Macroinvertebrate taxa from a southern New Zealand montane stream continuum

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Abstract

The macroinvertebrate communities of 2 forested and 2 open sites along a relatively unmodified montane beech forest stream continuum in the Devils Creek catchment, Reefton, on the west coast of the South Island, New Zealand, were investigated by intensive benthic sampling, and light trapping and sweeping for adults. Limited benthic sampling was also carried out at 4 other sites. Although taxonomic difficulties

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hindered specific resolution in some groups, 182 aquatic or semi-aquatic macroinvertebrate taxa were recorded, the most from any New Zealand stream investigated to date. Insects comprised 160 of these taxa, with the best represented orders being the Diptera (57 spp.) and Trichoptera (50 spp.). Comparisons with similar holarctic studies show that New Zealand streams need be no less species rich than their northern counterparts.
Keywords: beech forest; streams; macrofauna; Reefton; South Island.

INTRODUCTION

The composition and structure of macroinvertebrate communities in New Zealand rivers has received only limited attention. This can be attributed, in part, to taxonomic shortcomings which have been redressed considerably in the last 10-15 years (see Winterbourn & Gregson 1981). The first intensive study of a stream invertebrate community was carried out by Allen (1951) and formed part of his well-known investigation of the trout population of the Horokiwi Stream, just north of Wellington. Several subsequent studies (e.g., Burnet 1969; Hopkins 1970, 1976) considered benthic production in an endeavour to evaluate its potential as trout food. Community composition along several polluted rivers has been documented by several authors (e.g., Winterbourn et al. 1971; Penny 1976; Marshall & Winterbourn 1979; Winterbourn 1981). Studies of forested, headwater stream communities include those of Winterbourn (1978) in a small beech forest stream at Cass, Western Canterbury (43° 02'S, 171° 46'E), Zuur's (1978) unpublished survey of 4 very small, predominantly beech forest catchments draining into Donald Creek near the Hope Saddle, Nelson province (41° 35'S, 172° 45'E) and Towns' (1976, 1978, 1979) work along a stream continuum incorporating both forested and open sites in the Waitakere Ranges west of Auckland (ca. 30° 50'S, 174° 30'E). Towns' careful work revealed 144 taxa, hitherto unsuspected diversity for a New Zealand stream community.

The present paper lists and briefly discusses aquatic species collected along a stream continuum (Devils Creek catchment, Reefton) once designated for logging and conversion to exotic timbers under the West Coast beech forest scheme (New Zealand Forest Service 1971; New Zealand Ecological Society 1973; Searle 1975). This work formed part of a larger study on stream community structure and function in Devils Creek (Cowie 1980) and in turn was part of a broader research programme on the macroinvertebrate communities of New Zealand headwater streams (Winterbourn 1980; Winterbourn et al. 1981.

STUDY AREA AND METHODS

The Devils Creek catchment rises to altitudes of 600-750 m in foothills of the Victoria Range south southeast of Reefton on the west coast of the South Island (ca. 42° 10'S 171° 53'E; NZMS1 S38, Reefton; Fig. 1). Most tributaries of Devils Creek rise in either a stunted silver beech (*Nothofagus menziesii*), manuka (*Leptospermum scoparium*) association or grassland seepage areas, but at altitudes of about 300-550 m the catchment is dominated by silver beech forest with red beech (*N. fusca*) and hard beech (*N. truncata*) subdominant. Few podocarps are present. The subcanopy layer is poorly developed and consists largely of immature silver beech trees. Ferns predominate on the forest floor. Fuchsia (*Fuchsia excorticata*) is an important riparian species, but forested stream beds are not densely shaded. The valley opens out at about the junction of Devils and its major tributary Oriental Creek where predominantly introduced scrub and hardy grass species, together with a few exotic conifers, are present on the flood plain. The upper catchment (above site III) is relatively unmodified except for some clearing associated with early gold and coal mining (Henderson 1917; Suggate 1957), limited roading, and perhaps some cutting-over of podocarps. A more complete description of the study area is given in Cowie (in prep.).

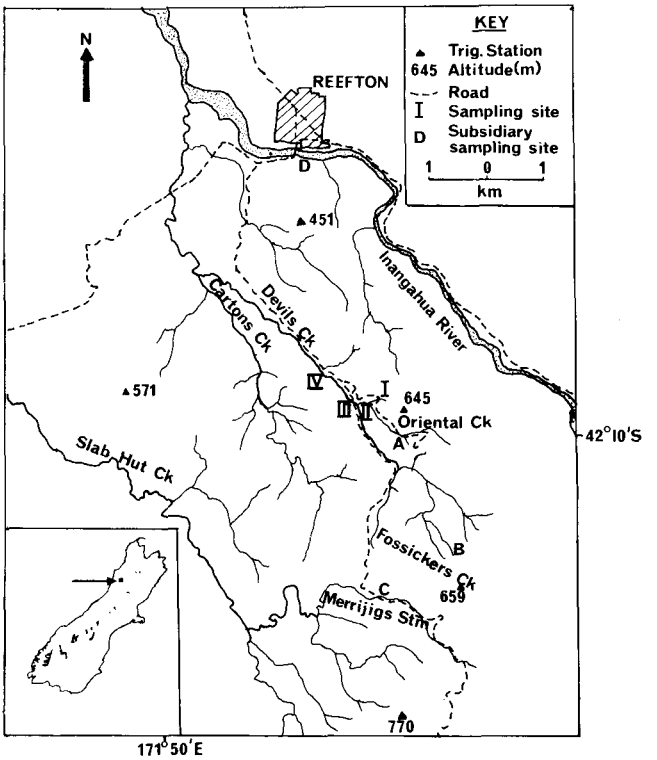

Fig. 1. The study area at Devils Creek catchment.

Intensive benthic sampling was carried out at 4 unstable sites prone to frequent and unpredictable flooding along a continuum from a 1st order forested tributary through 2nd order forested Oriental Creek to 2 open sites in 4th order Devils Creek (sites I-IV in Fig. 1, altitude range 360-280 m). The rough, unsorted nature of the substrate ruled out a quantitative benthic programme at the upper 3 sites: sampling was carried out semiquantitatively by the footkick method (Hynes 1970; Frost et al. 1971) using 1.0 mm and 0.2 mm mesh stream nets in tandem on 10 occasions between April 1976 and March 1977. Over 123 000 animals were collected during this programme and all were carefully sorted and identified to the lowest possible taxonomic level. Subsidiary benthic sampling was carried out once using the footkick method and a 0.5 mm mesh net at 4 other sites (sites A-D in Fig. 1). One of these was higher up Oriental Creek, 2 were in small, low gradient headwater streams in silver beech-manuka forest, and 1 was in the 6th order Inangahun River at Reefton.

Adult insects were collected on each visit to the study area (about 20 occasions from January 1976 to January 1979) by sweepnetting, beating streamside vegetation, and searching under semi-submerged rocks. On 6 occasions during warmer months light-trapping was carried out for up to 3 h starting about 30 min after sunset at site III. The trap employed a 160-watt fluorescent mercury bulb powered by a 50 cc Honda generator, and on warm nights attracted large numbers of insects, particularly Lepidoptera and Trichoptera.

RESULTS

At least 182 aquatic and semi-aquatic species, 160 of them insects, were recorded from the Devils Creek catchment (Table 1). At least 138 species were taken during the benthic sampling programme at sites I-IV, 13 as single individuals only, and 32 in numbers between 2 and 10. Eight species were represented by hand-collected adults only, and 10 species of Chironomidae and 21 species of Trichoptera were collected only by the light trap.

Table 1. Aquatic macroinvertebrates collected from Devils Creek catchment, Reefton, and adjacent areas, April 1976—October 1978. Conventions: P = only pupa positively identified; L = light trapped adults only; A = hand collected adults only; X = one specimen collected at main sampling sites; * = 2-10 specimens collected at main sampling sites.

PLATYHELMINTHES	
Tricladida	
Dugesiidae	
Neppia? montana (Nurse, 1950)	
NEMATOMORPHA	
Gordiidae	
Gordiidae indet.	X
ANNELIDA	
Oligochaeta	
Lumbricidae	
Eiseniella tetraedra (Savigny, 1826)	
Lumbriculidae	
Lumbriculus variegatus (Müller 1774)	
Stylodrilus heringianus Claparède, 1862	
Haplotaxidae	
Haplotaxis sp.	*
Naididae	
Slavina appendiculata d'Udekem, 1855	
Slavina sp. B	
Slavina sp. C	*
Pristina sp. (probably two species)	*
Nais? elinguis Müller, 1773	*
Tubificidae	
Telmatodrilus multiprostatus Brinkhurst & Jamieson, 1971	
Aulodrilus pluriseta (Piguet, 1906)	
Tubifex? tubifex Müller, 1774)	
Peloscolex sp. (near *carolinensis* Brinkhurst, 1965)	*
MOLLUSCA	
Gastropoda	
Hydrobiidae	
Potamopyrgus antipodarum (Gray, 1843)	
Physidae	
Gyraulus corinna (Gray, 1850)	
ARTHROPODA	
Crustacea	*
OSTRACODA	
Ostracoda indet.	
DECAPODA	
Parastacidae	
Paranephrops planifrons White, 1842	X
AMPHIPODA	
Eusiridae	
Paracalliope sp.	
Eusiridae indet.	*
ISOPODA	
Styloniscidae	
Styloniscus otakensis (Chilton, 1902)	*
COPEPODA	
Cyclopidae	
Acanthocyclops robustus (G.O. Sars, 1863)	X
Insecta	
COLLEMBOLA	
Isotomidae	
Isotomidae indet.	
Hypogastruridae	
Hypogastrura spp. (two species)	
Triacanthella sp.	
Neanuridae	
Setanodosa sp.	*
EPHEMEROPTERA	
Oligoneuridae	
Coloburiscus humeralis (Walker, 1853)	
Siphlonuridae	
Nesameletus? ornatus (Eaton, 1883)	
Ameletopsis perscitus (Eaton, 1899)	
Oniscigaster distans Eaton, 1899	
Leptophlebiidae	
Zephlebia (Neozephlebia)? nodularis (Eaton, 1871)	
Deleatidium "lillii" Eaton, 1899	
D. "myzobranchia" Phillips 1930 (at least two species)	
Deleatidium sp. C.	
Austroclima sepia (Phillips, 1930)	
Ephemeridae	
Ichthybotus sp.	*
ODONATA	
Coenagrionidae	
Xanthocnemis zealandica (McLachlan, 1873)	A
Petaluridae	
Uropetala carovei carovei (White, 1843)	A
PLECOPTERA	
Eustheniidae	
Stenoperla prasina (Newman, 1845)	
Austroperlidae	
Austroperla cyrene (Newman, 1845)	
Gripopterygidae	
Megaleptoperla grandis (Hudson, 1913)	*
Acroperla spiniger (Tillyard, 1923)	*
Nesoperla fulvescens (Tillyard, 1923)	A
Zelandoperla agnetis McLellan, 1967	
Z. denticulata Tillyard, 1923	*
Z. fenestrata fenestrata Tillyard, 1923	
Zelandobius confusus (Hare, 1910)	
Z. illiesi McLellan, 1969	*
Z. unicolor Tillyard, 1923	
Notonemouridae	
Spaniocerca zelandica Tillyard, 1923	
Spaniocercoides cowleyi (Winterbourn, 1965)	
Cristaperla fimbria (Winterbourn, 1965)	
MEGALOPTERA	
Corydalidae	
Archichauliodes diversus (Walker, 1853)	
COLEOPTERA	
Dytiscidae	
Liodessus plicatus (Sharp, 1882)	X
Hydraenidae	
Orchymontia maclellani Zwick, 1975	
Orchymontia sp. B	A
Hydraenidae sp. C	A
Hydrophilidae	
Paracymus sp.	
Hydrophiloidea indet.	
Elmidae	
Elmidae sp. A	
Elmidae sp. B	
Ptilodactylidae	
Ptilodactylidae indet.	
Helodidae	
Helodidae sp. A.	*
Helodidae sp. B	
Staphylinidae	
Staphylinidae sp. A	A
Staphylinidae sp. B	*, A
MECOPTERA	
Nannochoristidae	
Microchorista philpotti (Tillyard, 1917)	*

DIPTERA
- Tipulidae
  - *Limonia nigrescens* (Hutton, 1901)
  - *Limonia (Dicranomyia)* sp.
  - Eriopterini sp. A *
  - Eriopterini sp. B *
  - Eriopterini sp. C *
  - Eriopterini sp. D
  - *Paralimnophila skusei* Hutton, 1900
  - *Zelandotipula* sp.
- Dolichopodidae
  - ?Dolichopodidae indet.
- Psychodidae
  - Psychodidae indet. *
- Culicidae
  - *Nothodixa campbelli* Tonnoir, 1925
- Chironomidae
  - Tanypodinae
    - *Pentaneura* n.sp.
    - *Ablabesmyia malus* (Hutton, 1902) L
    - *Psectrotanypus apicincta* (Freeman, 1959) L
    - *P. languidus* (Hutton, 1902) L
    - *P. debilis* (Hutton, 1902) L
    - *P. apicinella* (Freeman, 1959) L
    - *Psectrotanypus* n.sp. L
  - Podonominae
    - *Parochlus spinosus* Brundin, 1966 P
    - *P. ohakunensis* (Freeman, 1959) P
    - *P. carinatus* Brundin, 1966 P
    - *P. pauperatus* Brundin, 1966 P
    - *P. novaezelandiae* Brundin, 1966 P
    - *Podochlus? knoxi* Brundin, 1966
    - Podonominae sp. B
    - Podonominae? sp. C *
  - Diamesinae
    - *Lobodiamesa campbelli* Pagast, 1947 A
  - Orthocladiinae
    - *Diplocladius (Stictocladius) lacuniferus* Freeman, 1959 P
    - *D. (Stictocladius) pictus* Freeman, 1959 P
    - *Syncricotopus pluriserialis* (Freeman, 1959) P
    - *Cricotopus zealandicus* Freeman, 1959 L
    - *Cricotopus* sp.
    - *Lymnophyes* sp. A
    - *Metriocnemus lobifer* Freeman, 1959 X, L
    - *Metriocnemus* sp. X
    - *Nanocladius* sp. X
    - *Psectrocladius* sp. L
    - *?Chaetocladius* sp. L
    - Orthocladiinae indet. A P
    - Orthocladiinae indet. B P
    - Orthocladiinae indet. C P
  - Chironominae
    - *Harrisius pallidus* Freeman, 1959 *
    - *Paucispinigera approximata* Freeman, 1959
    - *Polypedilum* spp. (at least two species)
    - *Tanytarsus vespertinus* Hutton, 1902
- Ceratopogonidae
  - Ceratopogonidae sp. A
  - Ceratopogonidae sp. B
- Simuliidae
  - *Austrosimulium multicorne* Tonnoir, 1925
  - *A. laticorne* Tonnoir, 1925
  - *A. ungulatum* Tonnoir, 1925
- Tanyderidae
  - Tanyderidae indet. X
- Empididae
  - Empididae sp. A
  - Empididae sp. B X
- Muscidae
  - *Limnophora* sp. *
  - Muscidae indet, *
- Tabanidae
  - Tabanidae sp. A *
  - Tabanidae sp. B *

NEUROPTERA
- Osmylidae
  - *Kempynus* sp.

TRICHOPTERA *
- Hydropsychidae
  - *Aoteapsyche colonica* (McLachlan, 1871) L
  - *A. raruraru* (McFarlane, 1973)
  - *A. tepoka* (Mosely, 1953)
- Polycentropodidae
  - *Plectrocnemia maclachlani* Mosley, 1953 L
  - *Polyplectropus puerilis* (McLachlan, 1868) L
- Philopotamidae
  - *Hydrobiosella stenocerca* Tillyard, 1924
- Rhyacophilidae
  - *Hydrobiosis spatulata* McFarlane, 1951
  - *H. umbripennis* McLachlan, 1868
  - *H. kiddi* McFarlane, 1951 L
  - *H. parumbripennis* McFarlane, 1951
  - *H. copis* McFarlane, 1960 L
  - *H. silvicola* McFarlane, 1951 L
  - *H. soror* McFarlane, 1951
  - *H. charadraea* McFarlane, 1951 L
  - *Tiphobiosis* sp.
  - *Psilochorema tautoru* McFarlane, 1964 L
  - *P. nemorale* McFarlane, 1951
  - *P. macroharpax* McFarlane, 1951 L
  - *P. leptoharpax* McFarlane, 1951
  - *Edpercivalia maxima* (McFarlane, 1939)
  - *E. fusca* (McFarlane, 1939) L
  - *Synchorema zygoneura* Tillyard, 1924
  - *Neurochorema confusum* (McLachlan, 1868) L
  - *Hydrochorema crassicaudatum* Tillyard, 1924 *
  - *H. tenuicaudatum* Tillyard, 1924
  - *Costachorema callistum* McFarlane, 1939 L
  - *C. psaroptera* McFarlane, 1939
- Hydroptilidae
  - *Oxyethira albiceps* (McLachlan, 1862)
  - *Paroxyethira hendersoni* Mosely, 1924 L
  - *P. kimminsi* Leader, 1972 L
- Calocidae
  - *Pycnocentrella eruensis* Mosely, 1953
- Conoesucidae
  - *Pycnocentria hawdonia* McFarlane, 1956 X
  - *P. sylvestris* McFarlane, 1973
  - *Beraeoptera roria* Mosely, 1953
  - *Pycnocentrodes* sp. *
  - *Olinga feredayi* (McLachlan, 1868)
- Oeconesidae
  - *Oeconesus maori* McLachlan, 1862 L
  - *O. similis* Mosely, 1953 *, L
  - *Pseudoconesus squamosus* Mosely, 1953 L
  - *Tarapsyche olis* McFarlane, 1960 *, L
  - *Zelandopsyche maclellani* McFarlane in McFarlane & Cowie, 1981 *
- Philoreithridae
  - *Philoreithrus agilis* (Hudson, 1904) L
  - *P. lacustris* Tillyard, 1924 L
- Helicopsychidae
  - *Helicopsyche zelandica* Hudson, 1904 L
  - *H. poutini* McFarlane, 1964 L
  - *H. albescens* Tillyard, 1924
- Leptoceridae
  - *Triplectides obsoleta* (McLachlan, 1862) X
  - *Triplectides obsoleta* (McLachlan, 1862) A
  - *T. dolichos* McFarlane in McFarlane & Cowie, 1981 L
  - *Hudsonema amabilis* (McLachlan, 1868)

Acarina
- At least four indeterminate species. (*, X)

Identification of Chironomidae and leptophlebiid mayflies posed a number of problems. Among the Chironomidae, 21 species of Orthocladiinae were distinguished positively in at least one life history stage, but the larvae and adults of only 3 species could be associated positively. Similarly 5 species of *Parochlus* (Podonominae) were identified from pupae but no adults were collected and the larvae of different species could not be separated. The taxonomy of *Deleatidium*, probably New Zealand's most common aquatic insect genus, is unresolved at present. Most of the *Deleatidium* larvae collected during the present study belonged to either the "myzobranchia" or "lillii" species complexes (Towns 1976; Winterbourn 1978) and at least 2 morphs of the former could be recognised from abdominal pigmentation patterns of fresh specimens.

Although adults of the notonemourid stoneflies *Spaniocercoides cowleyi* and *Cristaperla fimbria* were collected in quite large numbers at site III, very few larvae of the former and no larva of the latter were collected in benthic samples from the 4 main study sites. Adults of *S. cowleyi* have been recorded from a number of West Coast streams (McLellan 1973), but these are the first records of larvae. Similarly, although the adults are well known, larvae of *C. fimbria* have only been collected in low gradient streams rich in organic debris, such as Fossickers Creek in the study catchment (site B in Fig. 1). This suggests that larvae of *S. cowleyi*, and possibly those of *C. fimbria* may be hyporheic (i.e., deep substrate dwellers), as are some nearctic stoneflies (Coleman & Hynes 1970; Radford & Hartland-Rowe 1971; Stanford & Gaufin 1974).

These findings markedly extend the distribution ranges of several species. The oligochaete genus *Peloscolex* has not previously been recorded in the Australasian region (Brinkhurst 1971), and the species of *Tubifex* found may also be a new record. It had obvious affinities with *T. tubifex*, but differed from that species as described by Brinkhurst & Jamieson (1971). *Zelandoperla denticulata* (Plecoptera) and *Microchorista philpotti* (Mecoptera) have not been recorded previously outside south Westland (McLellan 1967) or west of the Main Divide respectively (R. L. C. Pilgrim, pers. comm.)

DISCUSSION

The 182 macroinvertebrate species collected during this study represents the largest number of taxa collected from any New Zealand stream system, surpassing the 144 taxa taken from the Waitakere River and its tributaries by Towns (1978, 1979). Table 2 compares community composition in Devils Creek with some other New Zealand streams and several comparable holarctic studies. Total numbers of macroinvertebrate or insect species per stream system are similar for the regions considered, but note that Bishop (1973) collected at least 309 taxa during his extensive survey of a tropical stream system in Malaysia.

The Diptera (principally Chironomidae and Tipulidae) and Trichoptera were both represented by more species in Devils Creek than in the Waitakere River. Towns (1979) considered that Chironomidae were relatively poorly presented in New Zealand, and although this may be the case in warmer northern streams, it was not so in the southern montane catchment considered here, where diverse representatives of the cool-adapted subfamilies Tanypodinae, Podonominae, and Orthocladiinae were collected. The 33 chironomid taxa collected is still much lower than numbers recorded from long-term studies in 2 nearctic stream systems (109 — Clifford 1978; 143 — Coffman 1973), and many more taxa were undoubtedly present in Devils Creek but could not be resolved because of taxonomic shortcomings. Trichoptera were also a more important element here than in many holarctic streams (see Table 2), although trichopteran diversity can be high in northern regions, e.g., Anderson & Wold (1972) found 39 species in an Oregon stream.

Fewer species of Ephemeroptera and more of Plecoptera were found in this study than by Towns (1978) in the Waitakere River area. The low number of mayfly species

Table 2. Taxonomic composition of the aquatic macroinvertebrate fauna collected from the Devils Creek catchment, Reefton, compared with that collected in similar studies from other New Zealand and Holarctic streams. N.A. = not applicable; * = updated by Coffman (1973).

	Source							
	Present Study	Towns 1976, 1978	Penny 1976	Minckley 1963	Ulfstrand 1968a	Mackay 1969	Coffman *et al.* 1971	Clifford 1978
	Area Description							
Species composition by major taxa groupings	Stream continuum 4 main sites Reefton, NZ	Stream continuum 4 main sites Auckland, NZ	Polluted river 11 sites Wellington, NZ	Spring-fed long stream reach (13 km) Kentucky, USA	Swedish rivers, 11 sites	Forested stream 4 sites Quebec, Canada	Order 3-4 forested stream, Pennsylvania, USA	Open river Alberta, Canada
Oligochaeta	14	9	4 +	12 +	N.A.	N.A.	N.A.	N.A.
Mollusca	2	6	7	6 +	N.A.	N.A.	N.A.	N.A.
Crustacea	6	9	3	13	N.A.	N.A.	N.A.	N.A.
Ephemeroptera	11	24	6 +	18 +	19	9	13	19
Plecoptera	14	8	6	6	24	10	5	4
Coleoptera	13	11	4	7	N.A.	5	15	31
All Diptera	57	24	12	30 +	N.A.	ca. 63	91 (157)*	113 +
Chironomidae	33	16	3	15	N.A.	ca. 36	71 (143)*	109
Tipulidae	8	3	1	3	N.A.	14	N.A.	—
Simuliidae	3	3	2	1	24	6	N.A.	4
Trichoptera	50	34	26	10 +	11	21	25	16
Total all species	182	144	74 +	146 +	N.A.	N.A.	N.A.	N.A.
Total insects only	160	114	60 +	115 +	78 +	120	192 (258)*	183

recorded in part reflects difficulties of species recognition within the Leptophlebiidae, but nevertheless is comparable with numbers found in some palaearctic (Ulfstrand 1968: table 16) and nearctic streams (Table 2). Note, however, that Bishop (1968) found 45 + mayfly species in small streams in the Great Lakes region of North America.

The Plecoptera are poorly represented in most New Zealand streams (McLellan 1975). More species were collected in the Devils Creek area than in the warmer Waitakere River (14 versus 8), which is not surprising as most stoneflies are cool-adapted (Illies 1966; Hynes 1976). Similar numbers of stonefly species have been recorded in some nearctic surveys (Table 2) (note, however, that Kerst & Anderson (1974) recorded 43 species in an Oregon stream), but this is lower than the 15-25 species of stonefly collected in some palaearctic streams (Ulfstrand 1968: table 16).

In the past, species diversity in New Zealand streams has generally been considered to be low (e.g., Percival MS cited in Stout 1973; Davis & Winterbourn 1977), a conclusion which can be attributed in part to imprecise identification and inadequate taxonomic resolution of several groups (Towns 1976, 1979). My findings and those of Towns (1976, 1978) show that low species diversity is not necessarily the rule in New Zealand streams, and further surveys which can utilise the recently expanded taxonomic knowledge of some major groups should confirm that many New Zealand streams are typically no less rich than their holarctic counterparts.

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