.25 - 97.25	4.25 - 95.75	7.50 - 95.75	2.50 - 95.50	0 - 95	0 – 93.25	0 - 99

biomass was estimated by extracting photosynthetic pigments (chlorophyll-α and phaeophytin) with 90% acetone at 5 ºC selected stones collected along the sampling length of each site. Absorbance was read at 750, 665 and 664nm on a Varian Cary 50 Conc. UV-Visible spectrophotometer™ before and after 0.1 M HCL was added. Pigment concentration (μg cm^2) was calculated following Steinman & Lamberti (1996). Three stone dimensions were measured to approximate the surface area and then halved to correct for the stone surface area available for periphyton growth following the approach described by Graham et al. (1988).

2.3 Invertebrate data

All invertebrate samples were collected during the Austral summer between early February and mid April of 2006. At each site a 2-min kick-net sample (250-μm mesh) was taken to cover most of benthic microhabitats in a riffle section of approximately 100 m^2. Samples were collected by disturbing the substrate upstream of the net while moving across the width of the channel. Macroinvertebrates and associated materials were preserved in 70% isopropyl alcohol. Invertebrate samples were rinsed through 500-μm sieve in the laboratory to process thoroughly (without subsampling) and all the invertebrates were identified to the lowest possible taxonomic level (usually to species or genus level) by using existing keys (e.g. Winterbourn et al. 2006, Towns and Peters 1996, McFarlane 1990, Cowley 1978).

2.4 GIS data extraction

The upstream catchment, downstream and segment-scale environmental variables of climate, topography, geology and landcover associated with the study streams were obtained from a large suite of environmental variables used for the Freshwater Environments of New Zealand River Classification (FWENZ) (Snelder et al. 2005). The FWENZ dataset has been derived using the New Zealand river network that was originally developed for the River Environment Classification

(REC) (Snelder and Biggs 2002) from a 30-m pixel digital elevation model (DEM) using ArcINFO (ESRI, California, USA) hydrological processing routines. Each river segment (uniquely identified by an attribute called NZReach number) in the FWENZ dataset is defined by its confluence with an upstream and downstream river section (Snelder et al. 2005). The environmental variables derived for the FWENZ classification characterise the environment of (1) the upstream catchment of each river segment, (2) the local segment itself, and (3) the downstream river network between the segment and the river mouth (Wild et al. 2005).

2.5 Data analysis

In order to examine the patterns in community composition Nonmetric Multidimensional Scaling (NMDS) (Kruskal and Wish 1978) ordination procedure was performed in PRIMER 6 (PRIMER E Ltd. U.K.) software (Clark and Warwick 2001), using Bray-Curtis (BC) distance measure. NMDS was chosen because it is well suited to data that are non-normal or are on discontinuous scales, and because of its robustness with regard to the "zero truncation problem" (Beals 1984) which occurs in an ordination of heterogeneous data sets with large number of zeros (De Cacère and Legendre 2008). An important attribute of the Bray-Curtis measure of compositional distance is that sites are grouped on the basis of the species they have in common and the species that are absent at both sites have no influence on biological distance measures (Clarke & Warwick 2001). Prior to calculating biological distances $\sqrt[4]{}$-transformations was applied to the abundance data to down-weight dominant taxa and place greater emphasis on taxonomic diversity. After transformation, the abundance data was also standardised for each species by the total number of individuals to ensure equal contribution of all species to the final distance estimate.

Analysis of similarity (ANOSIM) was used to calculate the global (i.e., overall) average difference in compositional similarity taken across all the ecoregions (global *R*) and the average difference in compositional similarity between particular pairs of ecoregions (pairwise *r*). The global *R* statistic measures the average difference between biological distances of sites located in different regions and the biological distances of sites within the same ecoregion (Clarke and Warwick 2001). Therefore, global *R* compares the degree to which the sites within an ecoregion are biologically more similar to each other than the average levels of similarity occurring across the wider datasets. The global *R* has a value of 1 if sites within region are more similar to each other than to any site from other regions. It is 0 when there is no difference between the biological distances of sites within region and those of sites in contrasting regions. Taxa contributing to the differentiation among the sites were determined by using the similarity percentages (SIMPER) routine (Clarke 1993), in PRIMER (Clarke and Warwick 2001).

In order to choose the environmental predictors of macroinvertebrate community pattern from a large suite of variables measured at different spatial scales, Pearson's correlation coefficients (denoted by *r*) were computed between the individual variables and the NMDS axis scores. Also, Principal Component Analysis (PCA) was performed to reduce the dimensionality of the large number of variables and to identify the variables with maximum loadings on the principle components explaining most of the variation in the original dataset. Prior to the PCA, the environmental data was normalised. This was necessary as the variables were on different scales and arbitrary origin. Although canonical correspondence analysis (CCA) (ter Braak 1986) has often been used by ecologists to see how well a subset of environmental variables explain the observed biotic pattern, it has been avoided in my analysis as it is still based on a linear model of relationship between the response (e.g. species abundance) data and the explanatory (e.g. abiotic data) variables (Makarenkov and Legendre 2002). This assumption of linearity in the relationship between community structure and abiotic variables is in most instances unrealistic when modelling ecological processes. In order to assess relationships on a plot-by-plot basis between a set of habitat variables and community structure, here PRIMER's BIOENV routine was followed (Clarke & Ainsworth 1993) using the environmental variables correlated with the NMDS axis scores. This routine determines which combinations of habitat variables provide the best correlations between the similarity matrices of habitat data (by using Euclidean distance measures) and biotic data (by using Bray-Curtis distance measures). The degree of correlation between the matrices is indicated by a weighted rank correlation coefficient ρ_w that is analogous to the Spearman rank coefficient (Clarke & Ainsworth 1993).

3 RESULTS

3.1 Regional pattern in stream characteristics

There was considerable variation in instream physico-chemical and riparian characteristics both within and between ecoregions (Table 2.1). Principal Component Analysis (PCA) explained 68% of variation in the reach-scale environmental data. Stream temperature and percent canopy cover had the highest positive loadings, and average water velocity had the highest negative loading on the first principal component (see Table 2.2 for summary of the PCA). Thus, axis 1 separated most of the forested streams that fell within the 4 ecoregions of the North Island and the North-West Nelson Forest ecoregion from the fast flowing mountainous streams in the Westland Forest, High Country and Southern Alps of the South Island (Fig. 2.2). Furthermore, this component distinguished the streams with comparatively high water temperature in the Northern Hill Country, Taupo Plateau, and Central Mountains from the cold streams at higher elevation in the Mt Taranaki Forest, High Country, Westland Forest, and Southern Alps ecoregions. The second component was related to channel morphology and instream habitat characterisitcs, with high positive loadings for embeddedness of streambed and a high negative loading for percentage of moss cover (bryophytes). This component, however, didn't show any clear regional delineation.

Table 2.2. Summary of the principle component analysis (PCA) and loadings of the environmental variables on each component. The highest loading for each variable is shown in bold. PC = Principal component.

	PC1	**PC2**	**PC3**	**PC4**	**PC5**
Eigenvalue	2.97	2.07	1.86	1.48	1.13
Cumulative % Variance	21.2	36	49.3	59.9	68
pH	0.036	-0.196	-0.327	**0.447**	-0.277
Temperature	**0.385**	0.306	-0.144	0.048	0.288
Conductivity	0.336	-0.242	-0.258	**0.36**	0.072
Channel width	-0.218	0.364	**-0.409**	-0.049	0.117
Site elevation	-0.312	-0.243	-0.005	-0.025	**-0.569**
Slope	-0.311	-0.184	0.212	0.301	**0.432**
Avg depth	-0.32	0.153	**-0.462**	-0.113	0.148
Avg velocity	**-0.406**	-0.045	0.135	0.333	0.236
Avg large woody debris	0.009	0.195	-0.02	**-0.353**	0.054
Embededness	0.082	**0.436**	0.161	0.371	-0.06
% Moss cover	0.097	**-0.405**	0.096	-0.11	0.449
Substrate size	-0.267	-0.255	**-0.378**	-0.226	0.155
% Canopy cover	**0.326**	-0.297	-0.027	-0.293	-0.009
Mean Chlorophyll *a*	0.185	-0.115	**-0.428**	0.198	0.032

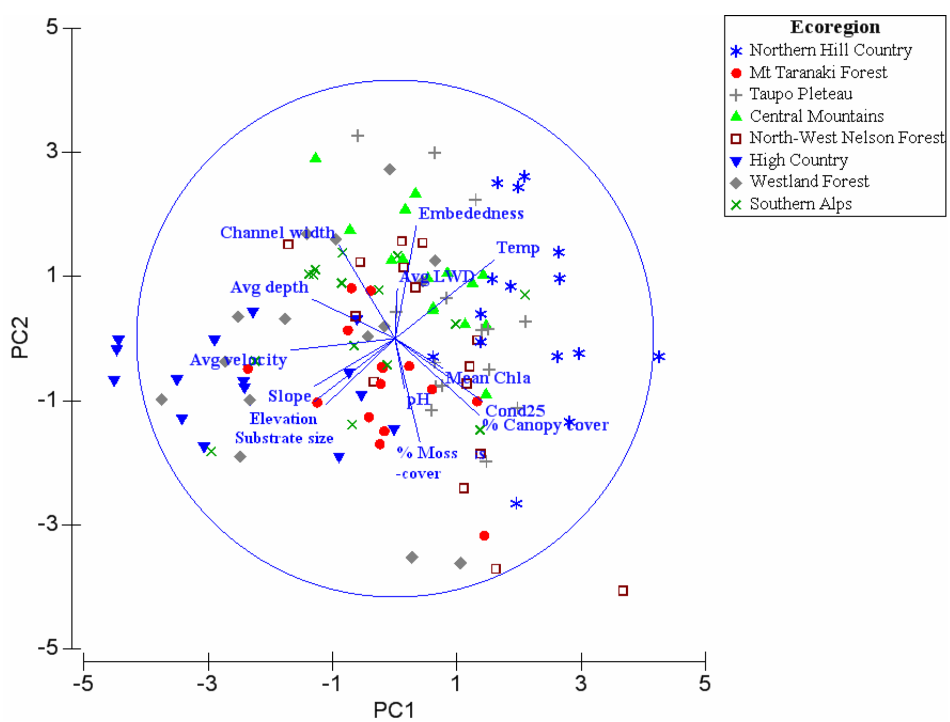


Fig. 2.2. Results of the Principal Component Analysis (PCA) performed on reach-scale measured variables. Cond25 = Stream conductivity, Temp = Temperature, Chla = Chlorophyll *a*, LWD = Large woody debris. PC = Principal component

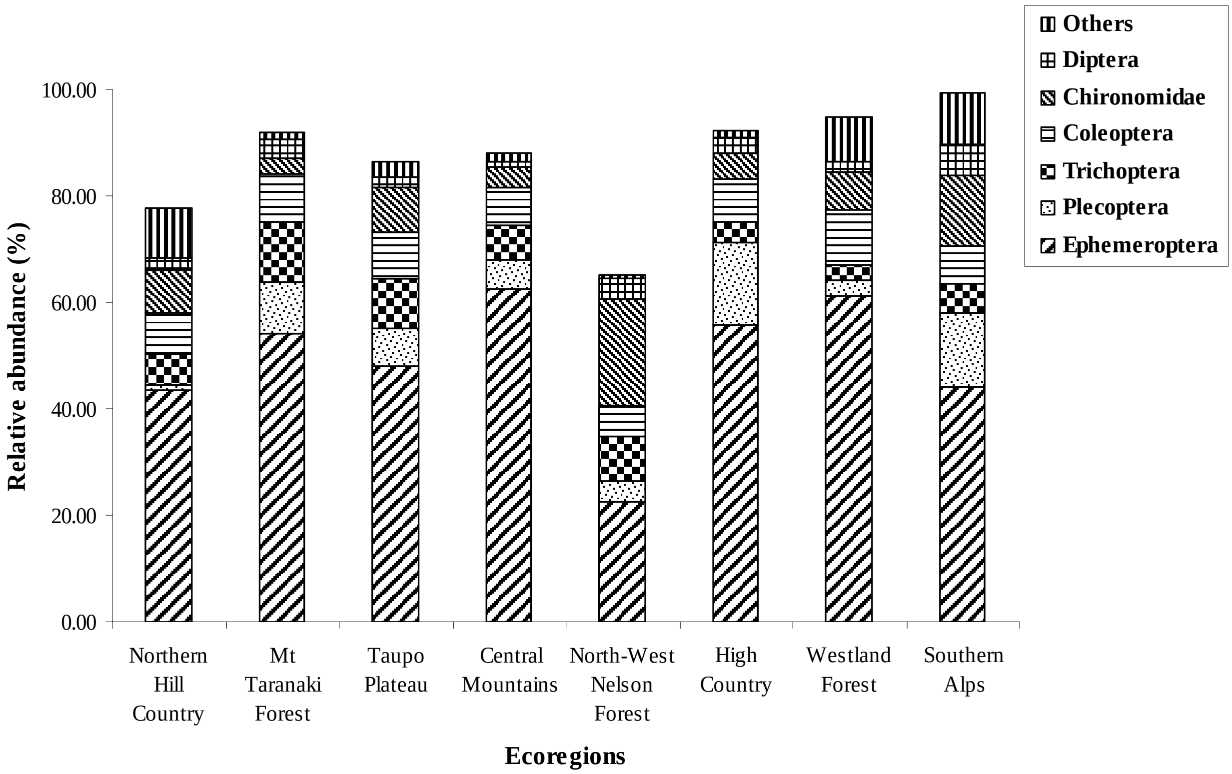
3.2 Spatial pattern in macroinvertebrate assemblage structures

Although a total of 138 stream invertebrate taxa were recorded from the study sites, the taxonomic richness ranged from 8 to 50 (mean = 8.27, SD = 8.27) per site. Two mayfly (*Deleatidium* spp. and *Nesameletus* spp.), and one stonefly taxa (*Zelandoperla* spp.), early instar larval stages of one caddisfly family (Hydrobiosidae), two beetle family (larval stage of Elmidae and adult stage of Hydraenidae), and one chironomidae taxa (*Cricotopus* spp.) were recorded at 80 to 90% of the sites. Among them *Deleatidium* spp. and Elmidae were the most abundant taxa, occurring with a mean relative abundance of 46% (ranging from 0 to 94%; SD = 25) of the macroinvertebrate community. Nine taxa (*Coloburiscus humeralis*, *Stenoperla prasina*, *Austroperla cyrene*, *Olinga spp.*, *Psilochorema spp.*, *Aphrophila spp.*, *Eriopterini spp.*, *Archichauliodes diversus,* and Chironominae) were recorded at 60 to 80% of the sites.

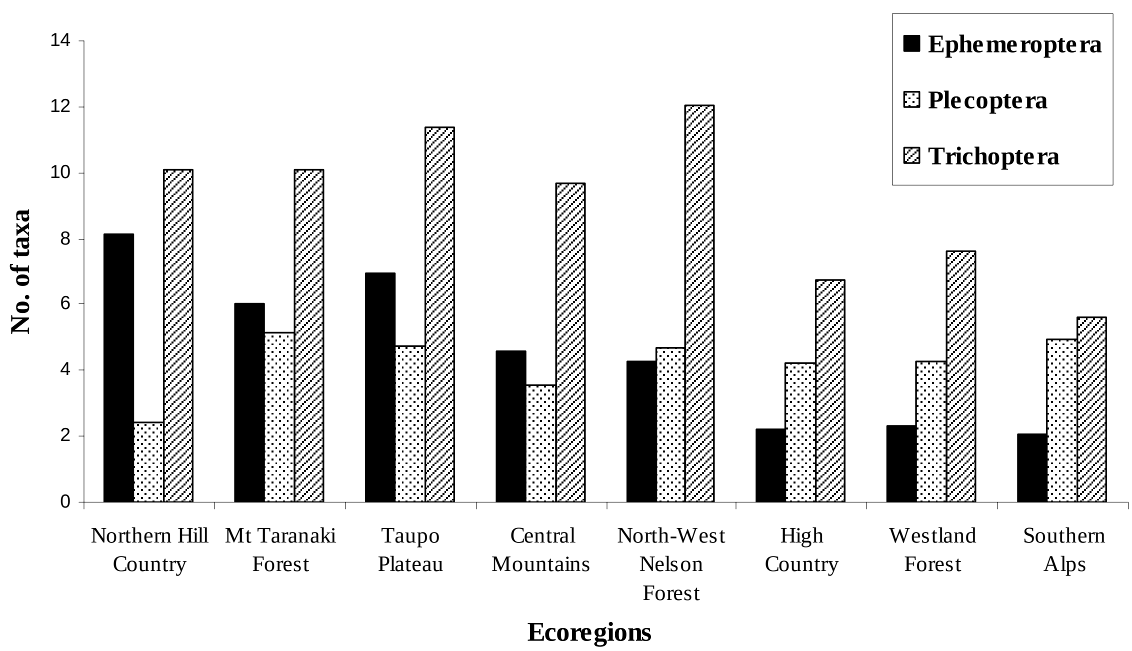
Although the variations in average EPT taxa richness and percent EPT among the 4 North Island regions and the Nelson region were marginal (SD = 1.89 and 3.27 respectively), local differences in EPT taxa richness and percent EPT were noticeable within each ecoregion (see Table 2.3). A gradual decrease in regional species richness of Ephemeroptera was observed along the North-South gradient, whereas the regional species richness of Trichoptera was quite uniform across the 4 ecoregions of North Island and the North-West Nelson Forest in South Island (Fig. 2.3b). Regional species richness of Plecoptera was quite uniform across all the 8 ecoregions in North and South Island. The relative abundance of Ephemeroptera was considerably high in Central Mountains, High Country, and Westland Forest, even though the Ephemeroptera taxa richness was low, indicating the high abundance of dominant mayfly taxa *Deleatidium* spp. in these regions. High species richness and low relative abundance of Ephemeroptera in the Northern Hill Country, and Taupo Plateau showed less dominance by *Deleatidium* spp. and coexistence of other less abundant mayfly taxa in these ecoregions (Fig. 2.3a).

Table 2.3. Summary statistics for the macroinvertebrate community metrices. LSR = Local species richness; RSR = Regional species richness; d = Margalef's species richness; J = Pielou's evenness; H'(log10) = Shannon Weiner diversity indices; 1-λ = Simpson's diversity indices.

	LSR	RSR	d	J'	H'(log10)	1 - λ	EPT richness	% EPT
Northern Hill Country		80						
Max	43		5.88	0.75	1.17	0.63	28	69.44
Min	23		3.11	0.51	0.72	0.90	13	47.50
Avg	35		4.71	0.65	1.01	0.83	21	58.90
SD	6		0.80	0.07	0.13	0.08	4	7.7
Mt Taranaki Forest		73						
Max	42		6.05	0.81	1.19	0.45	29	76.32
Min	14		2.31	0.30	0.38	0.90	7	47.37
Avg	31		4.48	0.64	0.96	0.79	21	66.22
SD	8		1.07	0.12	0.22	0.13	7	7.80
Taupo Plateau		83						
Max	48		6.55	0.79	1.34	0.54	28	72.22
Min	26		3.28	0.41	0.63	0.93	14	53.85
Avg	38		5.05	0.61	0.97	0.78	23	61.26
SD	5		0.86	0.11	0.20	0.12	4	5.80
Central Mountains		61						
Max	37		4.53	0.73	1.05	0.30	23	70.37
Min	15		2.68	0.23	0.31	0.87	8	53.33
Avg	28		3.60	0.48	0.68	0.60	18	63.76
SD	6		0.56	0.16	0.23	0.19	4	5.27
North-West Nelson Forest		97						
Max	50		6.02	0.77	1.15	0.71	30	71.88
Min	28		3.48	0.51	0.78	0.90	17	52.38
Avg	36		4.67	0.64	1.00	0.82	21	58.48
SD	6		0.81	0.07	0.10	0.06	3	5.00
High Country		79						
Max	41		5.98	0.77	1.24	0.45	19	65.38
Min	8		2.18	0.34	0.47	0.90	3	37.50
Avg	25		3.39	0.53	0.73	0.67	13	51.87
SD	9		1.09	0.14	0.22	0.14	4	7.72
Westland Forest		88						
Max	40		5.26	0.69	1.11	0.16	25	65.22
Min	11		1.60	0.17	0.20	0.89	5	45.45
Avg	27		3.65	0.42	0.60	0.53	14	51.86
SD	8		1.00	0.14	0.25	0.21	5	6.36
Southern Alps		74						
Max	40		5.37	0.78	1.13	0.37	21	55.26
Min	9		1.98	0.33	0.46	0.89	4	24.00
Avg	27		4.03	0.60	0.84	0.72	12	46.02
SD	9		1.04	0.12	0.18	0.13	5	8.00



(a)



(b)

Fig. 2.3. Regional delineation in (a) the relative abundances of major macroinvertebrate groups, and in (b) the species richness of Ephemeroptera, Plecoptera and Trichoptera.

Regional species richness (RSR) varied from 97 (North-West Nelson Forest) to 61 taxa (Central Mountains). Mean local species richness (LSR) varied from 25 (High Country) to 38 taxa (Taupo Plateau) with a considerable amount of variation in within-ecoregion LSR (see Table 2.3). There was no significant relationship between RSR and mean LSR (R^2 = 0.18, P > 0.05) and also between RSR and minimum LSR (R^2 = 0.23, P > 0.05). However, RSR was significantly related to maximum LSR (R^2 = 0.58, P = 0.03) (Figure 2.4).

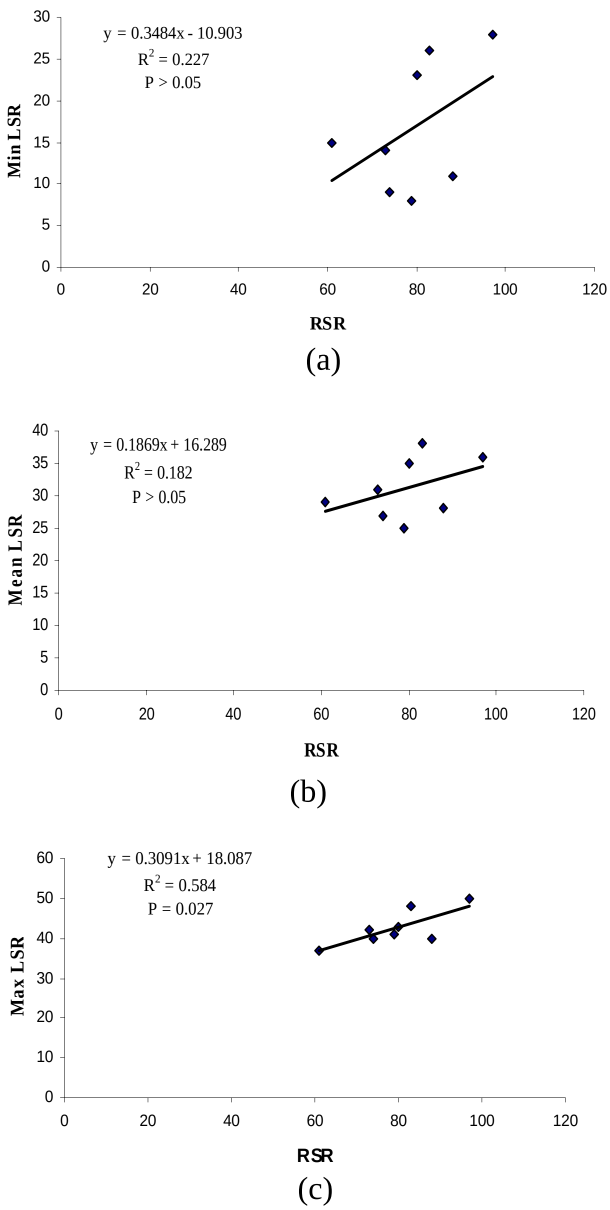


Fig. 2.4. Relationships between local (LSR) and regional (RSR) species richness of stream invertebrates. LSR = total number of taxa recorded from individual site, RSR = total number of taxa recorded from the whole region. LSR is represented by the (a) maximum, (b) minimum, and (c) mean values for each region. Solid lines represent the associated regression equation.

3.3 Multivariate analyses

An optimal non-metric multidimensional scale (NMDS) ordination (two dimensional) with the lowest stress value (stress value = 0.19) was obtained by using the $\sqrt[4]{}$-transformed abundance data standardised by the total number of individuals. Though sites did not form separate clusters on the NMDS ordination plot, most of the sites within each ecoregion grouped together on the ordination (Figure 2.5a). Pair-wise ANOSIM test showed that all the 4 North Island regions and Nelson in the South Island were significantly different from each other. Differences in community structure were very marginal (pairwise *r* varied from 0.128 to 0.168) among the High Country, Westland Forest, and Southern Alps. However, the invertebrate community structures of these three ecoregions in the South Island were significantly different from those of the four ecoregions in the North Island and also to that of the North-West Nelson Forest (Table 2.4).

Table 2.4. Results of pairwise analysis of similarity (ANOSIM) test performed on 8 classes of Ecoregion classification system.

	Northern Hill Country	Mt Taranaki Forest	Taupo Plateau	Central Mountains	North-West Nelson Forest	High Country	Westland Forest	Southern Alps
Northern Hill Country		0.533	0.344	0.483	0.537	0.719	0.727	0.706
Mt Taranaki Forest	0.533		0.377	0.519	0.645	0.657	0.576	0.65
Taupo Plateau	0.344	0.377		0.445	0.472	0.618	0.567	0.587
Central Mountains	0.483	0.519	0.445		0.568	0.571	0.52	0.616
North-West Nelson Forest	0.537	0.645	0.472	0.568		0.489	0.481	0.472
High Country	0.719	0.657	0.618	0.571	0.489		0.168	0.128
Westland Forest	0.727	0.576	0.567	0.52	0.481	0.168		0.103
Southern Alps	0.706	0.65	0.587	0.615	0.472	0.128	0.103	

Note: Pairwise *r* statistics calculated for each pair of classes are shown. Significance level % (P value) for pairwise *r* statistic calculated for each pair of classes is 0.001except for the pairs High Country & Westland Forest and High Country & Southern Alps where the P values are 0.007 and 0.006 respectively. Here ANOSIM is based on standardised $\sqrt[4]{}$-transformed abundance data which was then standardised by the total number of individuals for each species.

3.4 Correspondence of enviromental variables to macroinvertebrate assemblage patterns

Correlation of the NMDS axis scores with all the measured riparian and instream physical characteristics of the study sites identified water temperature (r = 0.60), velocity (r = 0.49), percent canopy cover (r = 0.46), conductivity (r = 0.40), elevation (r = 0.34) and slope (r = 0.33) as having the significant relationship with the axis1 scores. Only a few variables (percent moss cover, channel width, conductivity and reach elevation) were weakly correlated with NMDS axis2 scores. Among all the diversity measures LSR, EPT taxa richness, Margalef's diversity, and Shannon Weiner diversity were significantly correlated to water temperature, stream velocity, conductivity, and percent canopy cover (see Table 2.5), although none of these variables were able to explain more than 20% of variation in these community measures. The BIOENV routine showed that the combination (Spearman's ρ = 0.39) of measured variables, which explained best the biological distances among the sites, included water temperature, reach elevation, stream velocity, percentage of moss cover and canopy cover (see Table 2.6 for the summary of BIOENV routine & Fig. 2.5d).

Of all the upstream catchment-scale measures of GIS variables associated to the study streams, factors related to upstream climatic conditions (e.g. mean July and January air temperature, annual rainfall, solar radiation in summer and winter) and topographic features (e.g. proportion of catchment with a slope greater than 30º, average catchment slope and elevation were strongly associated (r varied from 0.48 to 0.73) with the NMDS axis scores. Also the upstream land cover variables like proportion of catchment covered with indigenous forest (r = 0.56), tussock (r = 0.48), exposed rocks or bare ground (r = 0.53) were associated to NMDS axis1 scores. Although three variables (percent of catchment area with tussock cover and catchment solar radiation in summer and winter) were correlated with NMDS axis 2 scores, their correlations with the axis 2 scores were not very strong (see Table 2.5 for summary of the correlations). Combinations (5 variables to the most at a time) of the upstream catchment-scale variables, which had the best relationship (global value of Spearman's ρ = 0.55, BIOENV routine) with the biological resemblance matrix, included the following variables: proportion of catchment area with slope greater than 30º, percentage of catchment covered with indigenous forest, tussock and bare ground, annual potential evapo-transpiration of catchment, average air temperature of catchment in the warmest month, and catchment solar radiation in summer and winter (see Table 2.6 & Fig. 2.5b).

The segment-scale variables which were significantly associated to the NMDS axis1 scores were the factors related to segment geomorphology (e.g. average segment slope, average segment elevation) and segment climate (e.g. average within segment minimum air temperature in summer, current wintertime equilibrium temperature, segment solar radiation in summer). None of the segment landcover variables (e.g. percentage of riparian area with indigenous forest cover) were found to have significant correlation with the NMDS axis scores (see Table 2.5 for the summary of correlations). Combinations of the segment and downstream variables, which were identified as having the best relationship (Spearman's ρ = 0.51, BIOENV routine) with the macroinvertebrate assemblage pattern, included segment solar radiation in summer and winter, mean January air temperature within segment, proportion of segment covered with bare ground, average elevation of segments, and downstream slope based on 30 m DEM grid (see Table 2.6).

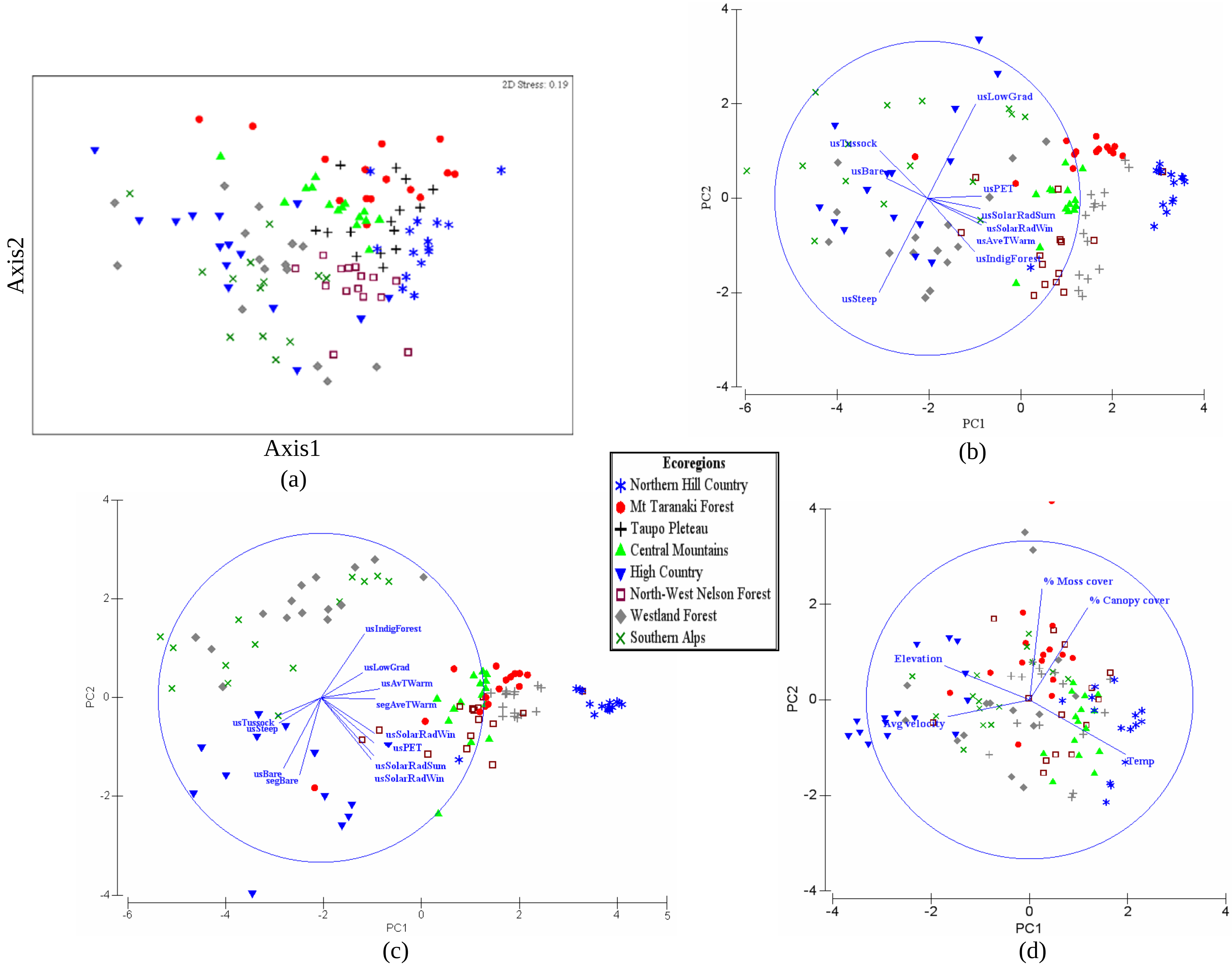


Fig. 2.5. (a) NMDS ordination of the study sites based Bray Curtis distance measures from $^4\sqrt{}$-transformed abundance data; and results of the Principal Component Analysis (PCA) on the (b) catchment-scale; (c) combination of catchment and segment-scale; and (d) reach-scale environmental factors best matching the biotic pattern of the study sites.

Table 2.5. Correlations (Spearman's coefficient) between the environmental variables at three spatial scales (upstream catchment, segment, and reach-scale) and the invertebrate community metrices as well as the NMDS axis scores. Here, only those variables, which were included in the best combinations by the BIOENV routine, were shown. Significant ($P < 0.001$) correlations were shown in bold. LSR = Local species richness; d = Margalef's species richness; J' = Pielou's evenness; H'(log10) = Shannon Weiner diversity indices; 1-λ = Simpson's diversity indices. us = Upstream; seg = Segment; ds = Downstream; SolarRadSum/ Win = Solar radiation in summer/ winter; AvTWarm = Mean July temperature; PET = Potential evapotranspiration. See the appendix of Wild et al. (2005) for the full list of FWENZ (Freshwater Environments of New Zealand River Classification) variables at catchment and segment and downstream-scale.

Catchment-scale variables	NMDS axis1	NMDS axis2	LSR	d	J'	H'(log10)	**1 - λ**	Relative Abundance			EPT taxa richness	% EPT
								Ephemeroptera	Plecoptera	Trichoptera		
usLowGrad	**0.567**	-0.150	**0.348**	**0.401**	**0.294**	**0.373**	**0.338**	-0.037	0.038	**0.209**	**0.467**	**0.416**
usBare	**-0.530**	-0.160	**-0.446**	**-0.383**	0.027	-0.172	-0.065	0.042	**0.343**	**-0.239**	**-0.473**	**-0.324**
usIndigForest	**0.557**	-0.033	**0.434**	**0.374**	-0.034	0.147	0.060	-0.022	**-0.389**	**0.227**	**0.499**	**0.371**
usSteep	**-0.567**	0.150	**-0.348**	**-0.401**	**-0.294**	**-0.373**	**-0.338**	0.037	-0.038	**-0.209**	**-0.467**	**-0.416**
usTussock	**-0.479**	**0.314**	**-0.288**	**-0.250**	-0.083	-0.174	-0.131	-0.001	**0.372**	**-0.232**	**-0.418**	**-0.416**
usAvTWarm	**0.727**	-0.122	**0.471**	**0.416**	**0.228**	**0.359**	**0.297**	-0.152	**-0.475**	**0.449**	**0.565**	**0.442**
usPET	**0.667**	-0.100	**0.467**	**0.410**	**0.338**	**0.436**	**0.403**	**-0.222**	**-0.194**	**0.475**	**0.546**	**0.413**
usSolarRadSum	**0.691**	**-0.309**	**0.455**	**0.406**	**0.390**	**0.476**	**0.441**	**-0.214**	**-0.206**	**0.487**	**0.613**	**0.554**
usSolarRadWin	**0.689**	**-0.279**	**0.419**	**0.372**	**0.312**	**0.404**	**0.365**	-0.148	**-0.381**	**0.435**	**0.563**	**0.500**
Segment-scale variables												
segBare	**-0.361**	-0.014	**-0.292**	**-0.293**	-0.056	-0.171	-0.088	0.037	**0.273**	-0.153	**-0.315**	**-0.221**
segAveTWarm	**0.661**	-0.135	**0.409**	**0.326**	0.170	**0.283**	**0.220**	-0.137	**-0.515**	**0.478**	**0.482**	**0.364**
segSolarRadSum	**0.667**	**-0.317**	**0.438**	**0.385**	**0.386**	**0.465**	**0.431**	**-0.212**	**-0.195**	**0.492**	**0.595**	**0.539**
segSolarRadWin	**0.689**	**-0.280**	**0.418**	**0.371**	**0.310**	**0.402**	**0.364**	-0.146	**-0.381**	**0.433**	**0.563**	**0.502**
dsMaxSlope_Grid	**-0.553**	0.120	**-0.322**	**-0.336**	-0.147	**-0.254**	**-0.193**	0.034	**0.280**	**-0.236**	**-0.377**	**-0.276**
segAveElev	**-0.377**	-0.083	**-0.241**	-0.171	0.000	-0.088	-0.028	0.121	**0.483**	**-0.338**	**-0.222**	-0.101
Latitude	**0.699**	**-0.330**	**0.385**	**0.357**	**0.295**	**0.381**	**0.340**	-0.084	**-0.362**	**0.367**	**0.544**	**0.516**
Reach-scale measured variables												
Temperature	**0.602**	-0.148	**0.351**	**0.265**	0.117	**0.215**	-0.166	-0.119	**-0.503**	0.124	**0.433**	**0.355**
Conductivity	**0.399**	**0.219**	**0.376**	**0.342**	**0.237**	**0.328**	**-0.300**	**-0.323**	**-0.220**	**-0.207**	**0.313**	0.060
Elevation	**-0.340**	**-0.180**	**-0.251**	-0.173	0.013	-0.082	0.032	0.179	**0.448**	-0.042	**-0.207**	-0.067
Current velocity	**-0.487**	0.121	**-0.304**	**-0.369**	**-0.430**	**-0.449**	**0.427**	**0.276**	0.170	**0.246**	**-0.388**	**-0.293**
% moss cover	**0.203**	**0.252**	**0.204**	**0.255**	**0.202**	**0.238**	**-0.210**	**-0.266**	-0.012	**-0.222**	0.128	-0.034
% Canopy cover	**0.462**	0.071	**0.353**	**0.467**	**0.286**	**0.374**	**-0.274**	-0.176	-0.113	**-0.333**	**0.366**	**0.195**

Most of these segment and catchment-scale variables, which had the best relationship with the biological resemblance matrix, were also found to have significant relationship with LSR, EPT taxa richness, percent of EPT, Margalef's, Shannon-Weiner's, and Simpson's diversity indices (Table 2.5). Correlation between EPT taxa richness and the segment and catchment-scale variables were stronger than those observed for any other diversity indices. EPT taxa richness was positively correlated with the proportion of catchment under indigenous forest cover (r = 0.50), the catchment and segment average air temperature in the warmest month, the catchment and segment solar radiation in summer and winter, and the potential evapo-transpiration of catchment, whereas it was negatively correlated with the proportion of catchment with tussock and bare ground, and proportion of catchment with slopes greater than 30º. Relative abundance of Plecoptera had a negative relationship with the proportion of catchment with indigenous forest cover, the catchment and segment average air temperature in the warmest month, whereas it had a positive relationship with the average elevation of segments (Table 2.5). The relative abundance of Trichoptera had a positive relationship with the catchment and segment solar radiation in summer and winter, and the catchment and segment average air temperature, whereas it had a negative relationship with the average elevation of segments. None of the variables had a strong relationship with the relative abundance of Ephemeroptera (Table 2.5).

Combination of a set of upstream and segment variables, which were identified by the BIOENV analyses as having best relationships with the biota, included proportion of catchment under indigenous forest cover, tussock land, and exposed bare rock, proportion of catchment with a slope greater than 30º, mean January air temperature within catchment and segment, catchment and segment-scale solar radiation during summer and winter, and potential evapo-transpiration within catchment (Spearman's ρ = 0.57, P = 0.001). However, correlation between the environmental resemblance matrix of the study sites based on Euclidean distance measures of the FWENZ segment variables and the biological resemblance matrix based on Bray-Curtis distance measures of $\sqrt[4]{}$-transformed abundance data dropped to 0.47 (P = 0.001), indicating stronger influence of the catchment level gradients on spatial variation in stream biota distribution than the variables associated with segments (see Table 2.6 for the summary of BIOENV routine).

Table 2.6. Results of the BIOENV routine performed on environmental variables measured at three different spatial scales (catchment, segment and reach-scale). The 'Best' combination (obtained from BIOENV routine) of catchment and segment-scale variables are also shown here. us = Upstream; seg = Segment; ds = Downstream; SolarRadSum/ Win = Solar radiation in summer/ winter; AvTWarm = Mean July temperature; PET = Potential evapo-transpiration; AveElev = Average elevation; Grad = Gradient. For detailed description of the FWENZ variables see Wild et al. 2005.

Saptial scale	**Combination of variables**	**Spearman rank correlation (ρ)**
Catchment	usLowGrad, usBare, usIndigForest, usSteep, usTussock, usAvTWarm, usPET, usSolarRadSum, usSolarRadWin,	0.55
Segment	segBare, segAveTWarm, segSolarRadSum, segSolarRadWin, dsMaxSlope_Grid, segAveElev	0.51
Reach	Water temparature, reach elevation, stream velocity, percent moss cover, percent canopy cover	0.39
Catchment and Segment	usIndigForest, usTussock, usBare, usLowGrad, usAvTWarm, usSolarRadSum, usSolarRadWin, usPET, segAveTWarm, segSolarRadSum, segSolarRadWin	0.57

4 DISCUSSION

4.1 Spatial pattern in macroinvertebrate assemblages

My finding, that all the study streams were dominated by a common core group of invertebrate taxa regardless of the type and percentage of riparian vegetation, was similar to those of previous studies on unmodified New Zealand rivers (Winterbourn et al. 1981; Quinn & Hickey 1990). Although the species constituents of this common core of invertebrate taxa in my study were almost the same with those found by Quinn & Hickey (1990), my list of core invertebrates included three more nonchironomid taxa, the stonefly *Austroperla cyrene*, beetle larvae Elmidae, and the adult beetle Hydraenidae. High growth of periphyton biomass resulting from increasing bed stability and retention of woody detritus might have contributed to the occurrence of the beetle larvae, Elmidae (Harding and Winterbourn 1995; Quinn et al. 1997) as the second most common species after *Deleatidium* in most of the study streams. Previous study (e.g. Death 2000) shows the preference of finer substrates by Elmidae. The lack of a strong correspondence between environmental gradients and the invertebrate community patterns was possibly due to the presence of a common core group of invertebrate taxa in high abundance throughout the study sites. According to Winterbourn et al. (1981), and Thompson and Townsend (2000) stream invertebrate communities in New Zealand are characterised by their lack of food specialisation and generalist strategy in habitat preference, which allows for the successful colonisation of the core group of invertebrate taxa in almost all unmodified streams. I found that it was not the presence or absence but the variation in abundance of the constituent species of this common invertebrate group, which contributed to the among-region difference in community structure in the forested headwater streams (see Appendix 3).

As most (about 75%) of my study reaches from the North Island and North-West Nelson Forest in the South Island were located in low gradient small forested streams, retention of terrestrial allochthonous inputs (leaf litters and large woody debris) as well as periphyton biomass was considerably high in most of these streams, which resulted into high diversity of Ephemeroptera and Trichoptera as well as overall species richness in these sites. Minkley (1963), Cowie (1980), Winterbourn et al. (1981), Death (1995), Death (2000) suggested that high faunal diversity is associated with more stable stream channels exhibiting high degree of substrate heterogeneity. High retention of terrestrial inputs in these forested headwater streams might also be the reason behind why shredder species like the stonefly taxa *Austroperla cyrene*, *Zelandobius*, and the adult beetle Hydraenidae (Parkyn and Winterbourn 1997) were common in most of my study sites. The occurence of obligate shredders (e.g. *Triplectides obsoletus*, *Oeconesus similis*, *Zelandopsyche ingens*) at a limited number of sites (only at 10% of the study sites) was quite similar to the findings of previous studies by Rounick & Winterbourn (1983), and Quinn & Hickey (1990), who claimed that shredders are poorly represented in New Zealand stream invertebrate community even in forested headwater streams. Interestingly, taxa richness of Plecoptera was almost the same in each ecoregion except it was comparatively low in Northern Hill Country because of the warm climate, as stoneflies are adapted to cool climates (Hynes 1976, Cowie 1983).

Comparatively low diversity of Ephmeroptera and Trichoptera in the High Country, Westland Forest, and Southern Alps of South Island could be explained from the fact that most of the study reaches in these regions were in steep montane tributaries characterised by high stream velocity, discharge of variable amount of erodable substrates, and also less retention of terrestrial organic inputs (Suren & Winterbourn 1991). In the past several studies

(Death 1996, Townsend et al. 1997) on the effect of bed-disturbance regime on species composition and richness have shown that species richness declines with increasing bed-disturbance.

Although, upstream catchments of the study streams in the Southern Alps and Westland Forest ecoregions were mostly under the indigenous forest cover or tussock, macroinvertebrate community composition of these two ecoregions were quite similar to those observed in the high altitude streams of the High Country (see Table 2.4 and Appendix 3), the upstream catchment and segment-scale landcover of which were mostly bare grounds with exposed rocks. So it is possible, that the biogeographic pattern in species distribution between the North and the South Islands combined with the low catchment temperature, steep terrain and low retention of organic inputs by the stream-beds were responsible for the less diverse Ephemeroptera and Trichoptera groups in these regions. High abundance but low species richness in Ephemeroptera group in these three regions of the South Island reflected the dominance of the highly abundant and generalist mayfly *Deleatidium* spp.

The strong latitudinal gradient in catchment and segment scale climatic conditions (e.g. solar radiation, mean air temperature in summer and winter) as well as in macroinvertebrate assemblage pattern (biological distance measures among the study sites) suggest the strong influence of geographic stratification in the biotic pattern of headwater streams. However, the dominance of a common group of invertebrate taxa across the headwater streams and the mixing of taxa with differing biogeographical patterns may be the reasons for not having a strong latitudinal gradient in macroinvertebrate diversity measures of my study sites.

The LSR as well as the EPT taxa richness of my study sites showed a wide among-stream variation within each ecoregion, suggesting that even in diverse regions some local habitats provide conditions that restrict the type and number of taxa able to colonise under such circumstances. It is not clear whether the significant relationship between RSR and maximum LSR in my study suggests that the upper limit of macroinvertebrate diversity in headwater streams depends on regional species pool (Heino et al. 2003), or whether it actually mirrors the feedback effects of variation in LSR across the region on RSR. Previous studies (Townsend et al. 1983, Malmqvist & Mäki 1994) demonstrated that even the neighbouring streams with differing environmental conditions may have considerably different macroinvertebrate communities. Allan (1995) found that often ≤ 50% of the regional species pool is found at any sampled site. Environmental filters at different spatial scales may, therefore, influence the probability that certain species of the regional species pool are able to colonise in a local assemblage (Poff 1997).

4.2 Correspondence of environmental gradients to macroinvertebrate assemblage patterns at different spatial scales

Local environmental conditions of streams are generally controlled by large-scale climatic, topographic and land-cover regimes. For example, several studies (e.g. Storey & Cowley 1997, Scarsbrook & Halliday 1999, Harding et al. 2006, Death & Collier 2008 in press) in the past have shown that upstream catchment vegetation is more strongly associated with the compositional pattern of microinvertebrate community than the riparian vegetation. In my study, upstream catchment scale variables exhibited stronger relationship with the variation in macroinvertebrate assemblage pattern among the study sites than the segment scale measurements of the same variables. The instream physicochemical factors and riparian characteristics measured from the study reaches had the least association with the spatial pattern of macroinvertebrate assemblages.

For example, catchment level topographic features (e.g. the upstream catchment elevation and the proportion of catchment with steep gradient) and landcover variables (e.g. proportion of catchment with indigenous forest cover, tussock and bare ground) had stronger association with the community assemblage pattern compared to the segment level measurements of these variables. The only segment level factors which were related to the stream invertebrate community were the seasonal variation in solar radiation and air temperature. Interestingly, the segment-scale average air temperature was not significantly correlated with the segment scale measurement of indigenous forest cover but it was positively related to the upstream catchment scale indigenous forest cover. However, several authors (Poff and Allan 1995, Lammert & Allan 1999) have highlighted how the scale of investigation (spatial extent of sampling) influences the relationship between predictive variables and biotic community, such that studies of greater spatial extent, like this one, are more likely to yield stronger links between catchment scale than local scale variables and stream invertebrate communities.

I found, that a combination of catchment and segment-scale variables had a stronger link with the invertebrate community than the individual variables. Clarke and Warwick (2001) suggested that a single environmental variable can not be expected to explain successfully the faunal composition pattern where the community composition is not essentially one-dimensional. This is because the streams are extremely heterogeneous environments and the organisms typically exhibit aggregated distribution across this spatially variable landscape but with differential responses to individual environmental gradients (Murphy et al. 1998). For example, I found that the relative abundance of Trichoptera increased with the increase in catchment and segment scale measurements of solar radiation, and mean July temperature, which were in turn positively associated with the proportion of upstream catchment with indigenous forest cover, whereas that of Plecoptera exhibits an opposite pattern. Although the combination of catchment-scale environmental factors were more capable of distinguishing the regional pattern in community assemblage structure than the segment-scale or reach-scale variables, combinations of the local scale factors (reach scale measurements of stream habitats and riparian characteristics), like stream velocity, stream temperature, reach elevation, percentage of bryophytes and canopy cover, were also able to determine the regional pattern in macroinvertebrate composition to some extent. This finding of my study suggests that the stream communities are structured by the processes at multiple spatial scales (Minshall 1988, Poff 1997), which is reflected in within-region variation in local assemblages.

4.3 Implications for biomonitoring

As unmodified headwater streams support the natural distribution of stream biota, data from this study, from the bioassessment perspective, provides a reference condition. From the strong congruence of upstream catchment-scale factors with the regional pattern in macroinvertebrate assemblage structure, it seems that landscape classifications, such as ecoregions (Harding & Winterbourn 1997) could provide a preliminary stage for bioassessment programs at national scale. However, this finding does not diminish the importance of stream segment and reach-scale factors which produce considerable variation in local species richness and abundance within ecoregions. For example, I found that the reach-scale canopy cover was as important as the catchment-scale measurement of the forest cover in determining the variation in macroinvertebrate compositional pattern, which illustrates terrestrial-aquatic linkages as well as a closer association of headwater streams with their surrounding landscape features. Therefore, even though regional delineations are useful to provide a base for stream bioassessment programmes, but such delineations should be used in combination with local (reach-scale instream and riparian) characteristics.

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GENERAL CONCLUSION

The results of my study showed that the classification performance of the FWENZ was optimum at FWENZ 100 class level, while that of the REC was optimum at the Geology level. As the New Zealand rivers and streams are grouped at a larger spatial scale (56 classes) by the REC Geology level than the FWENZ 100 class level, FWENZ 100 class was able to discriminate the biological variation of the study sites at a finer spatial scale than the REC Geology level. Also the FWENZ could better explain the local differences in community composition along with the influence of regional species pool on local species richness. Although the classification performance of the FWENZ 100 class level was, to some extent, influenced by the biogeographic pattern in species distribution between the North and South Island and also by the occurence of a core group of dominant taxa through out the study areas, between-class variation in species abundances was obvious at this classification level. This leads me to suggest that FWENZ 100 level should be used as an optimal spatial framework for environmental assessment and conservation management at national scale.

Better correspondence of macroinvertebrate assemblages to ecoregions in comparison to the other two river environment classifications (FWENZ and REC) could be explained from the strong congruence of upstream catchment-scale factors with the spatial pattern in macroinvertebrate community structures. Also the geographically extensive biological dataset (which was purposefully aimed at covering the whole length and breadth of New Zealand as much as possible) used in this study and the biogeographic pattern between the North and South Island of New Zealand may partly account for this strong performance by ecoregions. However as the study sites fell under only 8 ecoregions, there was little opportunity for the ecoregion approach to distinguish the fine scale (local) macroinvertebrate assemblage patterns observed across the study sites. Results from the Chapter 2 showed that despite the strong influences of cathment-scale factors on macroinvertebrate communities, local factors like water temperature, stream velocity, reach elevation, percent canopy cover and percent moss cover were also involved in explaining the within-region variation in assemblage patterns, which indicated the importance of regional as well as local factors in determining the organisation of stream invertebrate communities at multiple spatial scales (Fig. 2.6). Therefore, even though regional delineations are useful to provide a base for stream bioassessment programmes, but such delineations should be used in combination with local (reach-scale instream and riparian) characteristics. Better performance by the ecoregion approach at the bigger scale leads me to suggest that it would be worthwhile extending it to a finer scale by using the local-scale predictors of community assemblage pattern and to see if it performs better than the FWENZ or REC at that level.

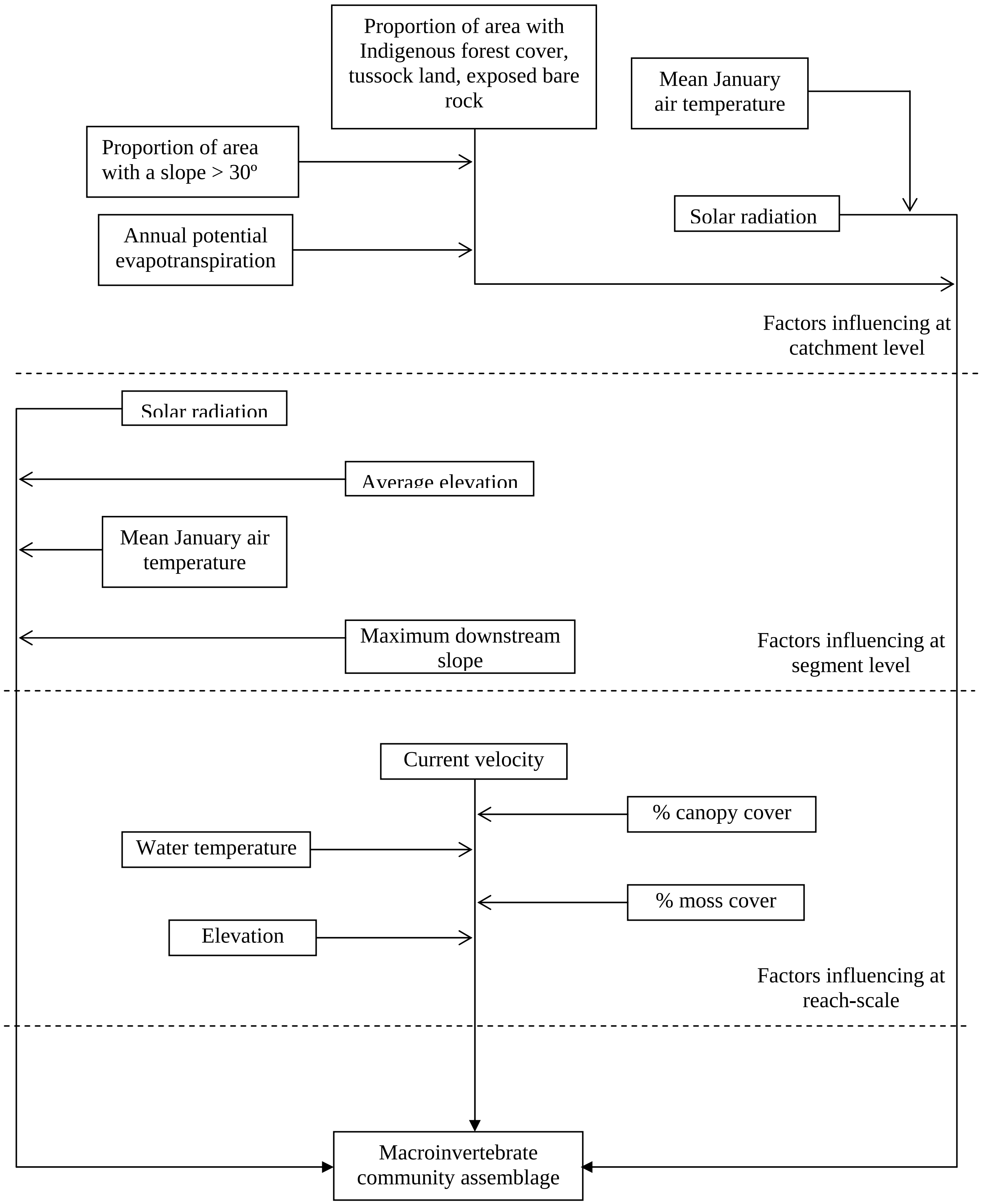

Fig. 2.6. Combinations of environmental variables influencing macroinvertebrate community structure at multiple spatial scales.

APPENDIX

Appendix 1. Ecoregion, REC and FWENZ class memberships of the study reaches

SITE	EASTING	NORTHING	NZREACH No.	Ecoregion	Climate	REC Source of Flow	REC Geology level	REC Landcover	REC Network Position	FWENZ 20 class level	FWENZ 50 class level	FWENZ 100 class level	FWENZ 150 class level	FWENZ 300 class level	FWENZ 200 class level
2Anna	2699328	6035272	9003726	Central Mountains	CW	CW/L	CW/L/HS	CW/L/HS/P	CW/L/HS/P/LO	8	25	53	84	153	47
Anna's Stm	2724535	6040856	9002255	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	8	25	53	84	153	47
Avalanche stream	2392599	5806431	13025885	High Country	CX	CX/M	CX/M/HS	CX/M/HS/T	CX/M/HS/T/LO	10	29	64	104	183	184
Beecham creek	2462735	6038824	10002695	North-West Nelson Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	1	3	5	6	12	138
Black river	2257024	5740465	12045603	Westland Forest	CX	CX/L	CX/L/Al	CX/L/Al/IF	CX/L/Al/IF/MO	7	23	50	81	148	155
Border stream	2254796	5735695	12046007	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	67	108	194	144
Broken creek	2270062	5741482	12045495	Westland Forest	CX	CX/M	CX/M/HS	CX/M/HS/T	CX/M/HS/T/LO	11	31	68	110	198	167
Brown trib	2462353	6038867	10002513	North-West Nelson Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	1	3	5	6	12	138
Bruce trib	2398233	5796118	13029344	High Country	CW	CW/M	CW/M/HS	CW/M/HS/T	CW/M/HS/T/LO	8	25	54	87	159	115
Caution creek	2269702	5741766	12045412	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	68	110	197	158
Cobb river	2476595	6009190	10007493	North-West Nelson Forest	CX	CX/M	CX/M/HS	CX/M/HS/IF	CX/M/HS/IF/MO	10	30	65	106	190	216
Cold Stream	2597709	6202769	6008378	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	6	15	23	41	79
Conor creek	2474092	5971855	10017159	North-West Nelson Forest	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/LO	8	27	58	92	167	116
Cow Pasture stream	2729364	6051530	7048716	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	8	25	53	84	153	47
Craigieburn stream	2408198	5784519	13033093	High Country	CW	CW/M	CW/M/HS	CW/M/HS/B	CW/M/HS/B/MO	10	30	65	105	185	206
Craigieburn trib	2407706	5783626	13033461	High Country	CW	CW/H	CW/H/SS	CW/H/SS/T	CW/H/SS/T/LO	10	30	65	105	186	194
Crashed Aircraft	2729429	6051515	7048845	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	9	28	62	98	176	280
Crusher Stream	2611253	6211968	6006600	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/P	CX/H/VA/P/LO	5	20	42	71	126	73
Devils Creek	2711825	6018859	9007544	Central Mountains	CX	CX/L	CX/L/HS	CX/L/HS/S	CX/L/HS/S/LO	1	7	16	24	42	55
Devil's Punchbowl stream	2392711	5807211	13024986	High Country	CX	CX/M	CX/M/HS	CX/M/HS/B	CX/M/HS/B/LO	10	29	64	104	183	184
Dry stream	2405684	5771331	13037183	High Country	CW	CW/M	CW/M/HS	CW/M/HS/B	CW/M/HS/B/LO	10	30	65	105	185	135
Education Lodge Stm	2870479	6308827	4020417	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/MO	1	9	19	30	58	107
Ford Stm	2869857	6313266	4019391	Taupo Plateau	CX	CX/L	CX/L/VA	CX/L/VA/IF	CX/L/VA/IF/LO	1	9	19	30	58	107
Fossil Creek	2463438	6039775	10002324	North-West Nelson Forest	CX	CX/L	CX/L/HS	CX/L/HS/IF	CX/L/HS/IF/LO	8	25	54	86	156	111
Fox river trib	2269526	5742899	12045251	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	68	110	197	158
Granity Creek	2474010	5970720	10017470	North-West Nelson Forest	CW	CW/H	CW/H/Pl	CW/H/Pl/IF	CW/H/Pl/IF/MO	3	14	31	50	94	190
Greyney's stream	2394875	5800881	13027649	High Country	CX	CX/M	CX/M/HS	CX/M/HS/IF	CX/M/HS/IF/LO	10	29	64	104	183	184
Halpin's stream	2394132	5802727	13027062	High Country	CX	CX/M	CX/M/HS	CX/M/HS/IF	CX/M/HS/IF/LO	11	32	69	112	201	205
Hauroko 1	2075084	5453842	15046881	Southern Alps	CW	CW/L	CW/L/SS	CW/L/SS/IF	CW/L/SS/IF/LO	1	3	7	10	18	290
Hauroko 2	2075947	5453222	15047528	Southern Alps	CW	CW/L	CW/L/SS	CW/L/SS/IF	CW/L/SS/IF/LO	1	3	7	10	18	290
Hepatica Stream	2487050	6035605	10003131	North-West Nelson Forest	CX	CX/L	CX/L/HS	CX/L/HS/IF	CX/L/HS/IF/LO	8	27	58	92	167	116
Kaitawa Stm (Waikanae Trib)	2689998	6034299	9003931	Central Mountains	CW	CW/L	CW/L/HS	CW/L/HS/IF	CW/L/HS/IF/MO	8	25	53	84	153	47
Kapakapanui Stm	2688977	6030224	9004942	Central Mountains	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/MO	8	25	53	84	153	47
Kapuni Stream	2605486	6208392	6007800	Mt Taranaki Forest	CX	CX/M	CX/M/VA	CX/M/VA/B	CX/M/VA/B/LO	1	4	9	13	22	74
Karakarere Stream	2564677	6662853	1006567	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/LO	2	10	22	34	65	22
Katikara Stream	2593614	6219622	6005711	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	4	9	13	22	74
Kaweora Road Stream	2594625	6203615	6008601	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/MO	1	6	15	23	41	79
Kiosk Stream	2117368	5569434	15008138	Southern Alps	CX	CX/M	CX/M/VB	CX/M/VB/T	CX/M/VB/T/LO	10	29	64	103	182	242
Kiwi Jacks creek	2276562	5752115	12044165	Westland Forest	CX	CX/H	CX/H/Al	CX/H/Al/IF	CX/H/Al/IF/LO	11	31	67	108	195	272
Kowai trib	2410195	5765603	13038840	High Country	CW	CW/H	CW/H/Al	CW/H/Al/T	CW/H/Al/T/MO	10	30	65	105	185	135
Last Creek	2110803	5594658	15004616	Southern Alps	CX	CX/H	CX/H/Pl	CX/H/Pl/T	CX/H/Pl/T/LO	12	36	77	124	217	269
Levapuro	2870371	6306985	4020792	Taupo Plateau	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/LO	1	9	19	30	58	107
Lyttles creek trib	2271142	5746197	12044858	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	68	110	197	158
MacKay Creek	2115856	5559516	15009933	Southern Alps	CX	CX/M	CX/M/SS	CX/M/SS/IF	CX/M/SS/IF/MO	10	30	65	105	187	248
Mamona Stream	2597758	6222955	6004585	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/P	CX/H/VA/P/LO	1	4	9	13	22	74
Manapouri 1	2073354	5480788	15036420	Southern Alps	CX	CX/M	CX/M/Pl	CX/M/Pl/T	CX/M/Pl/T/LO	8	25	55	88	160	222
Manapouri 2	2078084	5482058	15036210	Southern Alps	CW	CW/M	CW/M/Pl	CW/M/Pl/T	CW/M/Pl/T/LO	8	25	55	88	160	222
Manapouri 3	2080025	5481869	15036275	Southern Alps	CW	CW/H	CW/H/Pl	CW/H/Pl/T	CW/H/Pl/T/LO	8	25	55	88	160	222
Mangamuka tributary	2556208	6666834	1005878	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	1	1	3	3	7	142
Mangatainoka tributary	2725399	6055153	7048086	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	9	28	62	98	176	280
Mangatarere stream	2716194	6025722	9005995	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	8	25	53	84	153	47
Mangatarere tributary	2718377	6027563	9005547	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/P	CX/H/HS/P/MO	1	7	16	24	42	55
Marae stream	2570207	6657733	1007555	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/MO	1	8	18	27	49	41
McGrath creek	2392270	5807737	13025375	High Country	CX	CX/M	CX/M/HS	CX/M/HS/B	CX/M/HS/B/MO	11	31	67	109	196	191
Merrivale	2111116	5443775	15050498	Southern Alps	CW	CW/H	CW/H/Pl	CW/H/Pl/IF	CW/H/Pl/IF/MO	1	3	7	9	17	287
Merrivale tributary	2110933	5441378	15052010	Southern Alps	CW	CW/H	CW/H/Pl	CW/H/Pl/IF	CW/H/Pl/IF/LO	1	3	7	9	15	260
Mikimiki stream	2723575	6037991	9003106	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	8	25	53	84	153	47
Mill's creek	2270164	5741443	12045496	Westland Forest	CX	CX/M	CX/M/HS	CX/M/HS/T	CX/M/HS/T/LO	11	31	67	109	196	152
Mountain creek	2115194	5591571	15004936	Southern Alps	CX	CX/GM	CX/GM/Pl	CX/GM/Pl/B	CX/GM/Pl/B/MO	11	32	71	116	207	270
Ngutumoki stream	2594185	6220728	6005507	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	5	20	42	71	126	73

SITE	EASTING	NORTHING	NZREACH No.	Ecoregion	Climate	REC Source of Flow	REC Geology level	REC Landcover	REC Network Position	FWENZ 20 class level	FWENZ 50 class level	FWENZ 100 class level	FWENZ 150 class level	FWENZ 300 class level	FWENZ 200 class level
Oakura tributary (Left Branch)	2596753	6222392	6005220	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	5	20	42	71	126	73
Oaonui Stream	2593320	6206990	6007336	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	4	9	13	22	74
O'Conner creek	2276060	5751357	12044256	Westland Forest	CX	CX/L	CX/L/Al	CX/L/Al/IF	CX/L/Al/IF/LO	11	31	67	108	194	144
Opaopao Stream	2573216	6657946	1007487	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/LO	2	10	22	34	65	22
Orangihikoia	2861519	6273748	8001762	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/MO	1	9	19	29	54	139
Orangitutaetutu	2862222	6273145	8001837	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/MO	3	13	30	49	91	118
Orereti Stm	2860981	6276093	8001366	Taupo Plateau	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	1	9	19	30	57	35
Otapukawa Stm	2869868	6305766	4021036	Taupo Plateau	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/MO	3	13	30	49	91	118
Ouri Stream	2600458	6202059	6008893	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	5	20	42	71	126	73
Panatewaewae Stm	2701891	6049897	7048999	Central Mountains	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/MO	8	25	53	84	153	47
Pariwhakaoho River	2486050	6044010	10001881	North-West Nelson Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	8	27	58	92	167	116
Peel Creek	2476784	6008524	10007691	North-West Nelson Forest	CX	CX/M	CX/M/VB	CX/M/VB/IF	CX/M/VB/IF/LO	8	25	54	87	157	112
Pegleg creek	2392373	5811475	12036281	High Country	CX	CX/M	CX/M/HS	CX/M/HS/B	CX/M/HS/B/LO	11	31	67	109	196	191
Plato Creek	2119402	5577128	15006943	Southern Alps	CX	CX/H	CX/H/VB	CX/H/VB/IF	CX/H/VB/IF/LO	10	30	65	105	187	248
Pohatu Stm	2869536	6315365	4018847	Taupo Plateau	CW	CW/L	CW/L/VA	CW/L/VA/IF	CW/L/VA/IF/LO	1	9	19	30	58	107
Prices Creek	2558865	6620751	1015565	North-West Nelson Forest	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/MO	8	27	58	92	167	116
Pukekohe Stream	2476062	5973542	10016628	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/MO	1	8	18	27	49	41
Punaruku Stream	2564686	6662686	1006660	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/MO	2	10	22	34	65	4
Pureanui Stream	2629950	6643916	1010242	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	1	1	1	1	3	23
Rahuinui Stm	2867824	6265103	8003488	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	9	19	29	54	139
Reef Creek	2724348	6041400	9002149	Central Mountains	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/MO	8	25	53	84	153	47
Ribbonwood creek	2265618	5742085	12045409	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	67	108	194	144
Rocky creek	2269431	5745116	12044995	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	67	108	194	144
Rough creek	2392698	5805599	13026142	High Country	CX	CX/M	CX/M/HS	CX/M/HS/T	CX/M/HS/T/MO	11	32	69	112	201	205
Ruapapa Stm	2871677	6263751	8003838	Taupo Plateau	CX	CX/H	CX/H/SS	CX/H/SS/IF	CX/H/SS/IF/LO	8	25	53	84	153	47
Sams Creek	2490676	6015865	10006314	North-West Nelson Forest	CX	CX/H	CX/H/SS	CX/H/SS/S	CX/H/SS/S/MO	8	25	54	86	156	111
Sheepy Creek	2487529	6035801	10003136	North-West Nelson Forest	CX	CX/L	CX/L/HS	CX/L/HS/IF	CX/L/HS/IF/LO	1	8	18	27	50	143
Sheridan Creek	2696809	6033257	9004231	Central Mountains	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/LO	8	25	53	84	153	47
Small creek	2274199	5748868	12044489	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	68	110	197	158
Smithy creek	2277273	5753305	12043981	Westland Forest	CX	CX/H	CX/H/Al	CX/H/Al/IF	CX/H/Al/IF/LO	11	31	67	108	195	272
Smithy's creek	2117294	5571623	15007759	Southern Alps	CX	CX/M	CX/M/VB	CX/M/VB/IF	CX/M/VB/IF/MO	10	30	65	105	187	248
Soda Spring Stream	2555226	6667053	1005833	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	1	1	1	1	2	17
Stoney creek	2253725	5734362	12046123	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	11	31	67	108	195	272
Stony creek (Thirsty culver	2266971	5743046	12045272	Westland Forest	CX	CX/H	CX/H/HS	CX/H/HS/P	CX/H/HS/P/LO	11	31	67	108	194	144
Tapapa Stream	2554518	6667515	1005772	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/MO	1	1	1	1	2	17
Te Karetu Stm	2871511	6263617	8003852	Taupo Plateau	CX	CX/H	CX/H/SS	CX/H/SS/IF	CX/H/SS/IF/LO	1	9	19	29	54	139
Te Manawa Stm	2864404	6269567	8002440	Taupo Plateau	CX	CX/H	CX/H/SS	CX/H/SS/IF	CX/H/SS/IF/LO	1	9	19	29	54	139
Te Popo Stream	2606884	6210523	6007309	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	4	9	13	22	74
Thomas River trib	2404782	5777285	13035357	High Country	CW	CW/M	CW/M/HS	CW/M/HS/B	CW/M/HS/B/LO	10	30	65	105	185	135
Timaru Stream	2594650	6221317	6005402	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	4	9	13	22	74
Timaru Tributary	2594573	6221334	6005189	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	4	9	13	22	74
Tumutu Stream	2554880	6667712	1005705	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	1	1	1	1	2	17
Turnbull Creek	2485975	6044095	10001854	North-West Nelson Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	8	27	58	92	167	116
Twin creek	2392438	5809641	13024666	High Country	CX	CX/M	CX/M/HS	CX/M/HS/T	CX/M/HS/T/LO	10	29	64	104	183	184
Waiaruhe Stm	2865394	6267208	8003055	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	9	19	29	54	139
Waikare River	2623528	6648278	1009461	Northern Hill Country	WW	WW/L	WW/L/HS	WW/L/HS/IF	WW/L/HS/IF/MO	2	10	22	34	65	4
Waikawa Stm	2701727	6049767	7049067	Central Mountains	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/MO	8	25	53	84	153	47
Waikokatu stream	2561461	6619565	1015862	Northern Hill Country	WX	WX/L	WX/L/VA	WX/L/VA/IF	WX/L/VA/IF/LO	1	1	3	3	7	142
Waikokatu tributary	2561556	6619516	1015886	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/LO	1	1	3	3	7	142
Waiotukupuna Stm	2864607	6269321	8002644	Taupo Plateau	CX	CX/M	CX/M/SS	CX/M/SS/IF	CX/M/SS/IF/MO	1	7	16	24	43	147
Waipoua River	2562860	6616135	1016579	Northern Hill Country	WW	WW/L	WW/L/VA	WW/L/VA/IF	WW/L/VA/IF/MO	1	1	1	1	2	17
Waipuku Stream	2611319	6212492	6006915	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	5	20	42	71	126	73
Wairau river	2558660	6622027	1015357	Northern Hill Country	WX	WX/L	WX/L/VA	WX/L/VA/IF	WX/L/VA/IF/MO	1	1	3	3	7	142
Waiwhakaiho river tributary	2605348	6217594	6005642	Mt Taranaki Forest	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/MO	1	4	9	13	22	74
Walker Creek	2113903	5555130	15010745	Southern Alps	CX	CX/M	CX/M/SS	CX/M/SS/IF	CX/M/SS/IF/MO	8	25	55	88	161	297
Walsh Creek	2463640	6040550	10002342	North-West Nelson Forest	CX	CX/H	CX/H/HS	CX/H/HS/IF	CX/H/HS/IF/LO	8	25	54	86	156	111
Wangapeka Tributary	2474640	5973775	10016313	North-West Nelson Forest	CW	CW/H	CW/H/HS	CW/H/HS/IF	CW/H/HS/IF/LO	10	30	66	107	193	264
Wardens creek	2392445	5807061	13025673	High Country	CX	CX/M	CX/M/HS	CX/M/HS/IF	CX/M/HS/IF/LO	11	31	68	110	198	167
Waterfall creek	2116807	5565698	15008660	Southern Alps	CX	CX/M	CX/M/VB	CX/M/VB/IF	CX/M/VB/IF/LO	10	30	65	105	187	248
Wharetoe Stm	2862855	6271203	8002245	Taupo Plateau	CX	CX/H	CX/H/VA	CX/H/VA/IF	CX/H/VA/IF/LO	1	9	19	29	54	139

Appendix 2: instream physical variables and riparian characteristics measured from the study sites

	EASTING	NORTHING	Temp (Degree Centigrade)	Conductivity	Width (cm)	Height (m)	Slope (m)	Avg depth (cm)	Avg velocity (m/sec)	Avg LWD	Embededness	Bryophytes (%)	Substrate size index	% Canopy cover	Mean Chla (ug/cm2)
2Anna	2699328	6035272	12.35	88	120	120	0.09	11.93	0.22	720	1	2.00	161.03	90.50	1.21
Anna's stream	2724535	6040856	12.06	69	340	319	0.00	15.65	0.35	3800	2	1.50	57.71	95.75	1.36
Avalache stream	2392599	5806431	5.70	81	240	758	4.80	17.65	1.06	0	3	2.00	215.76	10.00	0.16
Beecham creek	2462735	6038824	14.00	32	290	148	0.09	19.83	0.43	12000	3	0.25	188.94	37.00	1.98
Black river	2257024	5740465	12.00	44	460	40	1.70	24.15	0.30	13138	3	20.00	74.51	36.25	0.67
Border stream	2254796	5735695	12.50	54	500	62	4.90	21.43	1.01	0	3	0.25	186.32	0.00	0.91
Braken creek	2270062	5741482	9.70	151	130	294	10.70	14.45	1.23	703	2	65.00	130.90	71.00	3.20
Brown trib	2462353	6038867	11.80	28	230	158	0.08	14.30	0.58	54000	2	2.00	153.32	66.00	1.16
Bruce tributary	2398233	5796118	8.10	40	100	655	0.83	14.10	1.10	1193	2	0.25	97.77	80.00	0.19
Caution creek	2269702	5741766	7.00	101	350	294	4.40	25.93	3.28	2543	3	5.00	188.18	82.67	0.31
Cobb river	2476595	6009190	9.10	88	600	839	0.02	24.70	0.80	0	4	0.50	119.61	16.50	1.39
Cold stream	2597709	6202769	8.10	84	390	400	0.08	22.60	0.40	1900	2	5.00	148.42	82.75	2.30
Conor creek	2474092	5971855	10.90	198	230	333	0.05	20.68	0.30	1858	2	15.00	190.69	91.00	2.87
Cow Pasture Stm	2729364	6051530	14.12	57	340	360	0.03	17.05	0.23	22100	2	0.25	177.39	77.25	1.13
Craigieburn stream	2408198	5784519	8.20	33	470	707	2.70	28.03	1.96	0	1	10.00	194.52	0.00	4.23
Craigieburn tributary	2407706	5783626	7.00	8	100	830	0.01	5.70	0.83	1763	2	2.00	65.46	95.00	1.03
Crashed Aircraft	2729429	6051515	14.61	47	870	356	0.04	23.28	0.28	0	2	0.50	189.49	66.25	0.44
Crusher stream	2611253	6211968	8.90	69	350	540	0.04	21.40	0.22	4500	1	10.00	209.19	86.25	2.59
Devils Creek	2711825	6018859	11.59	78	205	156	0.28	12.35	0.22	0	3	1.00	122.32	86.00	1.52
Devil's PunchBowl	2392711	5807211	5.80	37	450	773	5.30	30.13	1.95	6000	1	5.00	214.39	0.00	0.37
Dry creek	2405684	5771331	11.10	45	150	773	3.80	8.13	0.88	0	3	0.00	69.96	20.00	-0.01
Education Lodge	2870479	6308827	17.12	81	240	195	0.01	14.83	0.54	3140	4	0.25	77.32	4.25	3.54
Ford stream	2869857	6313266	13.60	80	170	180	0.06	11.03	0.20	1200	2	0.50	100.72	53.75	1.48
Fossil creek	2463438	6039775	13.10	28	320	134	0.04	21.93	0.28	9979	2	0.25	158.83	65.25	0.68
Fox river	2269526	5742899	8.30	34	300	214	13.60	18.05	3.23	5894	2	10.00	213.26	37.50	0.87
Granity creek	2474010	5970720	10.00	164	550	359	0.03	25.43	0.48	0	2	2.00	247.82	64.50	2.84
Greney's stream	2394875	5800881	6.30	105	140	690	18.30	12.90	1.47	4800	2	0.25	140.35	0.00	0.20
Halpins stream	2394132	5802727	5.90	71	390	700	4.20	22.30	1.70	0	3	0.25	167.19	20.00	0.53
Hauroko 1	2075084	5453842	9.40	148	150	159	0.01	14.13	0.28	2583	4	0.25	19.77	96.00	0.05
Hauroko 2	2075947	5453222	9.30	84	170	170	0.02	18.95	0.39	3736	3	10.00	58.67	74.00	0.70
Hepatica stream	2487050	6035605	9.90	219	135	78	0.01	9.60	0.19	0	2	85.00	57.90	95.50	4.22
Kaitawa Stm (Waikana	2689998	6034299	13.87	84	340	140	0.03	21.28	0.46	2240	2	0.50	70.94	66.00	0.82
Kapakapanui Stm	2688977	6030224	13.53	87	300	139	0.05	16.75	0.43	2350	3	0.25	122.26	84.75	1.19
Kapuni	2605486	6208392	8.20	35	375	860	0.07	30.10	0.46	1350	1	0.50	188.42	41.25	0.23
Karakarere	2564677	6662853	15.90	275	140	34	0.02	6.98	0.07	1200	3	0.50	46.76	87.00	2.02
Katikara	2593614	6219622	9.90	41	300	432	0.05	17.08	0.23	8583	2	10.00	236.27	83.50	1.57
Kaweora	2594625	6203615	10.60	105	320	326	0.02	23.78	0.44	0	2	2.00	163.39	90.25	1.09
Kiosk stream	2117368	5569434	7.10	35	210	371	0.02	10.18	0.35	7067	4	0.00	57.26	21.00	-0.07
Kiwi Jacks creek	2276562	5752115	10.40	25	360	320	7.10	19.18	1.75	4050	3	5.00	155.33	65.00	0.16
Kowai tributary	2410195	5765603	10.00	64	130	628	2.30	17.83	1.25	0	2	1.00	102.54	60.00	1.69
Last creek	2110803	5594658	8.50	11	190	456	0.03	17.88	0.28	7500	2	10.00	137.81	84.25	1.26
Levapuro	2870371	6306985	14.80	74	160	217	0.04	10.10	0.25	14700	2	0.25	108.17	85.00	5.11
Lyttle creek tributary	2271142	5746197	9.00	78	130	340	0.29	10.83	1.46	2100	3	0.25	146.15	31.43	0.38
Mackay creek	2115856	5559516	7.60	73	390	319	0.04	23.13	0.48	3000	3	0.25	125.37	27.25	0.15
Mamona	2597758	6222955	12.30	46	400	464	0.06	27.45	0.26	1500	2	2.00	227.27	73.25	0.83
Manapouri 1	2073354	5480788	4.90	14	330	950	0.10	16.98	0.22	0	1	5.00	362.85	21.25	0.34
Manapouri 2	2078084	5482058	7.10	12	160	587	0.07	10.33	0.35	6250	2	1.00	140.41	41.50	0.41
Manapouri 3	2080025	5481869	7.50	5	270	500	0.17	22.60	0.70	8007	1	10.00	297.42	47.50	0.44
Mangamuka	2556208	6666834	16.30	174	100	59	0.08	11.45	0.12	2440	1	5.00	165.25	87.00	2.74
Mangatainoka Tributar	2725399	6055153	13.63	48	995	340	0.02	22.53	0.42	0	3	0.25	169.57	26.50	0.26
Mangatarere Stm	2716194	6025722	13.48	61	365	255	0.01	16.18	0.41	0	2	0.50	143.03	71.50	1.82
Mangatarere Tributary	2718377	6027563	17.00	71	250	219	0.04	10.35	0.20	0	2	0.00	93.74	27.50	0.92
Marae	2570207	6657733	17.20	106	590	43	0.01	10.68	0.21	12750	3	0.25	75.15	22.50	1.60
McGrath creek	2392270	5807737	5.10	82	420	780	2.70	25.98	1.54	0	3	0.25	201.44	95.00	0.13
Merivale	2111116	5443775	7.60	78	680	150	0.02	30.75	0.65	27500	2	10.00	212.10	79.25	0.55
Merivale tributary	2110933	5441378	7.00	101	90	315	0.08	8.00	0.47	1014	2	10.00	66.79	99.00	0.38
Mikimiki Stm	2723575	6037991	15.19	58	575	307	0.00	19.38	0.43	0	2	0.00	131.27	53.00	1.26
Mill's creek	2270164	5741443	9.50	132	80	316	4.40	9.65	1.11	1279	1	50.00	110.31	93.25	1.54
Mountain creek	2115194	5591571	6.00	6	250	719	0.01	13.35	0.22	0	4	0.25	122.48	7.00	0.00
Ngutumoki	2594185	6220728	10.00	59	150	427	0.06	6.53	0.15	5407	2	20.00	113.75	86.25	1.63
Oakura	2596753	6222392	12.30	65	240	462	0.07	30.00	0.19	1708	2	15.00	225.22	80.25	2.52

	EASTING	NORTHING	Temp (Degree Centigrade)	Conductivity	Width (cm)	Height (m)	Slope (m)	Avg depth (cm)	Avg velocity (m/sec)	Avg LWD	Embededness	Bryophytes (%)	Substrate size index	% Canopy cover	Mean Chla (ug/cm2)
Oaonui	2593320	6206990	11.20	98	380	380	0.03	22.23	0.31	11150	2	1.00	150.00	18.25	1.36
O'Connor creek	2276060	5751357	10.90	6	170	320	2.30	11.80	0.25	5925	3	15.00	101.23	73.33	0.60
Opaopao	2573216	6657946	15.20	115	210	25	0.03	13.80	0.13	2543	3	1.00	34.69	89.75	1.22
Orangahikoia	2861519	6273748	13.73	79	330	700	0.01	21.75	0.46	0	2	0.25	74.85	46.25	2.63
Orangitutaetutu	2862222	6273145	13.41	72	725	699	0.02	18.10	0.60	18883	4	0.00	43.93	10.25	1.36
Orereti	2860981	6276093	11.25	65	230	797	0.04	10.13	0.29	3206	2	0.25	74.18	80.00	1.66
Otapukawa	2869868	6305766	17.57	68	350	212	0.01	21.90	0.67	5377	4	0.00	63.49	12.50	1.66
Ouri	2600458	6202059	10.80	63	850	440	0.03	24.53	0.44	3614	2	10.00	154.80	83.50	3.72
Panatewaewae Stm	2701891	6049897	16.72	79	390	180	0.02	28.23	0.46	23400	3	1.00	161.13	52.25	1.17
Pariwhakaoho river	2486050	6044010	12.00	152	510	98	0.02	21.35	0.38	0	3	0.25	193.00	27.50	2.20
Peel creek	2476784	6008524	7.80	236	1	847	0.15	8.70	0.09	1329	1	10.00	146.25	92.50	1.20
Pegleg	2392373	5811475	6.20	49	500	837	3.50	32.38	1.76	0	2	0.00	237.30	0.00	0.06
Plato creek	2119402	5577128	6.90	99	230	457	0.13	17.60	0.44	2888	1	2.00	190.39	38.25	1.08
Pohatu	2869536	6315365	13.63	88	205	124	0.03	20.95	0.25	875	2	10.00	153.99	91.00	5.23
Prices creek	2558865	6620751	14.90	122	130	316	2.70	13.28	0.11	2825	3	10.00	306.54	95.75	0.40
Pukekohe	2476062	5973542	11.80	247	150	280	0.06	15.63	0.25	0	1	5.00	252.41	64.00	8.70
Punaruku	2564686	6662686	16.70	128	240	24	0.01	8.13	0.18	1000	3	0.25	45.64	22.75	4.56
Pureanui	2629950	6643916	17.40	103	300	39	0.02	17.90	0.30	6726	4	0.25	30.90	51.25	1.38
Rahuinui	2867824	6265103	10.62	185	175	615	0.17	15.15	0.31	5667	2	2.00	215.16	95.75	8.74
Reef creek	2724348	6041400	12.64	61	450	337	0.01	17.60	0.40	2800	2	0.50	107.23	91.75	1.61
Ribbon wood creek	2265618	5742085	10.70	46	240	120	0.13	11.75	1.03	0	4	0.50	81.50	70.75	0.03
Rocky creek	2269431	5745116	9.80	48	350	213	7.30	23.03	2.28	0	3	0.25	192.47	43.50	0.15
Rough creek	2392698	5805599	5.90	83	600	770	6.70	26.83	2.15	0	2	0.25	220.45	0.00	0.20
Ruapapa	2871677	6263751	13.86	86	205	600	0.10	14.70	0.20	3583	2	2.00	212.64	89.00	0.28
Sams creek	2490676	6015865	12.10	49	310	160	0.03	21.55	0.21	0	1	0.25	195.20	2.50	0.80
Sheepy creek	2487529	6035801	12.50	63	320	79	0.02	12.40	0.20	0	2	5.00	134.12	78.50	2.15
Sheridan Creek	2696809	6033257	14.00	66	410	134	0.02	19.35	0.53	0	3	0.00	91.32	7.50	1.17
Small creek	2274199	5748868	10.80	60	200	337	21.00	14.80	1.33	2500	1	15.00	162.43	32.50	0.38
Smithy creek	2277273	5753305	11.10	53	230	170	14.70	20.08	1.37	0	3	12.00	307.76	43.33	0.88
Smithy's creek	2117294	5571623	6.70	42	520	378	0.01	16.83	0.57	15250	3	0.50	85.20	38.25	0.12
Soda spring	2555226	6667053	16.60	169	270	78	0.02	8.63	0.18	0	2	2.00	100.90	81.50	2.74
Stoney creek	2253725	5734362	12.90	41	460	78	0.60	18.63	1.61	0	3	0.25	166.06	19.50	2.00
Stony creek (thirsty cu	2266971	5743046	10.90	62	220	178	0.01	17.25	0.87	7600	2	0.25	181.16	55.31	0.02
Ta Papa	2554518	6667515	16.20	177	490	80	0.02	19.80	0.29	0	2	5.00	224.39	67.25	2.04
Te Karetu	2871511	6263617	12.72	157	180	610	0.01	12.93	0.17	5073	3	3.00	167.96	91.75	7.87
Te Manawa	2864404	6269567	11.44	113	210	633	0.07	16.25	0.17	3000	2	3.00	197.61	88.25	1.54
Te Popo	2606884	6210523	10.70	31	260	820	0.08	24.73	0.29	3009	1	10.00	172.22	50.00	0.20
Thomas river tributary	2404782	5777285	7.60	48	230	757	5.40	11.93	2.06	2005	4	0.25	83.07	0.00	0.11
Timaru	2594650	6221317	10.80	56	200	420	0.08	19.48	0.30	3270	1	15.00	243.40	80.75	0.86
Timaru tributary	2594573	6221334	12.20	81	260	418	0.06	21.55	0.17	1800	2	10.00	204.24	93.00	3.53
Tumutu	2554880	6667712	16.70	194	280	91	0.03	15.05	0.21	650	2	3.00	123.60	73.75	2.93
Turnbull creek	2485975	6044095	11.20	82	160	110	0.13	16.13	0.17	7470	2	2.00	166.71	91.75	0.98
Twin creek	2392438	5809641	6.20	34	330	879	11.60	20.98	0.30	0	1	0.25	193.71	0.00	0.08
Waiaruhe	2865394	6267208	12.58	146	320	700	0.06	17.65	0.23	15000	2	1.00	191.05	91.75	2.62
Waikare	2623528	6648278	18.10	100	180	20	0.01	13.38	0.44	3198	4	0.00	49.73	12.25	1.06
Waikawa Stm	2701727	6049767	14.85	81	480	180	0.03	24.53	0.36	0	2	0.50	179.19	37.50	1.71
Waikokatu	2561461	6619565	14.40	95	220	293	0.03	12.65	0.30	1080	3	5.00	160.86	82.50	0.25
Waikokatu trib.	2561556	6619516	14.20	97	130	293	0.01	12.93	0.11	927	3	0.50	69.06	78.50	0.15
Waiotukupuna	2864607	6269321	14.44	165	550	618	0.01	30.30	0.33	2400	4	0.00	211.81	51.00	2.50
Waipoua	2562860	6616135	15.10	130	490	123	0.03	24.80	0.23	0	2	20.00	270.90	68.25	2.84
Waipuku	2611319	6212492	9.00	62	380	533	0.03	20.10	0.31	3300	1	25.00	189.85	77.25	4.28
Wairau	2558660	6622027	14.00	102	260	320	0.00	20.10	0.17	4890	3	5.00	41.78	90.00	0.22
Waiwhakaiho	2605348	6217594	9.50	52	80	584	0.07	6.40	0.11	3527	2	60.00	164.73	97.25	2.27
Walker creek	2113903	5555130	7.40	59	580	280	0.04	23.35	0.63	29508	2	0.50	196.73	49.25	0.14
Walsh creek	2463640	6040550	12.20	29	460	120	0.04	18.03	0.53	0	2	0.25	181.26	22.00	1.48
Wangapeka trib	2474640	5973775	10.80	157	230	299	0.21	16.38	0.57	6100	1	25.00	199.76	80.50	4.42
Wardens creek	2392445	5807061	6.40	67	150	780	0.34	13.33	0.99	1904	2	5.00	205.22	90.00	0.19
Waterfall creek	2116807	5565698	7.80	132	300	373	0.05	16.28	0.70	6250	3	0.00	69.40	0.00	-0.03
Wharetoe	2862855	6271203	11.56	85	235	680	0.03	17.65	0.51	3480	4	0.00	61.82	89.25	2.96

Appendix 3. Similarity of Percentage (SIMPER) analyses showing average relative abundance of the taxa contributing most to differences in community composition between ecoregions. Percentage of contribution by each taxa to average within-class similarity is represented next to the relative abundance of each taxa. Here SIMPER analyses are based on 4√-transformed abundance data which was then standardised by the total number of individuals for each species.

	Ecoregions							
Taxa	Northern Hill Country	Mt Taranaki Forest	Taupo Plateau	Central Mountains	NorthWest Nelson Forest	High Country	Westland Forest	Southern Alps
Deleatidium spp	5.63	8.1	6.8	10.83	6.27	11.83	11.81	9.31
	8.44%	11.54%	10.14%	14.70%	9.83%	18.72%	19.07%	15.28%
Zelandobius confusus			2.41		2.32	6.03		3.48
			2.21%		2.61%	8%		4.80%
Aoteapsyche spp	2.52		1.65	4.33	3.77			
	2.55%		1%	5.39%	5.49%			
Orthopsyche spp	1.6	6.2	3.67					
	1.15%	7%	2.84%					
Coloburiscus humeralis	4.92	4.41	3.95	4	2.78			
	7.81%	6.37%	6.06%	4.61%	3.76%			
Nesameletus spp	2.41	3.8	2.87	2.56	2.06	5.11	5.17	2.61
	2.50%	5%	3.70%	2.23%	2.36%	6.21%	7.84%	2.01%
Elmidae	4.32	5.34	3.74	5.67	3.27	6.4	6.21	3.65
	6.60%	7.76%	5%	7.64%	4.19%	9.50%	9%	4.62%
Baraeoptera spp	2.63	2.18		3.09	3.47			
	1.86%	1.86%		2.82%	3.90%			
Olinga spp	3.9		2.67	4.36	3.84	2.56	1.34	
	4.86%		2.66%	4.71%	5%	2.68%	1.05%	
Oligochaeta	2.9					1.92	2.91	4.6
	3%					1.15%	3.46%	6.27%
Zelandobius furcillatus		3.32		2.03				
		4.02%		1.39%				
Helicopsyche spp	2.52	1.96	2.21	2.46	3.38			
	2.21%	2.13%	1.67%	1.71%	3.12%			
Neozephlebia scita	3.28		1.44					
	3.86%		1.31%					
Zelandoperla spp		3.28	3.11	4.83	2.56	4.07	3.4	4.94
		3.30%	4.26%	6.08%	3.43%	4.50%	5.33%	7%
Austroclima jollyae	3	3.05	1.74		1.42			
	3.47%	3.70%	1.26%		1%			
Chironomid C (Orthocladinae%					3.33	1.64	2.52	2.75
					4.72%	1.59%	3.13%	3.20%
Maoridiamesa spp			1.49		2.88	2.3		1.91
			1.03%		3.36%	2%		1.44%
Pycnocentrodes spp	3		2.24					
	2.86%		1.70%					
Zelandobius 'x'						3.34		1.64
						3.34%		1%
Costachorema brachyptera						2.11		3.02
						2.17%		3.70%

Appendix 4. Similarity of Percentage (SIMPER) analyses showing average abundance of the taxa contributing most to differences in community composition between REC Geology classes. Percentages of contribution by each taxa to average within-class similarity in community composition is represented next to the relative of each taxa. Here only the classes with significant (pairwise R statistic with P value < 0.05) difference in community composition are presented. Here SIMPER analyses are based on $\sqrt[4]{}$-transformed abundance data which was then standardised by the total number of individuals for each species. REC = River Environment classification.

	REC Geology classes												
Taxa	CX/H/HS	CX/H/SS	CX/H/VA	CX/H/AL	CX/M/VB	CX/M/HS	CX/L/HS	CX/L/AL	CW/H/HS	CW/M/HS	CW/H/PL	WW/L/VA	WW/L/HS
Deleatidium spp	10.8	6.03	7.56	10.8	11.07	10.83	6	7.7	9.7	10.37	6.85	4.73	6.44
	17.44%	10%	11.53%	17.13%	20.40%	16.80%	10.35%	10.41%	13.21%	18.33%	14.02%	7.60%	7.77%
Nesameletus spp	3.8	2.34	3.3	6.23	3.55	6.45		1.74	2.76	1.62	1.7	3.22	
	5%	3.33%	4.44%	5.70%	4.21%	8.55%		3.20%	3.10%	1.33%	1.10%	4.26%	
Coloburiscus humeralis	2.61	4.83	4.5				3.4		3.18	1.76	1.8	5.36	4.6
	2.65%	7.64%	7%				5.12%		5.07%	1.65%	1.01%	9.23%	5.67%
Austroclima jollyae		3	3								2.3	3.25	2.21
		3.05%	3.22%								1.72%	3.60%	2.17%
Neozephlebia scita		2.15					2					2.64	3.86
		1.65%					2.44%					2.54%	4.06%
Zelandobius confusus		3.02	1.45			6	1.5	4.4		5.26	4.5		
		4.24%	0.82%			7.23%	1%	8%		8.07	7.73%		
Zelandoperla spp	4	3	3	5.1	7.05	5	2.62		3.73		4.14	2.15	
	6.35%	4.40%	3.18%	9.33%	9.71%	7.14%	4%		4.50%		7.15%	2.54%	
Austroperla cyrene	2.7	2.04	2.52	3.31			2.82		2.4		4.5	1	
	3.77%	2.22%	3.70%	6.14%			3.50%		2.72%		8.06%	0.86%	
Aoteapsyche spp	2.5				2.72		2.62		3.86		2.1	3	3
	3%				4.03%		3.40%		6%		2.46%	3.13%	3.11%
Orthopsyche spp		2.5	5.4									1.44	
		2.65%	5.40%									1.02%	
Costachorema brachypterum					3.52	2.8							
					2.03%	3.66%							
Baraeoptera spp	2.24		1.64				3		2.77	5		4.6	
	2%		1.03%				3.42%		2.20%	5.50%		5.30%	
Olinga spp	3.06	2.24	1.3			1.72	4.06		4	3.3	1.6	3.53	5.35
	3.50%	1.63%	0.75%			1.50%	4.63%		5.33%	3.80%	1.07%	4.21%	7%
Zelolessica cheira		2.61	2.5					4.02					
		4.18%	3%					6.30%					
Helicopsyche spp	2.21	2.52	2.01				4.1						4.26
	1.61%	2.45%	2%				5%						5.37%
Elmidae	5.16	3.03	5	8	4.02	6.07	3	4.6	5.3	6.06	4.8	3.64	5.4
	7.45%	4.73%	7.20%	8.04%	5%	9%	3.40%	8%	8.52%	7.16%	8.02%	6.32%	7.30%
Oligochaeta	1.6				4.3				1.34	5	2.41	1.77	4.85
	1%				5.26%				1%	8.30%	4.54%	2.07%	5.63%

Appendix 5. Similarity of Percentage (SIMPER) analyses showing average abundance of the taxa contributing most to differences in community composition between FWENZ 100 level classes. Percentage of contribution by each taxa to average within-class similarity in community composition is represented next to the relative abundance of each taxa. Here only the classes with significant difference in community composition (Pairwise R statistic with P value < 0.05) are presented. SIMPER analyses are based on 4√-transformed abundacne data which was then standardised by the total number of individuals for each species. FWENZ = Freshwater Environments of New Zealand River Classification.

Taxa	FWENZ 100 level classes														
	Class 53	Class 42	Class 9	Class 19	Class 22	Class 3	Class 1	Class 58	Class 54	Class 64	Class 65	Class 67	Class 68	Class 7	Class 55
Deleatidium spp	10.6	7	9	6.46	7.23	5.65	4.63	5.54	7.02	11.78	10.71	13.6	10.25	5.01	9
	15%	9%	13.51%	10%	8.50%	8.35%	7.31%	9.52%	12.75%	17.60%	9%	24.20%	15.11%	6.23%	12.76%
Nesameletus spp	2.31	3.27	4.72	2.67	1.81	3.5	3	2.13	2.83	7.17	1.71	5.57	6.11		4.24
	2.12%	3.52%	8.33%	3.57%	1.24%	4.23%	3.90%	2.53%	4.71%	8.71%	1%	8.42%	8.79%		4.55%
Coloburiscus humeralis	3.83	5.04	3.71	4	5.4	4.7	5.55	2.5	2		2.11				
	4.80%	7.18%	5.08%	5.76%	7.62%	7.53%	9.19%	3.68%	1.53%		2.57%				
Austroclima jollyae		3.5	3.25	1.81	2.46	2.8	4.02	2							
		4.60%	3.84%	1.40%	2.42%	2.65%	5.04%	1.10%							
Neozephlebia scita				1.4	4.62	3	2.84	1.5							
				1.50%	6%	2.84%	2.87%	1.74%							
Zelandoperla spp	4.6	2.65		2.7		2.12	1.8	1.6	2.62	5	4.6	4.76	3.37	3.76	5
	6.07%	2.32%		3.01%		2.15%	1.66%	2.75%	3.12%	6.30%	5.05%	8.12%	5.18%	5.70%	6.44%
Zelandobius confusus			2.83	2.7					3.51	6.75	2.87	2.5		3	4.7
			3%	4.64%					5.39%	7.50%	3%	1.27%		3.47%	6.44%
Zelandobius furcillatus	2.25	4													
	1.75%	5.08%													
Aoteapsyche spp	3.8		3.7		2.53		3.6	3.17	3.13		2.6				
	4.50%		3%		2.24%		4.62%	4.31%	4.12%		2.58%				
Orthopsyche spp	2.05	9	3.72	4.6		3.17									
	1.56%	11.34%	3.17%	3.20%		4.65%									
Olinga spp	4.31			2.25	5	2.45	3.43	2.32	4.62	2.7	2.6				
	4.73%			2.33%	6.51%	1.88%	3.67%	2.60%	7.10%	2.40%	2.60%				
Baraeoptera spp	3.1	1.63	2.4		1.8		5.11	2.64	3		3.02				
	2.63%	1.75%	1.80%		1.63%		5.72%	2.34%	2.65%		2.07%				
Helicopsyche spp	2.32	1.86	2	2.19	4.4		2.16	4	2.28						
	1.60%	1.67%	2%	1.67%	5.20%		1.28%	3.45%	1.47%						
Costachorema brachypterum										3.7		1.4			3.23
										5.74%		1.05%			4.66%
Elmidae	5.61	4.35	6	3.7	5.27	3.19	3.91	3.52	2.02	5.91	5.6	6.41	6	3.87	3.87
	8.07%	5.62%	9.43%	5.26%	7%	4.70%	7%	5.17%	3.03%	6.30%	9%	9.06%	9.40%	4.44%	4.50%
Aphrophila spp	2.7	2.84	4.04	1.55	1.27		2.5	2.53	2.02		1.82	2.18			
	3.50%	3%	6.40%	1.33%	1.20%		3.17%	3.67%	2.64%		1.67%	2.75%			
Chironominae	1.6		1.5	2.25	3.17	3.64	3.36	2.71		4.64	1.26		1.78		
	1.40%		1.50%	2.50%	4.18%	5%	5.40%	3.50%		7.11%	1%		1.19%		
Cricotopus spp	3.75	3	3.03	3.53	1.66	3	3.1	3.74	4.62		4.85	4.8	4.71	3.71	5.4
	4.32%	4%	4.77%	5.14%	1.50%	4.11%	2.70%	5.40%	7.66%		8.12%	7.80%	8.09%	4.64%	8%
Oligochaeta					4.22	1.64	1.52	1.66			3.44	3.02	2.4	4.24	3.58
					4.72%	1.70%	1.27%	1.40%			3.63%	4%	1.85%	4.46%	5%

Appendix 6. Macroinvertebrate data collected from 120 study sites

SITE	Ecoregion	*Deleatidium sp.*	*Coloburiscus humeralis*	*Nesameletus sp.*	*Acanthophlebia cruentata*	*Atalophlebiodes cromwelli*	*Zephlebia dentata*	*Zephlebia spectabilis*	*Zephlebia inconspicua*	*Ameletopsis perscitus*	*Neozephlebia scita*	*Austroclima sepia*	*Austroclima jollyae*	*Austronella planulata*	*Oniscigaster wakefieldi*	*Oniscigaster distans*	*Icthybotus hudsoni*
2Anna	Central Mountains	72	0	8	0	0	14	0	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	697	379	0	0	0	0	0	0	2	22	3	0	0	0	0	1
Avalache stream	High Country	647	0	249	0	0	0	0	0	0	0	0	0	0	0	0	0
Beecham creek	North-West Nelson Forest	193	26	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Black river	Westland Forest	226	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0
Border stream	Westland Forest	888	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Braken creek	Westland Forest	92	0	10	0	0	0	0	0	0	0	0	6	0	0	0	0
Brown trib	North-West Nelson Forest	364	20	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Bruce tributary	High Country	147	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0
Caution creek	Westland Forest	1020	0	64	0	0	0	0	0	0	0	0	0	0	0	0	0
Cobb river	North-West Nelson Forest	736	384	0	0	0	0	0	0	0	4	0	80	0	0	0	0
Cold stream	Mt Taranaki Forest	360	62	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Conor creek	North-West Nelson Forest	464	65	48	0	0	0	0	0	0	2	0	12	0	0	0	0
Cow Pasture Stm	Central Mountains	742	69	5	3	0	3	0	0	0	0	0	0	0	0	0	0
Craigieburn stream	High Country	200	38	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Craigieburn tributary	High Country	1992	34	62	0	0	0	0	0	0	0	0	0	0	0	1	0
Crashed Aircraft	Central Mountains	505	73	22	0	0	1	0	0	0	0	0	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	363	26	49	0	0	0	0	0	0	0	0	10	0	0	0	0
Devils Creek	Central Mountains	262	62	0	0	0	5	0	0	0	3	0	0	0	0	0	0
Devil's PunchBowl	High Country	777	0	68	0	0	0	0	0	0	0	0	0	0	0	0	0
Dry creek	High Country	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	1864	145	75	5	0	0	0	0	0	0	0	0	0	0	0	0
Ford stream	Taupo Pleteau	669	67	7	2	0	19	0	0	1	0	0	0	0	0	0	0
Fossil creek	North-West Nelson Forest	215	16	1	0	0	0	0	0	3	0	0	0	0	0	0	0
Fox river	Westland Forest	989	0	170	0	0	0	0	0	0	0	0	0	0	0	0	0
Granity creek	North-West Nelson Forest	786	21	28	0	0	0	0	0	0	0	0	4	0	0	0	0
Greney's stream	High Country	1558	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0
Halpins stream	High Country	1037	0	130	0	0	0	0	0	0	0	0	0	0	0	0	0
Hauroko 1	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hauroko 2	Southern Alps	174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatica stream	North-West Nelson Forest	106	4	0	0	0	0	0	0	0	14	55	319	0	0	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	818	15	3	0	0	0	0	0	2	0	0	0	0	0	0	1
Kapakapanui Stm	Central Mountains	1204	10	0	1	0	0	0	0	3	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	101	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Karakarere	Northern Hill Country	226	207	1	8	0	59	0	2	3	60	5	33	2	0	0	0
Katikara	Mt Taranaki Forest	280	79	41	2	0	14	1	0	11	2	5	24	0	0	0	0
Kaweora	Mt Taranaki Forest	474	303	10	0	0	0	0	0	0	0	0	23	0	0	0	0
Kiosk stream	Southern Alps	156	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Kiwi Jacks creek	Westland Forest	754	0	233	0	0	0	0	0	0	0	0	0	0	0	0	0
Kowai tributary	High Country	900	170	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Last creek	Southern Alps	48	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0
Levapuro	Taupo Pleteau	130	87	16	0	0	2	0	0	1	4	0	0	0	0	0	3
Lyttle creek tributary	Westland Forest	708	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Mackay creek	Southern Alps	736	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Mamona	Mt Taranaki Forest	267	83	53	0	0	1	1	0	3	1	0	9	0	0	0	0
Manapouri 1	Southern Alps	422	0	72	0	0	0	0	0	0	0	0	0	0	0	0	0
Manapouri 2	Southern Alps	412	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0
Manapouri 3	Southern Alps	59	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangamuka	Northern Hill Country	115	43	1	4	0	0	0	2	0	26	31	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	1387	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangatarere Stm	Central Mountains	1406	50	13	1	0	0	0	0	0	0	1	0	0	1	0	0
Mangatarere Tributary	Central Mountains	656	24	18	1	0	8	0	0	0	1	0	0	0	0	0	0
Marae	Northern Hill Country	142	4	0	5	0	0	1	0	0	176	0	2	0	0	0	0
McGrath creek	High Country	1068	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0
Merivale	Southern Alps	513	64	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Merivale tributary	Southern Alps	186	0	0	0	0	0	0	0	0	0	0	104	0	0	0	0
Mikimiki Stm	Central Mountains	1729	27	27	16	0	2	0	0	4	9	0	0	0	0	0	0
Mill's creek	Westland Forest	92	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain creek	Southern Alps	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SITE	**Ecoregion**	*Deleatidium sp.*	*Coloburiscus humeralis*	*Nesameletus sp.*	*Acanthophlebia cruentata*	*Atalophlebiodes cromwelli*	*Zephlebia dentata*	*Zephlebia spectabilis*	*Zephlebia inconspicua*	*Ameletopsis perscitus*	*Neozephlebia scita*	*Austroclima sepia*	*Austroclima jollyae*	*Austronella planulata*	*Oniscigaster wakefieldi*	*Oniscigaster distans*	*Icthybotus hudsoni*
Ngutumoki	Mt Taranaki Forest	234	250	2	1	0	70	5	0	8	26	0	34	0	0	0	0
Oakura	Mt Taranaki Forest	195	138	26	1	0	49	24	0	7	19	4	82	0	0	0	0
Oaonui	Mt Taranaki Forest	326	53	60	0	0	0	0	0	0	0	0	33	0	0	0	0
O'Connor creek	Westland Forest	849	0	1	0	0	0	0	0	8	0	0	0	0	0	0	0
Opaopao	Northern Hill Country	243	184	0	3	0	0	0	0	1	418	0	43	0	0	0	0
Orangahikoia	Taupo Pleteau	723	23	34	4	0	0	0	0	3	1	1	0	0	0	0	5
Orangitutaetutu	Taupo Pleteau	1725	24	13	0	0	0	0	0	0	0	0	0	0	0	0	0
Orereti	Taupo Pleteau	346	32	54	0	0	3	0	0	0	2	0	4	0	0	0	0
Otapukawa	Taupo Pleteau	1207	19	244	4	0	0	0	0	0	0	0	0	0	0	0	0
Ouri	Mt Taranaki Forest	742	153	10	3	0	4	0	0	1	0	0	31	0	0	0	0
Panatewaewae Stm	Central Mountains	3173	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	732	6	32	0	0	0	0	0	0	0	0	0	0	0	0	0
Peel creek	North-West Nelson Forest	124	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0
Pegleg	High Country	244	0	154	0	0	0	0	0	0	0	0	0	0	0	0	0
Plato creek	Southern Alps	857	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0
Pohatu	Taupo Pleteau	1168	11	24	8	0	0	0	0	9	8	0	0	0	0	0	0
Prices creek	North-West Nelson Forest	310	4	1	0	0	0	0	0	0	1	0	3	0	0	0	0
Pukekohe	Northern Hill Country	460	189	0	15	8	0	12	9	0	0	0	8	0	0	0	0
Punaruku	Northern Hill Country	1020	254	8	0	0	2	0	0	2	56	0	34	0	0	0	0
Pureanui	Northern Hill Country	2	25	12	0	0	1	2	6	0	8	24	63	3	0	0	0
Rahuinui	Taupo Pleteau	212	92	1	0	0	32	0	0	0	0	6	16	0	0	0	0
Reef creek	Central Mountains	912	41	0	1	0	2	0	0	2	6	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	342	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky creek	Westland Forest	413	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough creek	High Country	1192	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0
Ruapapa	Taupo Pleteau	131	154	1	21	0	34	2	6	0	68	0	65	0	0	0	1
Sams creek	North-West Nelson Forest	1413	138	47	0	0	0	0	0	0	0	0	0	0	0	0	0
Sheepy creek	North-West Nelson Forest	356	32	29	0	0	0	0	0	3	23	0	35	0	0	0	0
Sheridan Creek	Central Mountains	2202	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Small creek	Westland Forest	740	0	307	0	0	0	0	0	0	0	0	0	0	0	0	0
Smithy creek	Westland Forest	2061	0	25	0	0	0	0	0	0	0	0	1	0	0	4	0
Smithy's creek	Southern Alps	569	1	86	0	0	0	0	0	0	0	0	0	0	0	0	0
Soda spring	Northern Hill Country	379	149	3	0	5	3	1	6	2	163	0	17	0	0	0	1
Stoney creek	Westland Forest	2458	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0
Stony creek (thirsty culvert)	Westland Forest	481	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	180	249	5	4	0	0	0	0	2	5	23	11	0	0	0	1
Te Karetu	Taupo Pleteau	128	148	2	3	0	43	5	0	0	5	6	50	0	0	0	2
Te Manawa	Taupo Pleteau	367	78	16	1	0	15	3	0	1	2	1	26	0	0	0	0
Te Popo	Mt Taranaki Forest	1730	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0
Thomas river tributary	High Country	541	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Timaru	Mt Taranaki Forest	166	54	31	0	0	0	0	0	1	0	3	36	0	0	0	0
Timaru tributary	Mt Taranaki Forest	221	56	43	5	0	22	15	0	2	3	27	139	0	0	0	0
Tumutu	Northern Hill Country	23	105	4	2	0	0	0	0	0	0	0	10	0	0	0	1
Turnbull creek	North-West Nelson Forest	249	15	17	0	0	2	0	0	0	2	1	0	0	0	0	1
Twin creek	High Country	803	0	218	0	0	0	0	0	0	0	0	0	0	0	0	0
Waiaruhe	Taupo Pleteau	381	29	10	1	0	4	0	0	0	1	7	15	0	0	0	0
Waikare	Northern Hill Country	1349	145	17	0	0	0	0	0	6	61	0	0	0	0	0	0
Waikawa Stm	Central Mountains	1946	9	17	2	0	0	0	0	0	0	0	0	0	0	0	0
Waikokatu	Northern Hill Country	209	128	47	6	0	6	5	0	4	11	26	93	2	0	0	0
Waikokatu trib.	Northern Hill Country	19	73	106	4	0	0	0	0	3	0	6	5	0	0	0	0
Waiotukupuna	Taupo Pleteau	249	62	5	1	0	0	0	0	3	3	0	2	0	0	0	0
Waipoua	Northern Hill Country	282	416	48	0	0	3	4	0	2	5	21	63	0	0	0	0
Waipuku	Mt Taranaki Forest	332	75	11	0	0	0	0	0	1	0	0	5	0	0	0	0
Wairau	Northern Hill Country	455	36	7	3	0	226	0	0	0	104	17	41	5	0	0	4
Waiwhakaiho	Mt Taranaki Forest	15	26	2	0	0	38	0	0	0	0	35	6	0	0	0	0
Walker creek	Southern Alps	785	3	1	0	0	0	0	0	0	0	0	30	0	0	0	0
Walsh creek	North-West Nelson Forest	782	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0
Wangapeka trib	North-West Nelson Forest	698	20	16	0	0	0	0	0	0	0	0	22	0	0	0	0
Wardens creek	High Country	1243	0	271	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfall creek	Southern Alps	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	538	82	2	2	0	25	0	0	0	9	4	29	0	0	0	1

SITE	**Ecoregion**	*Antipodochlora braueri*	*Zelandoperla sp.*	*Stenoperla prasina*	*Austroperla cyrene*	*Megaleptoperla grandis*	*Zelandobius furcillatus group*	*Zelandobius confusus group*	*Zelandobius 'x'*	*Taraperla ancilis*	*Taraperla howesi*	*Spaniocercoides sp.*	*Halticoperla sp.*	*Spaniocerca zelandica*	*Cristaperla sp.*	*Zelandobius illeisi*
2Anna	Central Mountains	0	11	0	0	0	4	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	0	90	12	105	0	1	0	0	0	0	0	0	0	0	0
Avalache stream	High Country	0	1	2	0	0	0	32	2	0	0	3	0	1	0	0
Beecham creek	North-West Nelson Forest	0	14	3	4	0	0	21	0	0	0	0	0	0	0	1
Black river	Westland Forest	0	0	2	1	0	0	76	0	50	0	9	0	0	0	0
Border stream	Westland Forest	0	1	2	11	19	0	0	0	0	0	0	0	0	0	0
Braken creek	Westland Forest	0	7	0	22	1	0	0	0	34	0	0	0	1	3	0
Brown trib	North-West Nelson Forest	0	40	7	0	0	0	34	0	1	0	0	0	0	0	0
Bruce tributary	High Country	0	0	20	4	0	0	145	0	0	0	8	2	99	4	0
Caution creek	Westland Forest	0	5	0	6	8	0	0	0	11	0	0	0	0	0	0
Cobb river	North-West Nelson Forest	0	232	28	4	0	0	192	4	4	0	0	0	0	0	0
Cold stream	Mt Taranaki Forest	0	37	5	1	3	61	0	0	0	3	0	0	0	2	0
Conor creek	North-West Nelson Forest	0	1	4	12	0	0	0	0	0	0	0	0	90	0	0
Cow Pasture Stm	Central Mountains	0	21	10	14	1	28	0	0	0	0	0	0	0	0	0
Craigieburn stream	High Country	0	4	0	0	0	0	6	104	0	0	0	0	0	0	0
Craigieburn tributary	High Country	0	0	0	1	0	0	50	214	0	0	0	0	30	10	0
Crashed Aircraft	Central Mountains	0	47	7	4	0	0	0	0	0	0	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	0	18	1	5	6	28	0	0	0	0	0	0	0	0	0
Devils Creek	Central Mountains	0	9	2	25	0	0	0	0	0	0	0	0	0	0	0
Devil's PunchBowl	High Country	0	57	1	0	0	0	151	127	0	0	0	0	0	0	0
Dry creek	High Country	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	0	107	1	2	0	0	0	0	0	0	0	0	0	0	0
Ford stream	Taupo Pleteau	0	21	12	1	0	0	11	0	0	0	0	0	1	0	0
Fossil creek	North-West Nelson Forest	0	17	4	0	0	0	9	0	2	0	1	0	0	0	0
Fox river	Westland Forest	0	8	0	9	11	0	0	0	0	0	0	0	4	0	0
Granity creek	North-West Nelson Forest	0	31	0	33	0	0	26	48	0	0	0	0	0	0	0
Greney's stream	High Country	0	8	8	1	4	0	51	7	0	0	0	0	1	0	0
Halpins stream	High Country	0	64	5	0	0	0	411	419	0	0	0	0	2	0	0
Hauroko 1	Southern Alps	0	1	0	0	0	0	0	0	0	0	0	0	3	49	0
Hauroko 2	Southern Alps	0	17	6	52	0	0	12	0	0	0	0	0	1	1	0
Hepatica stream	North-West Nelson Forest	0	1	7	122	0	0	16	0	0	0	0	0	57	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	3	13	17	0	7	0	0	0	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	29	6	21	3	9	0	0	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0
Karakarere	Northern Hill Country	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0
Katikara	Mt Taranaki Forest	0	9	2	17	0	60	30	0	0	2	0	0	0	0	1
Kaweora	Mt Taranaki Forest	0	188	5	8	8	5	0	0	0	0	0	0	0	2	0
Kiosk stream	Southern Alps	0	53	0	1	0	0	1	0	0	0	0	0	0	0	0
Kiwi Jacks creek	Westland Forest	0	15	1	4	6	0	0	0	0	0	0	0	0	0	0
Kowai tributary	High Country	0	4	14	0	0	0	0	0	0	0	0	0	0	0	0
Last creek	Southern Alps	0	0	3	14	1	0	9	0	3	0	0	0	7	3	0
Levapuro	Taupo Pleteau	0	35	2	2	0	3	0	0	0	1	0	0	2	0	0
Lyttle creek tributary	Westland Forest	0	2	0	24	0	1	0	0	0	0	0	0	9	0	0
Mackay creek	Southern Alps	0	29	0	6	0	0	7	5	0	0	0	0	1	0	0
Mamona	Mt Taranaki Forest	0	66	0	2	1	13	14	0	0	1	0	0	0	0	0
Manapouri 1	Southern Alps	0	60	0	2	0	0	23	1	0	0	0	0	0	0	0
Manapouri 2	Southern Alps	0	27	1	20	0	0	9	0	0	0	0	0	1	0	0
Manapouri 3	Southern Alps	0	11	0	28	0	0	51	0	5	0	0	0	3	0	0
Mangamuka	Northern Hill Country	0	12	2	1	0	0	0	0	0	0	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	0	63	0	15	2	6	0	0	0	0	0	0	0	0	0
Mangatarere Stm	Central Mountains	0	50	4	28	0	0	0	0	0	0	0	0	0	0	0
Mangatarere Tributary	Central Mountains	0	21	0	3	0	0	0	0	0	0	0	0	0	0	0
Marae	Northern Hill Country	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
McGrath creek	High Country	0	94	0	0	0	0	159	20	0	0	0	0	0	0	0
Merivale	Southern Alps	0	226	5	49	4	0	69	0	0	0	0	0	0	2	0
Merivale tributary	Southern Alps	0	11	2	76	0	0	31	0	3	0	0	0	6	7	0
Mikimiki Stm	Central Mountains	0	85	3	32	0	0	0	0	0	0	0	0	0	0	0
Mill's creek	Westland Forest	0	2	0	8	0	0	0	0	0	0	0	0	3	4	0
Mountain creek	Southern Alps	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

SITE	Ecoregion	*Antipodochlora braueri*	*Zelandoperla sp.*	*Stenoperla prasina*	*Austroperla cyrene*	*Megaleptoperla grandis*	*Zelandobius furcillatus group*	*Zelandobius confusus group*	*Zelandobius 'x'*	*Taraperla ancilis*	*Taraperla howesi*	*Spaniocercoides sp.*	*Halticoperla sp.*	*Spaniocerca zelandica*	*Cristaperla sp.*	*Zelandobius illeisi*
Ngutumoki	Mt Taranaki Forest	0	0	5	5	0	89	0	0	0	1	0	0	0	1	1
Oakura	Mt Taranaki Forest	0	7	3	6	1	13	0	0	0	4	0	0	0	0	0
Oaonui	Mt Taranaki Forest	0	499	3	2	7	1	0	0	0	0	0	0	0	0	0
O'Connor creek	Westland Forest	0	36	11	5	0	0	43	0	3	0	0	0	0	0	0
Opaopao	Northern Hill Country	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Orangahikoia	Taupo Pleteau	0	35	5	24	3	0	5	0	0	14	0	0	0	0	0
Orangitutaetutu	Taupo Pleteau	0	99	9	30	6	0	21	0	0	0	0	0	0	0	0
Orereti	Taupo Pleteau	0	22	10	1	1	2	203	0	0	0	0	0	1	0	0
Otapukawa	Taupo Pleteau	0	46	0	2	0	0	0	0	0	0	0	0	0	0	0
Ouri	Mt Taranaki Forest	0	70	9	31	50	49	0	0	0	2	0	0	0	2	0
Panatewaewae Stm	Central Mountains	0	496	9	37	0	7	0	0	0	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	0	13	4	11	0	0	0	0	8	0	0	0	0	0	0
Peel creek	North-West Nelson Forest	0	2	1	0	0	0	41	0	0	1	0	1	3	5	0
Pegleg	High Country	0	32	0	0	5	0	55	4	0	0	1	0	0	0	0
Plato creek	Southern Alps	0	56	1	35	2	0	2	7	0	0	0	0	10	1	0
Pohatu	Taupo Pleteau	0	9	9	5	0	1	0	0	0	0	0	0	0	0	0
Prices creek	North-West Nelson Forest	0	3	3	1	0	0	0	0	0	0	0	0	2	0	0
Pukekohe	Northern Hill Country	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0
Punaruku	Northern Hill Country	0	1	2	0	3	0	0	0	0	0	0	0	1	0	0
Pureanui	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	0	6	3	36	2	0	57	0	0	0	0	0	0	0	0
Reef creek	Central Mountains	0	32	5	50	0	13	0	0	0	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	3	0	0	1	0	0	0	0	0	0	0	2	0	0
Rocky creek	Westland Forest	0	1	0	0	0	0	0	0	11	0	0	0	0	0	0
Rough creek	High Country	0	155	2	0	1	0	97	128	0	0	0	0	0	0	0
Ruapapa	Taupo Pleteau	0	5	0	11	0	0	17	0	0	2	0	0	2	0	0
Sams creek	North-West Nelson Forest	0	20	5	0	0	0	5	0	1	0	0	0	5	0	0
Sheepy creek	North-West Nelson Forest	0	12	4	58	0	9	0	0	0	0	0	0	0	0	0
Sheridan Creek	Central Mountains	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Small creek	Westland Forest	0	22	0	20	3	5	0	0	6	0	0	0	7	0	0
Smithy creek	Westland Forest	0	288	17	34	13	0	67	22	0	0	0	0	0	0	0
Smithy's creek	Southern Alps	0	13	2	3	7	0	0	0	9	0	0	0	0	0	0
Soda spring	Northern Hill Country	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Stoney creek	Westland Forest	0	1	12	2	10	0	0	0	0	0	0	0	0	0	0
Stony creek (thirsty culvert)	Westland Forest	0	2	0	0	0	1	0	0	0	0	0	0	1	0	0
Ta Papa	Northern Hill Country	0	20	0	3	0	0	0	0	0	0	0	0	0	0	0
Te Karetu	Taupo Pleteau	0	8	2	12	12	0	12	0	0	2	0	0	0	0	0
Te Manawa	Taupo Pleteau	0	47	0	8	0	0	77	0	0	3	0	0	0	0	0
Te Popo	Mt Taranaki Forest	0	0	5	0	1	47	0	0	0	0	0	0	0	0	0
Thomas river tributary	High Country	0	273	2	0	0	0	1	4	0	0	0	0	2	0	0
Timaru	Mt Taranaki Forest	0	14	1	1	0	10	0	0	0	0	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	0	1	12	0	7	0	0	0	1	0	0	0	0	0
Tumutu	Northern Hill Country	0	29	0	4	0	0	0	0	0	0	0	0	0	0	0
Turnbull creek	North-West Nelson Forest	0	1	0	17	0	0	9	0	0	0	0	0	0	0	0
Twin creek	High Country	0	27	0	0	0	0	442	0	0	0	0	0	0	0	0
Waiaruhe	Taupo Pleteau	0	6	1	1	0	0	11	0	0	0	0	0	2	0	0
Waikare	Northern Hill Country	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Waikawa Stm	Central Mountains	0	128	18	13	1	1	0	0	0	0	0	0	0	0	0
Waikokatu	Northern Hill Country	0	7	4	3	2	0	0	0	0	0	0	0	0	0	1
Waikokatu trib.	Northern Hill Country	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0
Waiotukupuna	Taupo Pleteau	0	266	0	8	3	0	0	0	0	1	0	0	0	0	0
Waipoua	Northern Hill Country	0	25	0	1	2	0	0	0	0	0	0	0	0	0	0
Waipuku	Mt Taranaki Forest	0	5	4	10	30	36	0	0	0	3	0	0	0	0	0
Wairau	Northern Hill Country	2	0	10	3	1	0	0	0	0	0	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	0	0	0	3	0	0	22	0	0	3	0	0	0	0	0
Walker creek	Southern Alps	0	19	8	10	0	0	20	3	1	0	0	0	1	0	0
Walsh creek	North-West Nelson Forest	0	52	7	2	0	0	5	0	0	0	0	0	0	0	0
Wangapeka trib	North-West Nelson Forest	0	1	10	3	0	0	19	0	0	0	0	0	58	0	0
Wardens creek	High Country	0	23	1	0	0	0	5	0	0	0	0	0	0	0	0
Waterfall creek	Southern Alps	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	0	0	13	37	0	0	70	0	0	0	0	0	1	0	0

SITE	Ecoregion	*Acroperla trivacuata*	*Nesoperla sp.*	*Notonemoura sp.*	*Oeconesus similis*	*Zelandopsyche sp.*	*Olinga sp.*	*Baraeoptera sp.*	*Confluens sp.*	*Philorheithrus agilis*	*Pycnocentrodes sp.*	*Pycnocentria funerea*	*Pycnocentria evecta*	*Pycnocentria sylvestris*	*Zelolessica cheira*	*Zelolessica meizon*	*Hudsonema amabile*
2Anna	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	0	0	0	0	0	111	18	0	0	0	3	1	0	0	0	0
Avalache stream	High Country	0	0	0	2	0	2	0	0	2	0	0	0	0	0	0	0
Beecham creek	North-West Nelson Forest	0	0	0	0	0	222	431	1	0	0	0	1	3	0	0	0
Black river	Westland Forest	0	0	0	0	0	12	0	0	2	3	290	240	265	30	0	1
Border stream	Westland Forest	0	0	0	0	0	0	5	0	0	0	7	0	6	0	0	0
Braken creek	Westland Forest	0	0	0	9	0	0	0	0	3	0	0	0	0	50	0	0
Brown trib	North-West Nelson Forest	0	0	0	0	0	166	39	0	0	0	0	0	1	6	0	0
Bruce tributary	High Country	0	0	0	0	0	2	0	0	5	0	0	0	0	0	5	0
Caution creek	Westland Forest	0	0	0	2	0	5	0	0	3	0	0	0	0	0	0	0
Cobb river	North-West Nelson Forest	0	0	0	0	0	184	52	88	0	76	0	8	24	0	0	0
Cold stream	Mt Taranaki Forest	0	0	0	0	0	0	1	0	0	0	40	2	0	1	0	1
Conor creek	North-West Nelson Forest	0	0	0	0	0	6	6	3	12	0	0	0	8	70	0	0
Cow Pasture Stm	Central Mountains	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Craigieburn stream	High Country	0	0	0	1	0	71	10	12	0	17	0	12	0	4	0	0
Craigieburn tributary	High Country	0	0	0	0	0	86	0	0	29	0	0	0	0	0	0	0
Crashed Aircraft	Central Mountains	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Devils Creek	Central Mountains	0	0	0	0	0	128	5	0	0	0	0	0	0	0	0	0
Devil's PunchBowl	High Country	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Dry creek	High Country	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	0	0	0	0	0	752	0	48	0	4347	0	0	0	0	0	8
Ford stream	Taupo Pleteau	0	0	0	0	0	52	0	114	0	4	25	0	0	1	0	0
Fossil creek	North-West Nelson Forest	0	0	0	0	0	128	62	2	0	0	0	0	0	0	0	0
Fox river	Westland Forest	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Granity creek	North-West Nelson Forest	0	0	0	0	0	37	109	415	0	0	0	0	0	0	0	0
Greney's stream	High Country	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Halpins stream	High Country	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hauroko 1	Southern Alps	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hauroko 2	Southern Alps	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hepatica stream	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	11	171	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	0	0	0	0	385	8	0	0	15	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Karakarere	Northern Hill Country	0	0	0	0	0	80	0	0	0	1	0	0	0	0	0	1
Katikara	Mt Taranaki Forest	0	0	0	0	0	0	63	0	0	0	13	0	0	31	0	3
Kaweora	Mt Taranaki Forest	0	0	0	0	0	4	39	61	0	2	0	0	0	2	0	0
Kiosk stream	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kiwi Jacks creek	Westland Forest	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0
Kowai tributary	High Country	0	0	0	0	0	564	2720	0	0	1808	0	40	0	8	0	0
Last creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Levapuro	Taupo Pleteau	0	0	0	0	0	17	0	35	0	85	15	0	0	0	0	0
Lyttle creek tributary	Westland Forest	0	0	0	1	0	9	0	0	2	0	0	0	0	0	0	0
Mackay creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mamona	Mt Taranaki Forest	0	0	0	0	0	1	62	0	0	0	1	0	0	28	0	0
Manapouri 1	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manapouri 2	Southern Alps	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Manapouri 3	Southern Alps	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
Mangamuka	Northern Hill Country	0	0	0	0	0	67	34	0	0	42	0	0	0	1	0	2
Mangatainoka Tributary	Central Mountains	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Mangatarere Stm	Central Mountains	0	0	0	0	0	220	183	0	0	3	0	0	0	0	0	0
Mangatarere Tributary	Central Mountains	0	0	0	0	0	239	74	0	0	30	0	0	0	0	0	0
Marae	Northern Hill Country	0	0	0	0	0	611	0	0	0	343	0	0	0	0	0	7
McGrath creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Merivale	Southern Alps	0	0	0	1	0	17	0	0	0	0	0	0	0	0	1	0
Merivale tributary	Southern Alps	0	0	0	1	0	0	0	0	2	0	0	0	0	0	1	0
Mikimiki Stm	Central Mountains	0	0	0	0	0	950	93	0	0	3	4	0	0	0	0	0
Mill's creek	Westland Forest	0	0	1	0	0	41	0	0	3	0	0	0	0	3	0	0
Mountain creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

SITE	Ecoregion	*Acroperla trivacuata*	*Nesoperla sp.*	*Notonemoura sp.*	*Oeconesus similis*	*Zelandopsyche sp.*	*Olinga sp.*	*Baraeoptera sp.*	*Confluens sp.*	*Philorheithrus agilis*	*Pycnocentrodes sp.*	*Pycnocentria funerea*	*Pycnocentria evecta*	*Pycnocentria sylvestris*	*Zelolessica cheira*	*Zelolessica meizon*	*Hudsonema amabile*
Ngutumoki	Mt Taranaki Forest	0	0	0	0	0	0	2	0	0	0	2	0	0	12	0	2
Oakura	Mt Taranaki Forest	0	0	0	0	0	0	7	3	0	0	7	1	0	105	0	0
Oaonui	Mt Taranaki Forest	0	0	0	0	0	10	389	0	0	22	132	0	0	1	0	0
O'Connor creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0	0
Opaopao	Northern Hill Country	0	0	0	0	0	80	13	0	0	21	8	0	0	0	0	0
Orangahikoia	Taupo Pleteau	0	0	0	0	0	42	0	1	0	0	5	0	0	5	0	0
Orangitutaetutu	Taupo Pleteau	0	0	0	0	0	30	0	8	0	1	4	1	0	0	0	0
Orereti	Taupo Pleteau	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Otapukawa	Taupo Pleteau	0	0	0	0	0	215	0	0	0	57	0	0	0	0	0	1
Ouri	Mt Taranaki Forest	0	0	0	0	0	0	4	66	0	0	5	0	0	5	0	2
Panatewaewae Stm	Central Mountains	0	0	0	0	0	129	306	0	0	12	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	0	0	0	0	0	382	2083	0	0	113	0	0	0	0	0	0
Peel creek	North-West Nelson Forest	0	1	0	0	0	19	0	0	6	0	0	1	2	0	2	0
Pegleg	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plato creek	Southern Alps	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Pohatu	Taupo Pleteau	0	0	0	0	0	15	0	80	0	120	0	0	0	0	0	1
Prices creek	North-West Nelson Forest	0	0	0	1	0	33	18	167	5	0	0	0	0	26	0	0
Pukekohe	Northern Hill Country	0	0	0	0	0	424	0	0	0	67	0	0	0	0	0	5
Punaruku	Northern Hill Country	0	0	0	0	0	447	5	0	0	20	0	0	0	0	0	1
Pureanui	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Rahuinui	Taupo Pleteau	0	0	0	0	0	0	0	0	0	5	8	0	0	6	0	0
Reef creek	Central Mountains	0	0	0	0	0	43	10	0	0	0	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky creek	Westland Forest	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rough creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ruapapa	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	1	0	0	10	0	0
Sams creek	North-West Nelson Forest	0	0	0	0	0	293	443	46	0	0	0	2	0	20	0	0
Sheepy creek	North-West Nelson Forest	0	0	0	0	0	100	170	38	1	16	0	5	34	15	0	0
Sheridan Creek	Central Mountains	0	0	0	0	0	1	10	0	0	1	0	0	0	0	0	0
Small creek	Westland Forest	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0
Smithy creek	Westland Forest	0	0	0	0	0	2	0	0	0	0	0	0	0	0	9	0
Smithy's creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soda spring	Northern Hill Country	0	0	0	0	0	464	302	0	0	148	0	0	0	0	0	0
Stoney creek	Westland Forest	0	0	0	0	0	5	7	3	0	41	0	0	0	0	0	0
Stony creek (thirsty culvert)	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	0	0	0	0	0	114	877	0	0	439	0	9	0	0	0	0
Te Karetu	Taupo Pleteau	0	0	0	0	0	1	0	0	0	0	2	0	0	13	0	0
Te Manawa	Taupo Pleteau	0	0	0	0	0	10	0	16	0	16	0	7	0	5	0	0
Te Popo	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Thomas river tributary	High Country	0	0	0	0	0	95	60	0	0	12	0	0	0	0	0	0
Timaru	Mt Taranaki Forest	0	0	0	0	0	0	7	0	0	0	2	0	0	34	0	0
Timaru tributary	Mt Taranaki Forest	0	0	0	0	0	17	0	0	0	0	3	0	0	37	0	1
Tumutu	Northern Hill Country	0	0	0	0	0	12	1723	0	0	257	10	24	0	0	0	0
Turnbull creek	North-West Nelson Forest	0	0	0	0	0	2	1	0	0	0	0	0	4	3	0	0
Twin creek	High Country	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Waiaruhe	Taupo Pleteau	0	0	0	0	0	0	0	6	0	1	1	2	0	1	0	0
Waikare	Northern Hill Country	0	0	0	0	0	110	5	0	0	28	0	0	0	0	0	3
Waikawa Stm	Central Mountains	0	0	0	0	0	152	363	0	0	10	0	0	0	0	0	0
Waikokatu	Northern Hill Country	1	6	0	0	0	5	0	0	0	0	0	0	0	0	0	1
Waikokatu trib.	Northern Hill Country	0	0	0	0	0	2	2	0	0	0	0	0	0	1	0	4
Waiotukupuna	Taupo Pleteau	0	0	0	0	0	212	0	372	0	12	12	0	0	0	0	5
Waipoua	Northern Hill Country	0	0	0	0	0	62	57	0	0	7	15	4	0	1	0	0
Waipuku	Mt Taranaki Forest	0	0	0	0	0	1	5	5	0	0	4	1	0	11	0	0
Wairau	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0
Walker creek	Southern Alps	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Walsh creek	North-West Nelson Forest	0	0	0	0	0	164	20	0	0	0	0	1	0	0	0	0
Wangapeka trib	North-West Nelson Forest	0	0	0	0	0	14	6	33	1	0	0	0	0	0	63	0
Wardens creek	High Country	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Waterfall creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	0	0	0	0	0	6	0	3	0	0	15	0	0	0	0	0

SITE	Ecoregion	*Hudsonema alienum*	*Allocentrella sp.*	*Triplectides sp.*	*Rakiura vernale*	*Helicopsyche sp.*	*Aoteapsyche sp.*	*Orthopsyche sp.*	*Hydrobiosella stenocerca*	*Hydrobiosella mixta*	*Cryptobiosella sp.*	*Plectrocnemia maclachlani*	*Polyplectropus sp.*	*Psilochorema sp.*	*Hydrobiosis spatulata*
2Anna	Central Mountains	0	0	0	0	0	35	0	0	0	0	0	0	1	0
Anna's stream	Central Mountains	0	0	0	0	50	41	35	0	0	0	0	0	16	0
Avalache stream	High Country	0	0	0	0	0	0	0	2	0	0	0	0	1	0
Beecham creek	North-West Nelson Forest	0	0	0	0	88	21	0	0	0	0	0	0	3	0
Black river	Westland Forest	0	114	8	0	0	0	0	0	0	0	1	3	39	0
Border stream	Westland Forest	0	0	0	0	0	16	0	0	0	0	0	0	16	0
Braken creek	Westland Forest	0	0	1	0	0	0	0	0	0	0	0	0	15	8
Brown trib	North-West Nelson Forest	0	0	0	0	103	28	0	5	0	0	0	0	7	0
Bruce tributary	High Country	0	0	0	0	0	0	0	28	0	0	0	0	8	1
Caution creek	Westland Forest	0	0	0	0	0	0	0	2	0	0	0	0	6	0
Cobb river	North-West Nelson Forest	0	0	0	0	124	708	0	0	0	0	0	0	12	0
Cold stream	Mt Taranaki Forest	0	0	0	0	6	0	113	7	1	0	0	0	0	0
Conor creek	North-West Nelson Forest	0	0	0	0	32	162	0	135	0	0	0	0	13	1
Cow Pasture Stm	Central Mountains	0	0	0	0	1	21	17	17	0	0	0	0	4	0
Craigieburn stream	High Country	0	0	0	0	0	6	0	0	0	0	0	0	22	0
Craigieburn tributary	High Country	0	0	0	0	0	0	0	10	0	0	0	0	34	0
Crashed Aircraft	Central Mountains	0	0	0	0	0	37	0	0	0	0	0	0	3	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	4	0	101	1	0	0	0	0	0	0
Devils Creek	Central Mountains	0	0	0	0	13	6	70	6	0	0	0	0	17	0
Devil's PunchBowl	High Country	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Dry creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	0	0	0	0	11	217	0	0	0	0	4	0	38	0
Ford stream	Taupo Pleteau	0	0	0	0	84	20	323	13	6	0	0	0	3	0
Fossil creek	North-West Nelson Forest	0	0	0	0	119	23	0	2	0	0	0	0	0	0
Fox river	Westland Forest	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Granity creek	North-West Nelson Forest	0	0	0	11	0	50	0	0	6	0	0	0	22	0
Greney's stream	High Country	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Halpins stream	High Country	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Hauroko 1	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Hauroko 2	Southern Alps	0	0	0	0	0	0	0	22	0	0	0	0	12	1
Hepatica stream	North-West Nelson Forest	0	0	2	248	0	0	0	0	29	0	0	0	3	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	0	0	0	0	39	0	1	0	0	1	0	20	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	2	10	0	0	0	0	0	7	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Karakarere	Northern Hill Country	0	0	0	0	30	18	28	61	0	0	0	0	1	0
Katikara	Mt Taranaki Forest	0	0	0	0	8	0	17	2	0	0	0	0	0	0
Kaweora	Mt Taranaki Forest	0	0	0	0	4	0	160	0	0	0	0	0	4	0
Kiosk stream	Southern Alps	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Kiwi Jacks creek	Westland Forest	0	0	0	0	0	15	0	4	0	0	0	0	0	2
Kowai tributary	High Country	0	0	8	0	128	292	0	0	0	0	0	0	48	0
Last creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Levapuro	Taupo Pleteau	0	0	0	0	12	6	82	6	0	0	0	0	0	0
Lyttle creek tributary	Westland Forest	0	0	0	0	0	0	0	4	0	0	0	0	1	4
Mackay creek	Southern Alps	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Mamona	Mt Taranaki Forest	0	0	0	0	58	2	4	4	0	0	0	0	1	0
Manapouri 1	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Manapouri 2	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Manapouri 3	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	7	0
Mangamuka	Northern Hill Country	0	0	0	0	0	3	3	7	0	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	0	0	0	0	2	16	4	0	0	0	0	0	1	0
Mangatarere Stm	Central Mountains	0	0	0	0	30	4	7	10	0	0	0	0	8	0
Mangatarere Tributary	Central Mountains	0	0	0	0	431	251	0	0	0	0	0	0	7	0
Marae	Northern Hill Country	0	0	0	0	86	106	0	0	0	0	0	0	21	0
McGrath creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Merivale	Southern Alps	0	0	0	0	21	10	0	2	0	0	0	0	5	0
Merivale tributary	Southern Alps	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Mikimiki Stm	Central Mountains	0	0	0	0	212	64	12	0	0	0	0	0	12	0
Mill's creek	Westland Forest	0	0	22	0	0	0	0	5	0	1	0	0	10	9
Mountain creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SITE	**Ecoregion**	*Hudsonema alienum*	*Allocentrella sp.*	*Triplectides sp.*	*Rakiura vernale*	*Helicopsyche sp.*	*Aoteapsyche sp.*	*Orthopsyche sp.*	*Hydrobiosella stenocerca*	*Hydrobiosella mixta*	*Cryptobiosella sp.*	*Plectrocnemia maclachlani*	*Polyplectropus sp.*	*Psilochorema sp.*	*Hydrobiosis spatulata*
Ngutumoki	Mt Taranaki Forest	3	3	0	0	1	0	302	31	0	0	0	0	2	0
Oakura	Mt Taranaki Forest	0	7	0	0	4	0	28	0	0	0	0	0	2	0
Oaonui	Mt Taranaki Forest	0	0	0	0	0	116	0	0	0	0	0	0	2	0
O'Connor creek	Westland Forest	0	7	25	10	0	0	0	0	0	0	0	0	16	0
Opaopao	Northern Hill Country	0	0	0	0	180	80	0	6	0	0	0	0	7	0
Orangahikoia	Taupo Pleteau	0	0	0	0	0	0	5	1	0	0	0	0	0	0
Orangitutaetutu	Taupo Pleteau	0	0	0	0	0	12	0	0	0	0	0	0	3	0
Orereti	Taupo Pleteau	0	0	0	0	0	0	65	11	4	0	0	0	0	0
Otapukawa	Taupo Pleteau	0	0	0	0	0	33	0	0	0	0	7	0	35	0
Ouri	Mt Taranaki Forest	2	0	0	0	0	0	143	20	0	0	0	0	4	0
Panatewaewae Stm	Central Mountains	0	0	0	0	0	38	0	27	0	0	0	0	14	0
Pariwhakaoho river	North-West Nelson Forest	0	0	0	0	1834	182	0	0	0	0	0	0	14	0
Peel creek	North-West Nelson Forest	0	0	0	0	3	38	0	14	0	0	0	0	0	0
Pegleg	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plato creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Pohatu	Taupo Pleteau	1	0	0	0	63	524	0	2	0	0	0	0	9	0
Prices creek	North-West Nelson Forest	10	0	0	0	3	122	0	5	0	0	0	0	47	0
Pukekohe	Northern Hill Country	0	0	0	0	167	50	0	0	0	0	0	0	19	0
Punaruku	Northern Hill Country	0	0	1	0	32	40	0	0	0	0	0	0	7	0
Pureanui	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	0	4	0	0	8	0	358	6	3	0	0	0	0	0
Reef creek	Central Mountains	0	0	0	0	7	9	63	11	0	0	0	0	10	0
Ribbon wood creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Ruapapa	Taupo Pleteau	0	15	0	0	11	0	10	4	0	0	0	0	0	0
Sams creek	North-West Nelson Forest	0	0	1	0	25	253	0	20	0	0	0	0	7	0
Sheepy creek	North-West Nelson Forest	8	7	10	0	1760	113	0	8	0	0	0	0	14	0
Sheridan Creek	Central Mountains	0	0	0	0	0	4	0	0	0	0	0	0	8	0
Small creek	Westland Forest	0	1	0	0	0	1	0	0	0	0	0	0	1	0
Smithy creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	40	0
Smithy's creek	Southern Alps	0	0	0	0	0	5	0	0	0	0	0	0	1	0
Soda spring	Northern Hill Country	0	0	0	0	404	92	1	5	0	0	0	0	11	0
Stoney creek	Westland Forest	0	0	0	0	0	2	0	0	0	0	0	0	18	0
Stony creek (thirsty culvert)	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	0	0	0	0	11	228	0	0	0	0	0	0	0	0
Te Karetu	Taupo Pleteau	0	0	1	0	0	0	30	13	0	0	0	0	0	0
Te Manawa	Taupo Pleteau	0	0	0	0	103	0	42	11	2	0	0	0	0	0
Te Popo	Mt Taranaki Forest	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Thomas river tributary	High Country	0	0	0	0	0	124	0	1	0	0	0	0	9	0
Timaru	Mt Taranaki Forest	0	0	0	0	4	0	9	4	0	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	8	0	0	2	0	33	3	0	0	0	0	0	0
Tumutu	Northern Hill Country	0	0	0	0	0	93	0	0	0	0	0	0	0	0
Turnbull creek	North-West Nelson Forest	0	0	2	0	479	14	0	5	0	0	0	0	1	0
Twin creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Waiaruhe	Taupo Pleteau	0	0	0	0	84	0	15	3	0	0	0	0	0	0
Waikare	Northern Hill Country	0	0	0	0	155	0	40	1	0	0	0	0	4	0
Waikawa Stm	Central Mountains	0	0	0	0	483	21	0	11	0	0	0	0	7	0
Waikokatu	Northern Hill Country	0	0	0	0	1	0	45	15	0	0	0	0	8	0
Waikokatu trib.	Northern Hill Country	0	0	0	0	0	0	24	15	0	0	0	2	5	0
Waiotukupuna	Taupo Pleteau	0	0	0	0	608	80	0	0	0	0	0	0	6	0
Waipoua	Northern Hill Country	0	0	1	0	6	97	10	3	0	0	1	0	0	0
Waipuku	Mt Taranaki Forest	0	0	0	0	7	0	528	6	0	0	0	0	1	0
Wairau	Northern Hill Country	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	2	1	0	0	3	0	45	0	0	0	0	0	0	0
Walker creek	Southern Alps	0	0	0	0	0	23	0	1	0	0	0	0	13	0
Walsh creek	North-West Nelson Forest	0	0	0	252	0	4	0	0	0	0	0	0	1	0
Wangapeka trib	North-West Nelson Forest	0	0	0	21	0	301	0	82	0	0	0	0	1	0
Wardens creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Waterfall creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	0	0	0	0	0	0	9	8	3	0	0	0	3	0

SITE	**Ecoregion**	*Hydrobiosis charadraea*	*Hydrobiosis silvicola*	*Hydrobiosis harpidiosa*	*Hydrobiosis parumbripennis*	*Hydrobiosis umbripennis*	*Hydrobiosis gollanis*	*Hydrobiosis clavigera group*	*Hydrobiosidae 'X'*	*Edpercivalia maxima*	*Costachorema callista group*	*Costachorema xanthoptera*	*Costachorema brachyptera*	*Hydrochorema crassicaudatum*	*Neurochorema forsteri*	*Neurochorema confusum*
2Anna	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	0	0	0	3	0	1	3	0	0	0	0	0	0	0	0
Avalache stream	High Country	0	0	0	0	0	0	0	13	2	0	0	5	0	0	0
Beecham creek	North-West Nelson Forest	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0
Black river	Westland Forest	0	0	0	0	0	1	0	0	0	4	0	0	0	0	0
Border stream	Westland Forest	0	0	0	32	0	2	0	1	0	0	0	2	0	0	0
Braken creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown trib	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0
Bruce tributary	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caution creek	Westland Forest	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0
Cobb river	North-West Nelson Forest	0	0	0	84	0	0	4	0	0	0	0	0	0	96	0
Cold stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conor creek	North-West Nelson Forest	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Cow Pasture Stm	Central Mountains	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0
Craigieburn stream	High Country	0	0	0	9	0	0	0	0	0	0	0	0	0	9	0
Craigieburn tributary	High Country	2	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Crashed Aircraft	Central Mountains	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Devils Creek	Central Mountains	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0
Devil's PunchBowl	High Country	19	6	0	0	0	0	0	1	0	0	0	7	0	0	0
Dry creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	0	0	0	13	0	0	2	0	0	0	0	0	0	0	0
Ford stream	Taupo Pleteau	0	0	0	4	0	0	3	0	0	13	0	0	0	0	0
Fossil creek	North-West Nelson Forest	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Fox river	Westland Forest	3	5	0	1	0	0	0	0	0	7	0	0	0	0	0
Granity creek	North-West Nelson Forest	0	0	0	5	0	0	8	0	0	0	0	0	0	0	0
Greney's stream	High Country	25	6	0	0	0	0	0	5	1	0	0	9	0	0	0
Halpins stream	High Country	12	7	0	0	0	0	0	0	0	0	0	10	0	0	0
Hauroko 1	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hauroko 2	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatica stream	North-West Nelson Forest	0	1	0	2	0	4	0	0	0	0	0	0	0	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Karakarere	Northern Hill Country	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0
Katikara	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kaweora	Mt Taranaki Forest	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
Kiosk stream	Southern Alps	2	0	0	1	0	0	0	0	0	0	0	11	0	0	0
Kiwi Jacks creek	Westland Forest	4	1	0	0	0	0	0	0	0	4	0	0	0	0	0
Kowai tributary	High Country	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0
Last creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
Levapuro	Taupo Pleteau	0	0	0	4	0	0	0	0	0	7	1	0	0	0	0
Lyttle creek tributary	Westland Forest	0	2	0	0	0	0	0	0	1	1	0	0	0	0	0
Mackay creek	Southern Alps	2	0	0	0	0	0	0	0	0	0	0	24	0	0	0
Mamona	Mt Taranaki Forest	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Manapouri 1	Southern Alps	4	0	3	0	0	0	0	0	0	0	0	7	0	0	0
Manapouri 2	Southern Alps	6	7	0	0	0	0	0	0	0	0	0	5	0	0	0
Manapouri 3	Southern Alps	0	9	0	0	0	0	0	0	0	0	0	4	0	0	0
Mangamuka	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Mangatainoka Tributary	Central Mountains	0	0	0	4	1	0	5	0	0	13	0	0	0	0	0
Mangatarere Stm	Central Mountains	0	0	0	2	0	0	4	0	0	6	0	0	0	1	0
Mangatarere Tributary	Central Mountains	0	0	0	6	0	0	5	0	0	2	0	0	0	4	0
Marae	Northern Hill Country	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0
McGrath creek	High Country	2	0	0	0	0	0	0	0	0	0	0	7	0	0	0
Merivale	Southern Alps	5	3	0	0	0	0	0	0	0	0	0	3	0	0	0
Merivale tributary	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mikimiki Stm	Central Mountains	0	0	0	3	0	0	5	0	0	0	0	0	0	0	0
Mill's creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mountain creek	Southern Alps	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0

SITE	Ecoregion	*Hydrobiosis charadraea*	*Hydrobiosis silvicola*	*Hydrobiosis harpidiosa*	*Hydrobiosis parumbripennis*	*Hydrobiosis umbripennis*	*Hydrobiosis gollanis*	*Hydrobiosis clavigera group*	*Hydrobiosidae 'X'*	*Edpercivalia maxima*	*Costachorema callista group*	*Costachorema xanthoptera*	*Costachorema brachyptera*	*Hydrochorema crassicaudatum*	*Neurochorema forsteri*	*Neurochorema confusum*
Ngutumoki	Mt Taranaki Forest	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oakura	Mt Taranaki Forest	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oaonui	Mt Taranaki Forest	0	0	0	3	0	0	0	0	0	1	2	0	0	0	2
O'Connor creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opaopao	Northern Hill Country	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Orangahikoia	Taupo Pleteau	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0
Orangitutaetutu	Taupo Pleteau	0	0	0	15	0	0	1	0	0	3	0	0	0	0	0
Orereti	Taupo Pleteau	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Otapukawa	Taupo Pleteau	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ouri	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0
Panatewaewae Stm	Central Mountains	0	0	0	1	0	0	5	0	0	1	0	0	1	0	0
Pariwhakaoho river	North-West Nelson Forest	0	0	0	29	0	0	1	0	0	0	0	0	7	4	0
Peel creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Pegleg	High Country	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Plato creek	Southern Alps	11	2	0	0	0	0	0	0	0	0	0	16	0	0	0
Pohatu	Taupo Pleteau	0	0	0	18	0	0	3	0	0	1	0	0	0	0	0
Prices creek	North-West Nelson Forest	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
Pukekohe	Northern Hill Country	0	0	0	16	0	0	1	0	0	0	0	0	0	2	0
Punaruku	Northern Hill Country	0	0	0	5	0	0	6	0	0	0	0	0	0	2	0
Pureanui	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reef creek	Central Mountains	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	2	0	0	0	0	0	2	0	4	0	0	0	0	0
Rocky creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough creek	High Country	14	0	0	0	0	0	0	0	0	0	0	13	0	0	0
Ruapapa	Taupo Pleteau	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0
Sams creek	North-West Nelson Forest	0	0	0	4	0	0	6	0	0	0	0	4	0	0	0
Sheepy creek	North-West Nelson Forest	0	0	0	5	0	1	1	0	0	0	0	0	0	0	0
Sheridan Creek	Central Mountains	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0
Small creek	Westland Forest	4	20	0	0	0	0	0	0	0	0	0	40	0	0	0
Smithy creek	Westland Forest	9	0	0	3	0	0	0	0	0	0	0	19	0	0	0
Smithy's creek	Southern Alps	0	0	2	0	0	0	0	0	0	5	0	0	0	0	0
Soda spring	Northern Hill Country	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0
Stoney creek	Westland Forest	0	0	0	3	0	0	0	0	0	0	0	3	0	0	0
Stony creek (thirsty culvert)	Westland Forest	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	0	0	0	2	0	0	0	0	0	0	1	0	0	3	0
Te Karetu	Taupo Pleteau	0	0	0	1	0	1	0	0	0	1	0	0	0	0	1
Te Manawa	Taupo Pleteau	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
Te Popo	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thomas river tributary	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timaru	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Tumutu	Northern Hill Country	0	0	0	9	0	0	0	0	0	1	0	0	0	0	1
Turnbull creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Twin creek	High Country	4	0	0	0	0	0	0	1	0	0	0	3	0	0	0
Waiaruhe	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikare	Northern Hill Country	0	0	0	2	0	0	10	0	0	0	0	0	0	0	0
Waikawa Stm	Central Mountains	0	0	0	2	0	0	5	0	0	2	0	0	0	0	0
Waikokatu	Northern Hill Country	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Waikokatu trib.	Northern Hill Country	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Waiotukupuna	Taupo Pleteau	0	0	0	12	0	0	0	0	0	0	0	0	0	5	0
Waipoua	Northern Hill Country	0	0	0	4	0	0	0	0	0	5	0	0	0	1	0
Waipuku	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Wairau	Northern Hill Country	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Walker creek	Southern Alps	0	4	0	4	0	0	0	0	0	0	0	5	0	0	2
Walsh creek	North-West Nelson Forest	4	0	0	0	0	0	0	0	0	0	0	7	0	0	0
Wangapeka trib	North-West Nelson Forest	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Wardens creek	High Country	11	7	0	0	0	0	0	0	0	0	0	7	0	0	0
Waterfall creek	Southern Alps	2	0	0	0	0	0	0	0	0	0	0	7	0	0	0
Wharetoe	Taupo Pleteau	0	0	0	1	0	0	1	0	0	3	0	0	0	0	0

SITE	Ecoregion	*Hydrobiosidae early instar*	*Oxyethira sp.*	Trichopteran pupa	*Archichauliodes diversus*	*Elmidae sp.*	*Scirtidae sp.*	Hydraenidae	*Ptilodactylidae sp.*	Hydrinid larva	*Elmidae (adult)*	*Aphrophila neozelandica*	*Eriopterini sp.*	*Neocurupira tonnoiri*	*Neocurupira hudsoni*	*Peritheates harissi*	*Peritheates turrifer*
2Anna	Central Mountains	1	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	24	0	2	69	34	0	57	10	0	0	37	5	0	0	0	0
Avalache stream	High Country	9	0	0	0	10	3	4	0	0	0	0	0	0	0	0	0
Beecham creek	North-West Nelson Forest	13	0	0	9	4	0	14	0	0	0	45	0	1	12	0	0
Black river	Westland Forest	30	8	2	30	74	3	16	0	0	0	0	3	0	0	0	0
Border stream	Westland Forest	44	0	0	4	188	0	1	0	0	0	47	9	0	0	0	0
Braken creek	Westland Forest	7	0	0	0	31	1	17	0	0	0	0	0	0	0	0	0
Brown trib	North-West Nelson Forest	16	0	0	13	13	0	8	0	0	0	8	0	0	2	0	0
Bruce tributary	High Country	3	0	1	0	4	2	0	0	0	0	1	1	0	0	0	0
Caution creek	Westland Forest	6	0	0	0	71	0	4	0	0	0	0	1	0	0	0	0
Cobb river	North-West Nelson Forest	208	0	0	0	132	0	144	0	0	0	524	0	0	0	0	0
Cold stream	Mt Taranaki Forest	6	0	0	4	73	0	9	1	0	0	30	11	0	0	0	0
Conor creek	North-West Nelson Forest	3	0	0	0	326	0	10	5	0	0	1	8	0	3	0	0
Cow Pasture Stm	Central Mountains	7	0	0	43	46	0	4	0	0	0	8	3	0	0	0	0
Craigieburn stream	High Country	42	1	0	19	1	13	1	0	0	0	11	1	0	0	0	0
Craigieburn tributary	High Country	86	0	1	0	140	0	114	0	0	0	0	14	0	0	0	0
Crashed Aircraft	Central Mountains	8	0	0	9	1	0	8	0	0	0	6	1	0	0	0	0
Crusher stream	Mt Taranaki Forest	5	0	0	0	40	0	8	0	0	0	5	0	0	0	0	0
Devils Creek	Central Mountains	44	0	0	66	36	0	19	0	0	0	7	0	0	0	3	0
Devil's PunchBowl	High Country	26	0	0	0	732	0	0	0	0	0	81	7	0	4	0	0
Dry creek	High Country	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	48	0	7	14	67	0	116	0	0	0	82	6	0	0	0	0
Ford stream	Taupo Pleteau	39	0	0	56	44	0	54	0	0	0	16	6	0	0	0	0
Fossil creek	North-West Nelson Forest	12	0	0	8	0	0	5	0	0	0	4	0	25	3	0	0
Fox river	Westland Forest	20	2	0	0	55	1	1	0	0	0	18	0	0	0	0	0
Granity creek	North-West Nelson Forest	25	0	0	8	750	0	6	0	0	0	76	0	2	0	0	0
Greney's stream	High Country	28	0	0	0	330	0	13	0	0	0	0	6	0	0	0	0
Halpins stream	High Country	9	0	0	0	418	0	2	0	0	0	144	8	0	67	0	0
Hauroko 1	Southern Alps	1	0	0	0	0	32	0	0	0	0	0	30	0	0	0	0
Hauroko 2	Southern Alps	3	0	0	0	200	3	19	0	0	0	0	26	0	0	0	0
Hepatica stream	North-West Nelson Forest	22	1	3	0	141	0	1	4	0	0	13	0	0	0	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	6	0	2	18	165	0	51	0	0	0	9	4	0	0	4	0
Kapakapanui Stm	Central Mountains	21	0	0	5	87	0	5	1	0	0	1	3	0	0	0	0
Kapuni	Mt Taranaki Forest	3	0	0	0	4	0	0	0	0	0	4	5	0	0	0	0
Karakarere	Northern Hill Country	12	0	2	8	54	1	12	0	0	1	2	0	0	0	0	0
Katikara	Mt Taranaki Forest	0	0	0	15	75	0	14	0	0	0	33	0	0	0	0	0
Kaweora	Mt Taranaki Forest	13	0	1	10	138	0	37	1	0	0	62	5	0	0	0	0
Kiosk stream	Southern Alps	11	0	0	0	0	1	2	0	0	0	3	6	0	0	0	0
Kiwi Jacks creek	Westland Forest	6	0	0	0	531	0	7	0	0	0	0	2	4	0	0	0
Kowai tributary	High Country	98	0	4	36	48	0	10	0	0	0	226	0	0	0	0	0
Last creek	Southern Alps	2	0	0	0	0	0	3	0	0	0	1	5	0	0	0	0
Levapuro	Taupo Pleteau	18	0	1	33	113	0	69	0	0	0	44	18	0	0	0	0
Lyttle creek tributary	Westland Forest	0	0	0	0	89	0	8	0	0	0	0	33	0	0	0	0
Mackay creek	Southern Alps	30	0	0	1	4	0	0	0	0	0	6	7	0	2	0	0
Mamona	Mt Taranaki Forest	13	1	0	15	59	0	4	0	0	0	40	2	0	0	0	0
Manapouri 1	Southern Alps	4	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0
Manapouri 2	Southern Alps	33	0	0	0	139	0	0	0	0	1	0	1	0	0	0	0
Manapouri 3	Southern Alps	23	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0
Mangamuka	Northern Hill Country	3	0	0	6	9	0	15	0	0	0	7	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	11	0	0	3	180	0	4	0	1	0	19	3	0	0	0	0
Mangatarere Stm	Central Mountains	5	0	0	29	198	0	27	0	0	0	34	0	0	0	0	0
Mangatarere Tributary	Central Mountains	22	1	1	9	505	0	37	0	0	0	51	0	0	0	0	0
Marae	Northern Hill Country	24	0	5	6	452	0	70	0	0	0	7	0	0	0	0	0
McGrath creek	High Country	2	0	0	0	32	0	0	0	0	0	5	1	0	46	0	0
Merivale	Southern Alps	8	0	0	4	86	10	18	0	0	0	0	10	0	0	0	0
Merivale tributary	Southern Alps	8	0	0	0	38	13	4	0	0	0	0	9	0	0	0	0
Mikimiki Stm	Central Mountains	35	0	0	49	325	0	33	1	0	0	34	2	0	0	0	0
Mill's creek	Westland Forest	20	0	1	0	0	0	3	0	0	0	1	1	0	0	0	0
Mountain creek	Southern Alps	0	0	0	0	0	0	6	0	0	0	0	6	0	0	0	0

SITE	Ecoregion	*Hydrobiosidae early instar*	*Oxyethira sp.*	Trichopteran pupa	*Archichauliodes diversus*	*Elmidae sp.*	*Scirtidae sp.*	Hydraenidae	*Ptilodactylidae sp.*	Hydrinid larva	*Elmidae (adult)*	*Aphrophila neozelandica*	*Eriopterini sp.*	*Neocurupira tonnoiri*	*Neocurupira hudsoni*	*Peritheates harissi*	*Peritheates turrifer*
Ngutumoki	Mt Taranaki Forest	16	0	0	2	24	0	5	1	0	0	0	0	0	0	0	0
Oakura	Mt Taranaki Forest	8	0	0	23	38	0	13	0	0	0	25	1	0	0	0	0
Oaonui	Mt Taranaki Forest	27	7	0	46	57	0	15	0	0	0	6	10	0	0	0	0
O'Connor creek	Westland Forest	31	0	0	1	59	0	204	0	0	0	4	0	0	0	0	0
Opaopao	Northern Hill Country	9	0	0	19	189	0	185	2	0	1	2	1	0	0	0	0
Orangahikoia	Taupo Pleteau	22	0	0	47	211	0	67	16	0	0	7	15	0	0	0	0
Orangitutaetutu	Taupo Pleteau	17	0	0	27	401	0	69	1	0	0	7	20	0	0	0	0
Orereti	Taupo Pleteau	4	0	0	0	44	0	21	1	1	0	0	18	0	0	1	0
Otapukawa	Taupo Pleteau	15	0	0	3	51	0	11	0	0	0	1	16	0	0	0	0
Ouri	Mt Taranaki Forest	5	0	0	16	72	0	49	1	0	0	30	6	0	0	0	0
Panatewaewae Stm	Central Mountains	14	0	0	8	154	0	17	0	0	0	13	3	0	0	25	0
Pariwhakaoho river	North-West Nelson Forest	190	0	2	5	23	0	31	0	0	0	195	0	8	0	0	0
Peel creek	North-West Nelson Forest	15	0	0	0	7	4	138	1	0	0	0	0	0	0	0	0
Pegleg	High Country	0	0	0	0	40	0	0	0	0	1	1	0	0	21	4	0
Plato creek	Southern Alps	19	0	2	0	235	0	13	0	0	0	0	4	0	37	0	0
Pohatu	Taupo Pleteau	53	0	5	38	130	0	86	3	0	2	48	0	0	0	0	0
Prices creek	North-West Nelson Forest	23	0	0	14	56	12	6	3	0	0	54	0	0	0	0	0
Pukekohe	Northern Hill Country	43	0	0	14	507	0	9	1	0	0	7	2	0	0	0	0
Punaruku	Northern Hill Country	22	0	2	0	470	2	54	0	0	0	4	3	0	0	0	0
Pureanui	Northern Hill Country	2	0	0	7	2	0	0	0	0	1	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	9	0	0	0	207	0	3	1	0	0	0	3	0	0	1	0
Reef creek	Central Mountains	19	0	1	14	24	0	20	0	0	0	4	5	0	0	0	0
Ribbon wood creek	Westland Forest	7	0	0	0	21	0	0	0	0	0	1	2	1	0	0	0
Rocky creek	Westland Forest	0	0	0	0	68	0	0	0	0	0	0	0	0	0	0	0
Rough creek	High Country	6	0	0	0	122	0	1	0	0	0	5	1	0	20	0	0
Ruapapa	Taupo Pleteau	4	0	2	10	33	0	68	0	0	0	1	5	0	0	0	0
Sams creek	North-West Nelson Forest	14	18	0	2	21	0	68	0	1	0	19	0	0	0	0	0
Sheepy creek	North-West Nelson Forest	74	21	0	14	42	0	70	0	0	0	61	0	0	0	0	0
Sheridan Creek	Central Mountains	6	0	0	1	48	0	0	0	0	1	9	3	0	0	0	0
Small creek	Westland Forest	41	0	1	0	597	0	1	0	0	0	2	0	5	0	0	0
Smithy creek	Westland Forest	101	0	0	1	100	0	19	0	0	0	3	14	0	0	0	0
Smithy's creek	Southern Alps	6	0	0	0	87	0	15	0	0	0	2	0	5	0	0	0
Soda spring	Northern Hill Country	9	0	0	14	74	0	27	0	0	0	10	0	0	0	0	0
Stoney creek	Westland Forest	22	0	1	2	79	0	0	0	0	0	3	22	1	0	0	0
Stony creek (thirsty culvert)	Westland Forest	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	15	0	0	37	89	0	3	0	0	0	40	0	0	0	0	0
Te Karetu	Taupo Pleteau	4	0	0	84	14	0	17	7	0	0	0	3	0	0	0	0
Te Manawa	Taupo Pleteau	11	0	0	19	14	0	43	2	0	0	1	4	0	0	0	0
Te Popo	Mt Taranaki Forest	0	1	0	0	582	0	14	0	0	0	7	28	0	0	0	0
Thomas river tributary	High Country	3	0	0	8	49	1	0	0	0	0	0	1	0	0	0	0
Timaru	Mt Taranaki Forest	0	0	0	2	49	0	5	0	0	0	53	2	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	0	0	11	39	0	13	0	0	0	4	0	0	0	0	0
Tumutu	Northern Hill Country	26	4	1	43	82	0	0	1	0	0	30	0	0	0	0	0
Turnbull creek	North-West Nelson Forest	10	0	0	0	2	0	6	0	0	0	1	0	2	0	0	0
Twin creek	High Country	3	0	0	0	41	0	0	0	0	0	0	0	0	7	1	0
Waiaruhe	Taupo Pleteau	3	0	0	10	2	0	6	1	0	0	0	0	0	0	1	0
Waikare	Northern Hill Country	11	0	0	2	149	0	43	0	0	0	0	2	0	0	0	0
Waikawa Stm	Central Mountains	28	0	0	7	107	0	12	1	0	0	1	3	0	0	37	0
Waikokatu	Northern Hill Country	10	0	0	4	8	8	7	0	0	0	4	1	0	0	0	0
Waikokatu trib.	Northern Hill Country	14	0	0	1	5	5	1	0	0	0	0	1	0	0	0	0
Waiotukupuna	Taupo Pleteau	69	0	0	44	0	0	27	0	0	0	5	1	0	0	0	0
Waipoua	Northern Hill Country	6	0	0	6	54	0	1	0	0	4	47	0	0	0	0	0
Waipuku	Mt Taranaki Forest	4	0	0	0	132	0	31	2	0	0	75	2	0	0	0	0
Wairau	Northern Hill Country	6	0	0	52	66	4	24	16	0	0	0	1	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	4	0	0	0	9	0	2	6	0	0	1	0	0	0	0	0
Walker creek	Southern Alps	38	0	0	29	8	0	2	0	0	0	52	8	0	0	0	0
Walsh creek	North-West Nelson Forest	14	0	0	2	5	0	4	0	0	0	12	0	0	9	0	15
Wangapeka trib	North-West Nelson Forest	1	0	1	0	194	0	12	3	0	0	18	1	0	0	0	0
Wardens creek	High Country	23	0	0	0	49	0	10	0	0	0	0	10	0	1	0	2
Waterfall creek	Southern Alps	6	0	0	0	1	0	0	0	0	0	0	5	0	5	0	0
Wharetoe	Taupo Pleteau	10	0	1	34	34	0	28	11	2	0	4	38	0	0	0	0

SITE	Ecoregion	*Limonia nigrescens*	*Paralimnophila skusei*	*Hexatomini sp.*	*Psychodidae sp.*	*Tabanidae sp.*	*Mischoderus sp.*	*Muscidae sp.*	*Ceratopogonidae sp.*	*Empididae sp.*	*Molophilus sp.*	*Hydrophilidae sp.*	Dipteran pupa	Amphipoda	Isopoda	Ostracoda
2Anna	Central Mountains	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Anna's stream	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avalache stream	High Country	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Beecham creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black river	Westland Forest	0	1	2	0	0	0	1	0	0	2	0	0	0	0	0
Border stream	Westland Forest	0	0	0	0	0	0	0	0	5	0	0	0	1	0	0
Braken creek	Westland Forest	0	0	0	1	0	0	0	1	7	2	0	0	0	0	0
Brown trib	North-West Nelson Forest	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Bruce tributary	High Country	3	1	0	0	25	0	0	0	1	0	0	0	0	3	0
Caution creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Cobb river	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cold stream	Mt Taranaki Forest	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0
Conor creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Cow Pasture Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Craigieburn stream	High Country	2	3	2	0	0	0	15	0	7	0	0	0	0	0	0
Craigieburn tributary	High Country	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0
Crashed Aircraft	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Devils Creek	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Devil's PunchBowl	High Country	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Dry creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	0	2	0	0	1	0	0	0	0	0	0	3	0	0	0
Ford stream	Taupo Pleteau	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Fossil creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fox river	Westland Forest	9	0	0	1	0	0	0	0	0	1	0	2	0	0	0
Granity creek	North-West Nelson Forest	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Greney's stream	High Country	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Halpins stream	High Country	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Hauroko 1	Southern Alps	0	10	0	0	0	7	1	1	4	0	0	0	1	0	0
Hauroko 2	Southern Alps	3	2	0	1	0	4	0	0	6	2	0	0	35	3	0
Hepatica stream	North-West Nelson Forest	0	0	1	0	0	0	0	0	110	0	0	4	2	1	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0
Karakarere	Northern Hill Country	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Katikara	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Kaweora	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Kiosk stream	Southern Alps	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Kiwi Jacks creek	Westland Forest	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Kowai tributary	High Country	8	6	0	0	0	0	2	0	6	0	0	0	0	0	0
Last creek	Southern Alps	1	0	0	0	0	0	0	0	22	1	0	0	0	0	0
Levapuro	Taupo Pleteau	0	0	0	0	0	1	0	0	7	0	0	9	0	0	0
Lyttle creek tributary	Westland Forest	1	0	1	2	0	0	0	0	2	1	0	0	2	0	0
Mackay creek	Southern Alps	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Mamona	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Manapouri 1	Southern Alps	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Manapouri 2	Southern Alps	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
Manapouri 3	Southern Alps	1	0	1	0	0	0	1	1	1	3	0	0	0	0	0
Mangamuka	Northern Hill Country	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Mangatarere Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangatarere Tributary	Central Mountains	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0
Marae	Northern Hill Country	0	8	0	0	3	0	0	0	1	0	0	3	0	0	0
McGrath creek	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Merivale	Southern Alps	0	1	0	0	0	0	0	0	1	0	0	0	15	0	0
Merivale tributary	Southern Alps	0	0	0	0	0	0	0	0	7	1	5	0	175	1	0
Mikimiki Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mill's creek	Westland Forest	0	0	0	0	0	0	1	0	6	0	0	0	0	0	1
Mountain creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

SITE	Ecoregion	*Limonia nigrescens*	*Paralimnophila skusei*	*Hexatomini sp.*	*Psychodidae sp.*	*Tabanidae sp.*	*Mischoderus sp.*	*Muscidae sp.*	*Ceratopogonidae sp.*	*Empididae sp.*	*Molophilus sp.*	*Hydrophilidae sp.*	Dipteran pupa	Amphipoda	Isopoda	Ostracoda
Ngutumoki	Mt Taranaki Forest	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Oakura	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Oaonui	Mt Taranaki Forest	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
O'Connor creek	Westland Forest	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Opaopao	Northern Hill Country	0	11	0	0	0	0	0	0	0	0	1	0	0	0	0
Orangahikoia	Taupo Pleteau	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0
Orangitutaetutu	Taupo Pleteau	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Orereti	Taupo Pleteau	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Otapukawa	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ouri	Mt Taranaki Forest	0	0	0	0	0	0	2	0	0	1	0	2	1	0	0
Panatewaewae Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	0	0	0	0	0	0	6	0	0	0	0	2	0	0	0
Peel creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0
Pegleg	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plato creek	Southern Alps	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Pohatu	Taupo Pleteau	0	2	0	0	0	0	0	0	2	0	0	3	0	0	0
Prices creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0
Pukekohe	Northern Hill Country	0	2	0	0	3	0	0	0	1	0	0	0	0	0	0
Punaruku	Northern Hill Country	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0
Pureanui	Northern Hill Country	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	0	0	0	0	0	0	0	0	4	0	4	0	1	0	0
Reef creek	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocky creek	Westland Forest	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Rough creek	High Country	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Ruapapa	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sams creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sheepy creek	North-West Nelson Forest	3	2	0	0	0	0	0	0	15	0	0	1	0	0	0
Sheridan Creek	Central Mountains	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Small creek	Westland Forest	4	0	0	0	0	0	17	0	0	1	0	0	0	0	0
Smithy creek	Westland Forest	0	0	0	0	0	0	8	0	2	0	0	0	0	0	0
Smithy's creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Soda spring	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stoney creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stony creek (thirsty culvert)	Westland Forest	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0
Ta Papa	Northern Hill Country	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
Te Karetu	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Te Manawa	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Te Popo	Mt Taranaki Forest	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Thomas river tributary	High Country	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Timaru	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Tumutu	Northern Hill Country	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Turnbull creek	North-West Nelson Forest	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Twin creek	High Country	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Waiaruhe	Taupo Pleteau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikare	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikawa Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikokatu	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Waikokatu trib.	Northern Hill Country	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Waiotukupuna	Taupo Pleteau	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0
Waipoua	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0
Waipuku	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Wairau	Northern Hill Country	0	1	0	0	0	0	0	0	7	0	0	0	551	0	0
Waiwhakaiho	Mt Taranaki Forest	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0
Walker creek	Southern Alps	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0
Walsh creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wangapeka trib	North-West Nelson Forest	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Wardens creek	High Country	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Waterfall creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0

SITE	**Ecoregion**	*Potamopyrgus antipodarum*	*Gyraulus sp.*	*Latia sp.*	Oligochaeta	Chironominae	Polypedilum	*Cricotopus sp.*	*Naonella sp.*	*Eukieferiella sp.*	Tanypodinae	*Maoridiamesa sp.*	*Chironomid B*	*Chironomid C*	*Parochlus sp.*	*Podonominae B*
2Anna	Central Mountains	0	0	0	0	1	0	13	0	0	9	0	1	0	0	0
Anna's stream	Central Mountains	0	0	0	5	2	0	26	0	1	0	0	0	0	0	0
Avalache stream	High Country	0	0	0	0	0	0	6	0	0	0	1	0	0	0	0
Beecham creek	North-West Nelson Forest	2	0	0	0	0	0	28	0	0	1	8	0	31	0	0
Black river	Westland Forest	0	0	0	0	0	0	95	0	0	0	0	0	3	1	0
Border stream	Westland Forest	0	0	0	2	0	0	47	2	0	20	36	0	5	1	0
Braken creek	Westland Forest	676	3	0	11	49	7	37	0	7	0	0	14	0	22	0
Brown trib	North-West Nelson Forest	0	0	0	0	0	0	80	43	0	0	20	6	16	0	0
Bruce tributary	High Country	1	0	0	8	51	2	50	0	0	0	0	15	0	71	0
Caution creek	Westland Forest	9	0	0	0	0	0	10	0	0	0	0	1	4	0	0
Cobb river	North-West Nelson Forest	12	0	0	0	0	0	1688	0	0	0	416	0	884	0	0
Cold stream	Mt Taranaki Forest	0	0	0	0	0	0	0	1	7	0	0	0	4	0	0
Conor creek	North-West Nelson Forest	0	0	0	49	4	15	57	0	0	0	0	0	7	4	0
Cow Pasture Stm	Central Mountains	0	0	0	0	4	0	10	0	0	8	0	0	0	0	0
Craigieburn stream	High Country	3	0	0	42	5	0	47	0	0	8	2	9	10	2	0
Craigieburn tributary	High Country	0	0	0	20	0	0	126	0	0	14	0	10	0	30	0
Crashed Aircraft	Central Mountains	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	0	0	4	0	0	0	0	0	3	0	0
Devils Creek	Central Mountains	0	0	0	0	0	0	30	0	1	0	0	5	0	0	0
Devil's PunchBowl	High Country	0	0	0	0	0	0	47	0	0	0	5	12	9	3	0
Dry creek	High Country	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
Education Lodge	Taupo Pleteau	0	0	0	0	144	0	823	0	26	22	103	0	12	0	0
Ford stream	Taupo Pleteau	3	0	0	0	70	0	31	1	0	0	13	20	0	0	0
Fossil creek	North-West Nelson Forest	0	0	0	0	0	0	5	19	1	0	14	0	5	0	0
Fox river	Westland Forest	0	0	0	14	10	0	82	0	0	0	0	31	7	0	0
Granity creek	North-West Nelson Forest	0	0	0	12	4	0	75	0	0	0	25	24	24	0	0
Greney's stream	High Country	0	0	0	2	0	0	127	0	0	0	1	0	5	47	0
Halpins stream	High Country	0	0	0	1	0	0	28	0	0	0	0	3	5	2	0
Hauroko 1	Southern Alps	63	0	0	221	0	0	68	0	0	5	0	4	13	4	0
Hauroko 2	Southern Alps	3	0	0	12	33	5	12	0	0	1	0	0	1	22	0
Hepatica stream	North-West Nelson Forest	6	0	0	9	2	6	5	0	1	0	4	0	62	0	0
Kaitawa Stm (Waikanae Trib)	Central Mountains	8	0	0	0	0	0	8	1	0	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	0	0	11	0	0	4	0	0	0
Karakarere	Northern Hill Country	79	0	0	4	30	0	7	0	1	8	0	0	0	0	0
Katikara	Mt Taranaki Forest	0	0	0	0	6	0	19	2	0	2	0	0	0	0	0
Kaweora	Mt Taranaki Forest	0	0	0	0	3	0	8	0	6	0	0	0	0	0	0
Kiosk stream	Southern Alps	0	0	0	59	1	0	5	0	1	0	5	0	3	2	3
Kiwi Jacks creek	Westland Forest	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0
Kowai tributary	High Country	7	0	0	0	2	0	124	0	0	16	104	10	8	0	0
Last creek	Southern Alps	0	0	0	2	7	3	100	0	0	0	15	0	0	0	0
Levapuro	Taupo Pleteau	9	0	0	2	196	0	98	0	28	6	57	14	0	0	0
Lyttle creek tributary	Westland Forest	0	0	0	88	0	0	32	0	0	0	0	6	2	16	0
Mackay creek	Southern Alps	0	0	0	0	13	0	24	0	2	0	0	0	0	0	0
Mamona	Mt Taranaki Forest	0	0	0	0	1	0	55	0	10	0	0	11	23	0	0
Manapouri 1	Southern Alps	0	0	0	1	0	0	6	0	3	0	22	0	7	0	0
Manapouri 2	Southern Alps	0	0	0	42	0	0	134	0	8	0	0	0	38	18	0
Manapouri 3	Southern Alps	0	0	0	2	0	0	29	0	0	3	0	4	3	0	0
Mangamuka	Northern Hill Country	0	0	0	2	3	0	3	0	1	0	0	0	0	0	0
Mangatainoka Tributary	Central Mountains	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Mangatarere Stm	Central Mountains	0	0	0	0	3	0	25	9	8	4	1	2	0	0	0
Mangatarere Tributary	Central Mountains	3	0	0	2	68	0	198	48	30	4	34	22	0	0	0
Marae	Northern Hill Country	4	0	0	1081	81	0	65	3	11	0	14	0	0	0	0
McGrath creek	High Country	0	0	0	0	0	0	4	0	2	0	3	0	5	0	0
Merivale	Southern Alps	18	0	0	2	5	2	2	0	0	0	0	1	4	14	0
Merivale tributary	Southern Alps	0	0	0	4	0	2	6	0	0	0	0	0	0	29	0
Mikimiki Stm	Central Mountains	0	0	0	0	5	0	6	3	3	2	0	1	0	0	0
Mill's creek	Westland Forest	817	0	0	40	76	18	47	0	0	12	0	38	0	384	0
Mountain creek	Southern Alps	0	0	0	8	0	0	0	0	0	0	0	0	0	0	1

SITE	Ecoregion	*Potamopyrgus antipodarum*	*Gyraulus sp.*	*Latia sp.*	Oligochaeta	Chironominae	Polypedilum	*Cricotopus sp.*	*Naonella sp.*	*Eukieferiella sp.*	Tanypodinae	*Maoridiamesa sp.*	*Chironomid B*	*Chironomid C*	*Parochlus sp.*	*Podonominae B*
Ngutumoki	Mt Taranaki Forest	0	0	0	0	5	0	27	0	0	0	0	0	0	0	0
Oakura	Mt Taranaki Forest	3	0	1	1	4	0	10	0	0	1	0	0	4	0	0
Oaonui	Mt Taranaki Forest	0	0	0	0	0	0	13	0	0	0	0	0	38	0	0
O'Connor creek	Westland Forest	0	0	0	23	118	0	35	0	0	1	0	0	0	0	0
Opaopao	Northern Hill Country	11	0	0	336	82	0	4	1	1	4	0	0	0	0	0
Orangahikoia	Taupo Pleteau	0	0	0	0	2	0	98	2	0	7	110	0	32	0	0
Orangitutaetutu	Taupo Pleteau	0	0	0	0	17	0	12	3	11	0	3	0	23	0	0
Orereti	Taupo Pleteau	0	0	0	0	0	0	10	0	11	0	0	4	0	0	0
Otapukawa	Taupo Pleteau	0	0	0	1	2	0	16	3	0	6	0	0	3	0	0
Ouri	Mt Taranaki Forest	1	0	0	1	0	0	5	0	5	0	0	0	0	0	0
Panatewaewae Stm	Central Mountains	0	0	0	0	3	0	3	1	1	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	0	0	0	0	544	74	672	0	0	16	280	76	32	0	0
Peel creek	North-West Nelson Forest	4	0	0	0	1	9	29	0	0	0	0	1	1	7	0
Pegleg	High Country	0	0	0	1	0	0	0	0	0	0	0	0	5	0	0
Plato creek	Southern Alps	0	0	0	51	5	0	96	0	0	0	37	49	458	1	0
Pohatu	Taupo Pleteau	85	0	0	21	34	0	19	3	11	0	6	3	0	0	0
Prices creek	North-West Nelson Forest	0	0	0	23	2	2	410	6	12	2	272	50	22	0	0
Pukekohe	Northern Hill Country	61	0	0	331	333	0	103	14	21	12	1	0	12	0	0
Punaruku	Northern Hill Country	3	0	0	66	12	0	14	0	5	1	0	0	0	0	0
Pureanui	Northern Hill Country	0	0	0	1	1	0	22	0	1	1	0	0	0	0	0
Rahuinui	Taupo Pleteau	1	0	0	1	2	0	23	0	6	0	0	3	0	0	0
Reef creek	Central Mountains	0	0	0	5	4	0	3	0	0	5	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	0	0	0	0	0	7	0	0	1	0	0	2	0	0
Rocky creek	Westland Forest	0	0	0	3	0	0	14	0	0	0	0	0	3	0	0
Rough creek	High Country	0	0	0	0	0	0	19	0	0	0	1	0	4	0	0
Ruapapa	Taupo Pleteau	2	0	0	0	0	0	7	0	2	0	0	0	0	0	0
Sams creek	North-West Nelson Forest	0	0	0	1	1	6	272	1	0	1	59	0	123	0	0
Sheepy creek	North-West Nelson Forest	1	1	0	8	48	20	110	0	0	8	1	16	33	0	0
Sheridan Creek	Central Mountains	0	0	0	0	0	0	276	0	70	0	4	5	0	0	0
Small creek	Westland Forest	0	0	0	2	16	0	74	0	0	0	1	18	27	0	0
Smithy creek	Westland Forest	0	1	0	43	12	1	223	0	0	0	18	45	56	6	0
Smithy's creek	Southern Alps	0	0	0	1	0	0	3	0	0	0	3	5	6	0	0
Soda spring	Northern Hill Country	0	0	0	9	43	0	7	0	0	0	0	0	0	0	0
Stoney creek	Westland Forest	9	0	0	28	9	0	16	1	1	6	4	6	7	2	0
Stony creek (thirsty culvert)	Westland Forest	1	0	0	2	0	0	7	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	0	0	0	0	50	0	1	0	0	0	0	0	8	0	0
Te Karetu	Taupo Pleteau	1	1	0	0	3	0	29	0	1	2	0	0	0	0	0
Te Manawa	Taupo Pleteau	4	0	0	0	3	0	73	3	6	0	2	1	0	0	0
Te Popo	Mt Taranaki Forest	0	0	0	12	1	0	6	1	0	0	0	0	0	0	0
Thomas river tributary	High Country	1	0	0	2	1	0	0	0	0	0	0	2	0	0	0
Timaru	Mt Taranaki Forest	0	0	0	0	1	0	9	0	0	0	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	14	0	1	0	0	0	3	0	0	1	0	0	0	0	0
Tumutu	Northern Hill Country	4	0	0	8	122	0	247	34	25	0	24	0	143	0	0
Turnbull creek	North-West Nelson Forest	65	0	0	0	20	74	4	0	0	4	2	0	7	0	0
Twin creek	High Country	0	0	0	0	0	0	5	0	0	0	1	0	0	0	0
Waiaruhe	Taupo Pleteau	1	1	0	1	0	0	2	0	0	0	0	0	0	0	0
Waikare	Northern Hill Country	19	0	0	85	8	0	0	0	0	7	0	0	0	0	0
Waikawa Stm	Central Mountains	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0
Waikokatu	Northern Hill Country	0	0	0	0	55	0	5	0	4	8	0	0	0	0	0
Waikokatu trib.	Northern Hill Country	0	0	0	4	72	0	40	3	19	38	6	0	0	0	0
Waiotukupuna	Taupo Pleteau	0	0	0	0	99	0	252	7	0	3	78	15	41	0	0
Waipoua	Northern Hill Country	124	0	22	0	6	0	0	1	1	1	1	0	0	0	0
Waipuku	Mt Taranaki Forest	0	0	0	1	1	0	30	0	8	0	1	0	12	0	0
Wairau	Northern Hill Country	4	0	0	2	10	0	7	0	0	2	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0
Walker creek	Southern Alps	0	0	0	35	22	0	126	0	2	0	59	16	62	1	0
Walsh creek	North-West Nelson Forest	0	0	0	0	0	0	304	0	0	0	157	0	263	0	0
Wangapeka trib	North-West Nelson Forest	0	0	0	14	0	5	78	0	0	0	7	0	19	0	0
Wardens creek	High Country	0	0	0	0	0	1	22	0	0	1	0	0	2	19	0
Waterfall creek	Southern Alps	0	0	0	3	0	0	1	0	0	0	1	0	0	0	0
Wharetoe	Taupo Pleteau	0	0	0	0	43	0	44	1	0	0	0	0	29	0	0

SITE	Ecoregion	Chironomid pupa	*Austrosimulium sp.*	*Nothodixa sp.*	*Paradixa sp.*	Flatworm	*Nematomorpha sp.*	Nematoda	*Paratya curvirostris*	*Paranephrops planifrons*	*Paranephros "x"*	*Kempynus sp.*	*Nannochorista philpotti*	Colembola
2Anna	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Anna's stream	Central Mountains	0	0	0	0	6	0	0	0	0	0	0	0	0
Avalache stream	High Country	1	1	0	0	1	0	0	0	0	0	0	0	0
Beecham creek	North-West Nelson Forest	2	12	0	0	0	0	0	0	0	0	0	0	0
Black river	Westland Forest	4	16	0	0	0	0	0	0	0	0	0	0	0
Border stream	Westland Forest	7	0	0	0	0	0	0	0	0	0	0	0	0
Braken creek	Westland Forest	3	88	0	0	0	0	0	0	0	0	0	0	0
Brown trib	North-West Nelson Forest	13	10	0	0	0	0	0	0	0	0	0	0	0
Bruce tributary	High Country	1	7	1	0	0	0	0	0	0	0	1	0	0
Caution creek	Westland Forest	0	8	0	0	0	0	0	0	0	0	0	0	0
Cobb river	North-West Nelson Forest	152	20	0	0	0	0	0	0	0	0	0	0	0
Cold stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Conor creek	North-West Nelson Forest	3	5	3	0	3	0	0	0	0	0	0	1	0
Cow Pasture Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Craigieburn stream	High Country	11	16	0	0	0	0	0	0	0	0	0	0	0
Craigieburn tributary	High Country	0	4	8	0	4	0	4	0	0	0	0	0	0
Crashed Aircraft	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Crusher stream	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	2	0	0
Devils Creek	Central Mountains	1	0	0	0	0	0	0	0	0	0	0	0	0
Devil's PunchBowl	High Country	2	0	0	0	0	0	0	0	0	0	0	0	0
Dry creek	High Country	0	0	0	0	0	1	0	0	0	0	0	0	0
Education Lodge	Taupo Pleteau	12	40	0	0	0	0	0	0	0	0	0	0	0
Ford stream	Taupo Pleteau	0	0	0	0	18	0	0	0	0	0	0	0	0
Fossil creek	North-West Nelson Forest	0	15	0	0	0	0	0	0	0	0	0	0	0
Fox river	Westland Forest	3	2	1	0	0	0	0	0	0	0	0	0	0
Granity creek	North-West Nelson Forest	4	0	0	0	2	1	0	0	0	0	0	0	0
Greney's stream	High Country	0	1	2	0	1	0	0	0	0	0	0	0	0
Halpins stream	High Country	0	0	2	0	0	0	0	0	0	0	0	0	0
Hauroko 1	Southern Alps	1	0	0	2	1	0	0	0	0	0	0	1	0
Hauroko 2	Southern Alps	6	0	0	0	0	0	0	0	0	2	0	0	1
Hepatica stream	North-West Nelson Forest	0	5	0	0	0	0	0	0	0	0	0	0	1
Kaitawa Stm (Waikanae Trib)	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Kapakapanui Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Kapuni	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Karakarere	Northern Hill Country	1	17	0	0	0	0	0	9	0	0	0	0	0
Katikara	Mt Taranaki Forest	2	0	0	0	0	0	0	0	0	0	0	0	0
Kaweora	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Kiosk stream	Southern Alps	2	5	0	0	0	0	0	0	0	0	0	0	1
Kiwi Jacks creek	Westland Forest	0	2	0	0	0	0	0	0	0	0	0	0	0
Kowai tributary	High Country	4	26	0	0	16	0	2	0	0	0	0	0	2
Last creek	Southern Alps	2	13	0	0	2	0	0	0	0	0	0	0	0
Levapuro	Taupo Pleteau	17	11	1	0	2	1	0	0	0	0	0	0	0
Lyttle creek tributary	Westland Forest	0	1	0	0	0	4	0	0	0	0	0	0	0
Mackay creek	Southern Alps	2	17	0	0	0	0	0	0	0	0	0	0	0
Mamona	Mt Taranaki Forest	5	0	0	0	0	0	0	0	0	0	0	0	0
Manapouri 1	Southern Alps	1	9	0	0	1	0	0	0	0	0	0	0	0
Manapouri 2	Southern Alps	2	4	0	0	0	0	0	0	0	0	0	0	0
Manapouri 3	Southern Alps	0	14	0	0	0	0	0	0	0	0	0	0	2
Mangamuka	Northern Hill Country	0	6	1	2	0	0	0	0	0	0	0	0	2
Mangatainoka Tributary	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Mangatarere Stm	Central Mountains	6	0	0	0	0	0	0	0	0	0	0	0	0
Mangatarere Tributary	Central Mountains	6	0	0	0	0	0	0	0	0	0	0	0	0
Marae	Northern Hill Country	5	17	0	0	0	0	0	2	0	0	0	0	0
McGrath creek	High Country	2	0	2	0	0	0	0	0	0	0	0	0	0
Merivale	Southern Alps	0	5	0	0	0	0	0	0	0	0	0	0	0
Merivale tributary	Southern Alps	0	5	2	0	6	0	0	0	0	0	0	1	0
Mikimiki Stm	Central Mountains	1	0	0	0	0	0	0	0	0	0	0	0	0
Mill's creek	Westland Forest	2	81	0	0	9	2	0	0	0	0	0	0	0
Mountain creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0

SITE	Ecoregion	Chironomid pupa	*Austrosimulium sp.*	*Nothodixa sp.*	*Paradixa sp.*	Flatworm	*Nematomorpha sp.*	Nematoda	*Paratya curvirostris*	*Paranephrops planifrons*	*Paranephros "x"*	*Kempynus sp.*	*Nannochorista philpotti*	Colembola
Ngutumoki	Mt Taranaki Forest	0	0	0	0	0	0	0	0	1	0	0	0	1
Oakura	Mt Taranaki Forest	0	0	1	0	0	0	0	0	0	0	0	0	0
Oaonui	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
O'Connor creek	Westland Forest	4	12	0	0	0	0	0	0	0	0	0	0	0
Opaopao	Northern Hill Country	0	44	0	0	0	0	0	14	0	0	0	0	0
Orangahikoia	Taupo Pleteau	4	0	0	0	0	0	0	0	0	0	0	0	0
Orangitutaetutu	Taupo Pleteau	0	14	0	0	0	0	0	0	0	0	0	0	0
Orereti	Taupo Pleteau	1	0	0	0	0	1	0	0	0	0	0	0	0
Otapukawa	Taupo Pleteau	0	24	0	0	0	0	0	0	0	0	0	0	0
Ouri	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Panatewaewae Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Pariwhakaoho river	North-West Nelson Forest	82	48	0	0	0	0	0	0	0	0	0	0	0
Peel creek	North-West Nelson Forest	1	13	8	0	7	0	0	0	0	0	0	0	27
Pegleg	High Country	0	3	0	0	0	0	0	0	0	0	0	0	0
Plato creek	Southern Alps	8	8	6	0	0	0	0	0	0	0	0	0	0
Pohatu	Taupo Pleteau	0	40	0	0	0	0	0	0	0	0	0	0	0
Prices creek	North-West Nelson Forest	10	12	0	0	0	0	0	0	0	0	0	0	0
Pukekohe	Northern Hill Country	42	1	0	0	0	0	0	17	0	0	0	0	0
Punaruku	Northern Hill Country	0	160	0	0	0	0	0	0	0	0	0	0	0
Pureanui	Northern Hill Country	0	0	0	1	0	0	0	0	0	0	0	0	0
Rahuinui	Taupo Pleteau	0	0	2	0	0	1	0	0	0	0	0	0	0
Reef creek	Central Mountains	1	0	0	0	0	0	0	0	0	0	0	0	0
Ribbon wood creek	Westland Forest	0	2	0	0	0	1	0	0	0	0	0	0	0
Rocky creek	Westland Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough creek	High Country	0	0	5	0	0	0	0	0	0	0	0	0	0
Ruapapa	Taupo Pleteau	0	1	0	0	2	0	0	0	0	0	0	0	0
Sams creek	North-West Nelson Forest	2	112	0	0	0	0	0	0	0	0	0	0	0
Sheepy creek	North-West Nelson Forest	14	17	0	0	0	0	0	0	0	0	0	0	0
Sheridan Creek	Central Mountains	3	0	0	0	0	0	0	0	0	0	0	0	0
Small creek	Westland Forest	4	2	0	0	1	0	0	0	0	0	0	0	0
Smithy creek	Westland Forest	30	12	0	0	0	0	0	0	0	0	0	0	0
Smithy's creek	Southern Alps	0	3	0	0	0	0	0	0	0	0	0	0	0
Soda spring	Northern Hill Country	1	10	0	1	0	0	0	5	0	0	0	0	0
Stoney creek	Westland Forest	2	0	0	0	0	0	0	0	0	0	0	0	0
Stony creek (thirsty culvert)	Westland Forest	0	3	0	0	0	0	0	0	0	0	0	0	0
Ta Papa	Northern Hill Country	1	22	0	0	0	0	0	0	0	0	0	0	0
Te Karetu	Taupo Pleteau	3	4	0	0	0	0	0	0	0	0	0	0	0
Te Manawa	Taupo Pleteau	0	0	0	0	0	1	0	0	0	0	0	0	0
Te Popo	Mt Taranaki Forest	0	0	0	0	0	0	0	0	0	0	0	0	3
Thomas river tributary	High Country	0	0	0	0	0	0	0	0	0	0	0	0	0
Timaru	Mt Taranaki Forest	3	0	0	0	0	0	0	0	0	0	0	0	0
Timaru tributary	Mt Taranaki Forest	0	0	1	0	0	0	0	0	0	0	0	0	0
Tumutu	Northern Hill Country	5	106	0	0	0	0	0	0	0	0	0	0	0
Turnbull creek	North-West Nelson Forest	0	0	0	0	0	0	0	0	0	0	0	0	0
Twin creek	High Country	0	0	0	0	1	0	0	0	0	0	0	0	0
Waiaruhe	Taupo Pleteau	0	0	0	0	0	1	0	0	0	0	0	0	0
Waikare	Northern Hill Country	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikawa Stm	Central Mountains	0	0	0	0	0	0	0	0	0	0	0	0	0
Waikokatu	Northern Hill Country	2	5	0	1	0	0	0	0	0	0	0	0	0
Waikokatu trib.	Northern Hill Country	7	0	0	1	0	0	0	0	0	0	0	0	0
Waiotukupuna	Taupo Pleteau	7	4	0	0	0	0	0	0	0	0	0	0	0
Waipoua	Northern Hill Country	0	7	0	0	1	0	0	0	0	0	0	0	0
Waipuku	Mt Taranaki Forest	1	0	0	0	0	0	0	0	0	0	0	0	0
Wairau	Northern Hill Country	2	86	0	0	0	0	0	0	0	0	0	0	0
Waiwhakaiho	Mt Taranaki Forest	0	0	0	0	0	0	0	0	1	0	0	0	0
Walker creek	Southern Alps	13	18	0	0	0	0	0	0	0	0	0	0	1
Walsh creek	North-West Nelson Forest	8	15	0	0	0	0	0	0	0	0	0	0	0
Wangapeka trib	North-West Nelson Forest	6	2	0	0	0	0	0	0	0	0	0	0	1
Wardens creek	High Country	3	5	0	0	0	0	0	0	0	0	0	0	0
Waterfall creek	Southern Alps	0	0	0	0	0	0	0	0	0	0	0	0	0
Wharetoe	Taupo Pleteau	1	7	1	0	0	1	0	0	0	0	0	0	0