

Adult Aquatic Insect Fauna of the Mokau River

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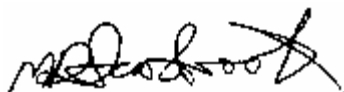
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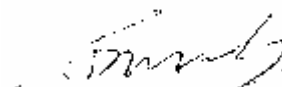
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Executive Summary

The high productivity of the Mokau River and three of its tributaries along a 2.5 km reach was reflected in the very large numbers of adult EPT collected and a high diversity of species.

Nearly 60 species comprising nearly 40,000 individuals were caught using a combination of UV light traps and Malaise nets.

The tributaries contributed 95% of all species recorded, with one site having 81% of all species present. 43% of all species were only collected within the tributaries.

The main river sites yielded 65%, and the tributaries 92% of the total species caught by light trap alone.

No species of special conservation significance were recorded, however the ecological range was extended for four species. Specimens of a caddisfly potentially new to science were caught along the Mokau River and its lower tributary.

1. Introduction

The Mokau River drains the Rangitoto Range south of Te Kuiti and flows southwest to enter North Taranaki Bight of the Tasman Sea, draining a basin of 1,425 square km. The Mokau River and catchment contains rolling landscapes primarily used for intensive dairy, sheep and beef farming. Geology predominantly consists of tephra on hills & downlands, plus some tertiary sandstone and limestone, and greywacke & argillite (Hayes et al. 1989; NIWA unpublished reports).

Environment Waikato wishes to ascertain the aquatic invertebrate biodiversity values of the Mokau River. As part of this, adult stages of the groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), or as they are collectively known EPT, were sampled at six sites along the mainstem and tributaries of the Mokau River covering a stretch between 1.8-4.3 km downstream of the Wairere Falls dam, or a total distance of 2.5 km.

The aims of this study were to (1) document the adult aquatic insect fauna of selected tributary and mainstem sites on the Mokau River; (2) provide an indication of their regional significance within the Waikato, and report on species of biodiversity or conservation significance; and (3) provide an indication of their likely habitats.

2. Methods

Adult aquatic insects were collected at six sites (Fig. 1) using ultraviolet (UV) light traps and Malaise nets from 18 November 2006 to 16 January 2007. Three sites were sampled on the true right of the main stem of the river (light traps only), and one site in each of three of its unnamed first order tributaries (light traps and Malaise nets) with varying amounts of native forest fragments present (Table 1; Figure 1). The upper most sites (Sites 2 and 2a) were approximately 1.8 km down stream of the Wairere Falls dam. Tributary sampling sites were approximately 130–250 m inland from their confluence with the Mokau River and respective comparable mainstem light trap. This reduced the chances of light traps interfering with each other.

Table 1: Sampling site details.

Site name	Grid reference	Water width	Distance from Mokau River (m)	Vegetation
Site 1 – Mokau R main stem	E2683408 N6294728	>15 m	–	Grazed pasture
Site 1a – forested trib	E2683416 N6294994	1 m	250	Mahoe dominated, fern, Fushia
Site 2 – Mokau R main stem	E2683743 N6295107	>15 m	–	Grazed pasture
Site 2a – forested trib	E2683839 N6295237	0.6 m	150	Wineberry dominated, high leaf litter
Site 3 – Mokau R main stem	E2681778 N6293774	>15 m	–	Grazed pasture
Site 3a – forested trib	E2681750 N6293940	0.5 m	130	Scattered tree ferns, ferns and Totara

Malaise nets were only deployed at the tributaries where they spanned the channel, and were emptied at intervals of 28–30 days. Malaise nets were constructed of netting (c. 500 μ m mesh) and were 1.7 m long by 1.2 m wide. One end of the net was lower (1.3 m from the ground) than the other (1.6 m) to encourage trapped insects to move towards the higher end where two sampling jars containing 50% ethylene glycol were located. Jars were removed on light trapping nights, and reset the following morning when they were filled with new preservative.

Light traps were deployed for one night each month and were <20 m from the Malaise nets. Each light trap consisted of a low power (6 W) model F6T5 blacklight fluorescent tube laid over a white dish (38 X 27 X 6 cm). The dish was half-filled with water into which a few drops of detergent had been mixed to break the water surface tension. The lights were powered by 12 V batteries run from timing units which enabled all lights to be turned on and off simultaneously. Light traps were placed within 1 m of the stream edge and set to run from 21:00–23:00 hrs and 02:00–03:00 hrs.

EPTs were classified using coded abundance after Stark (1998) where ‘Rare (R)’ = 1–4, ‘Common (C)’ = 5–19, ‘Abundant (A)’ = 20–99, ‘Very Abundant (VA)’ = 100–499, ‘Very, Very Abundant (VVA)’ = 500+ individuals.

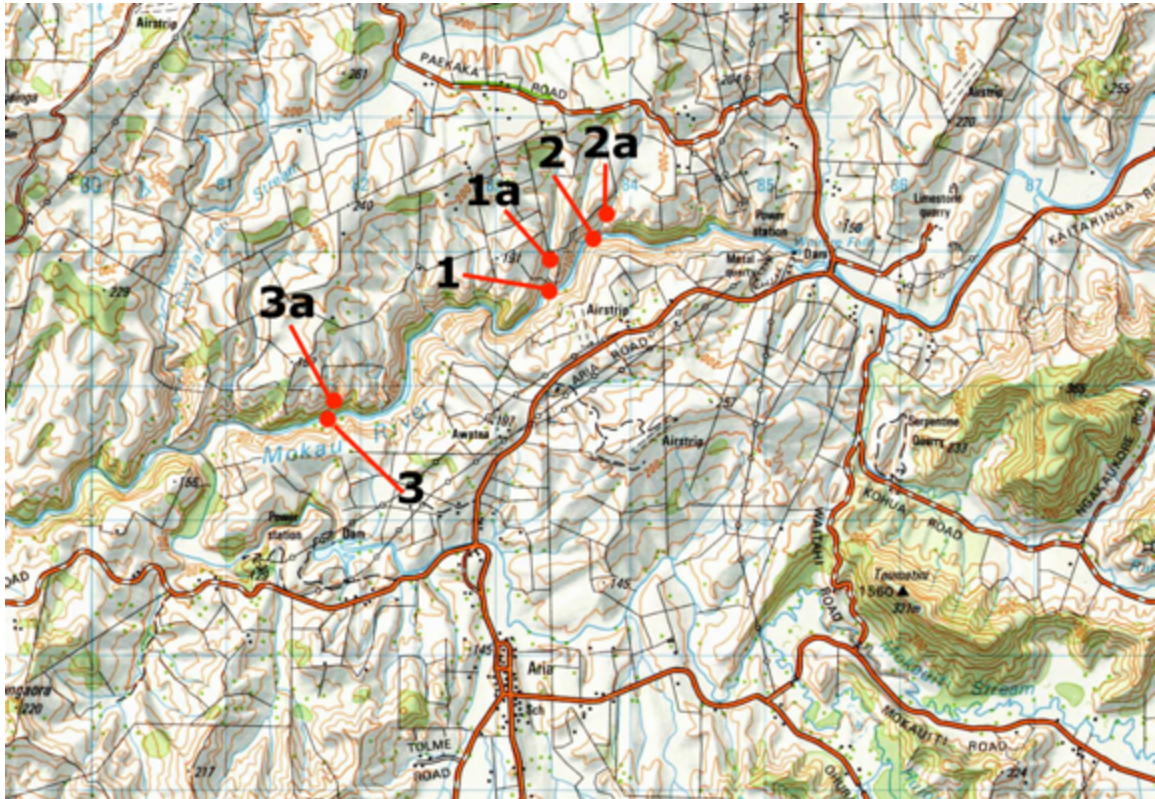


Figure 1: Mokou River and tributary sampling sites.

3. Results and discussion

3.1 Abundance and composition

Results are summarised in Appendices 1 and 2. A total of 39,955 adult EPT individuals representing 14 families, 35 genera, and 58 species were collected by a combination of Malaise nets and UV light traps. Numbers of EPT individuals collected per site ranged from 860–15307, and taxa richness from 25–47, for both trapping methods combined. The main river sites had the greatest numbers of individuals (9168–15307). EPT richness was greatest at the tributary sites (34–47), with 9–21 more species collected compared to its respective main river site. Tributary Site 1a was the most diverse site with 81% of all species caught, and Site 2 (Mokau River) the least diverse (43%).

Fifty-one species of EPT were collected by light traps and 42 species were collected by Malaise nets. Fifteen recognised species plus a suspected new species of *Costachorema* were only ever collected by the light traps. Seven species were only ever collected by the Malaise nets placed across the tributaries. Caddisflies were the most abundant order of insect caught at all sites in numbers (38,096 or 95% of total catch) and diversity (10 families, 24 genera, 44 species), or approximately 20% of New Zealand's total caddisfly fauna. The mayfly fauna was represented by Leptophlebiidae and Coloburiscidae, with 6 genera and 11 species (24% of known New Zealand fauna). Mayflies contributed to nearly one-third of EPT numbers at the tributary sites, and nearly 20% of all species recorded. At the main river sites mayflies comprised less than 2% of total numbers, but 15% of all species caught. Twice as many mayflies (numbers and species) were caught at the tributary sites than main river sites. Mayflies were observed exhibiting diurnal flight activity at both main river and tributary sites. The lower number of mayflies at the main river sites may have been an artifact of the collection methods, as Malaise nets were able to collect over a 24 hr period for up to 30 days, whereas the light traps represented a single night's sample over a few hours. Stoneflies were poorly represented in this study with only three species from two families recorded (<3% of the New Zealand fauna). Stoneflies contributed to less than 6% of the EPT number and diversity at the forested sites and were absent from the main river sites. This may also have been influenced by collection method, as these species are not normally attracted to UV light. Overall, mayflies and stoneflies contributed 4% and 0.4% of total numbers of adult insects caught, respectively.

3.2 Temporal patterns

The greatest numbers of EPT were collected by light traps from the three main river sampling sites in January 2006. Over 29,000 adults (mainly caddisflies) comprising 24

species (55% of all caddis species caught) were collected in a three hour period, including a very large number of algal grazers and piercers, and filter feeding larval caddisflies, indicating the highly productive nature of the river. Although there are no known large river adult EPT studies in New Zealand to directly compare results, a light trapping survey of EPT at nine urban tributary streams and seepages of the Waikato River, Hamilton City during the same period and using the same trapping times collected 1,713 individuals and 26 species (unpublished data), considerably less than the Mokau River and its three tributaries. In addition, a light trapping study of a pasture stream at Whatawhata, near Hamilton, excluding the Hydroptilidae (micro-caddisflies), collected 579 individuals and 24 species during summer (unpublished data). Even when Hydroptilidae were excluded from the three Mokau River samples, over 30,000 individuals and 49 species were nonetheless caught. A Malaise net placed across native forest stream at Whatawhata during the same summer months collected 460 EPT, comprising 43 species (unpublished data).

3.3 Spatial patterns

The three Mokau River sites contributed less than 57% to the total biodiversity, whereas the forested tributaries contributed nearly 95% of all EPT species recorded. If comparable collection methods are analysed, light traps at the main river sites yielded 65%, and the tributaries 92% of the total species caught by light trap alone. Light traps collected 25–26 species at each main river site, and 27–36 species at each tributary site. Three species collected at the main river sites by light traps were not collected at the tributaries. Conversely, 16 species were light trapped at the tributaries but not the main river.

The high numbers of species recorded from the tributaries may reflect that many of New Zealand's aquatic invertebrate fauna have evolved in forested conditions, as New Zealand was once largely covered in forest (Davies-Colley et al. 2000). The presence of forest fragments and bank-side seepages on the tributaries provided refugia and suitable habitats for obligatory native forest and/or seepage specialists (i.e., the caddisflies, *Cryptobiosella hastata*, *Ecnomina zealandica*, *Edpercivalia thomasoni*, *Hydrobiosella mixta*, *Hydrobiosis gollanis*, *Polyplectropus impluvii*, *Tiphobiosis cowiei*, *T. plicosta*, *T. kleinpastei*, and the mayflies *Acanthophlebia cruentata*, *Zephlebia borealis?*, *Z. nebulosa* and *Z. versicolor*) as 43% (25 species) of all taxa were only collected within these tributaries. Species exhibiting site specificity such as *C. hastata*, *E. thomasoni*, *Austronella planulata*, *E. zealandica* were only collected from Site 1a; *T. plicosta* from Site 2a; and *Hudsonema alienum*, *A. cruentata* and *Zelandobius furcillatus* from Site 3a. The restriction of certain species to single sites may have been attributable to a lack of connectivity between forest habitats or a reflection of a species' poor dispersal capabilities.

3.4 Biodiversity and conservation significance

Many of the more abundant species present in the main river samples were either absent or rarely encountered (classified as 'R', 1–4 specimens present) in the tributaries. These tended to be species more commonly associated with larger streams and rivers, and open landscapes within the central North Island such as *Aoteapsyche* spp., *Hydrobiosis* spp., *Pycnocentroides* spp. and the microcaddisflies, *Oxyethira* and *Paroxyethira*. The caddisflies *Aoteapsyche* sp. X and *Helicopsyche albescens*, and the mayfly *Zephlebia tuberculata* were only collected in light traps placed near the main river.

Species classified as rare were much more likely to be encountered at the tributary sites than at the comparable main river sites e.g., Site 1a had the greatest number of classified as 'R' species (21), and Site 1 had the least (3). On average, less than 6 species were classified as R at the main river sites and 18 species at the tributary site. However, rarely encountered species at one site were not necessary R at other sites, such as *Costachorema xanthopterum*, *Aoteapsyche* spp., *Pycnocentroides* spp. and microcaddisflies. These taxa were rarely encountered in the forested tributaries, but ranged from 'abundant (A)' to 'very, very abundant (VVA)' (20–500+ individuals) at the main river sites, as they are considered more indicative of open landscapes. Ten species were classified as R at all the sites they occurred, including a potentially new species of *Costachorema* (predominantly from the main river) and three species of *Tiphobiosis* (tributaries only). Most other rarely encountered taxa included many species considered ubiquitous e.g., *H. alienum*, *Hydrobiosis parumbripennis* and *Triplectides dolichos*. When total numbers are considered for all sites combined, seven species were classified as R in this study: four caddisflies (*H. alienum*, *Hydrobiosis parumbripennis*, *P. aurifusca*, *T. cowiei*); two mayflies (*A. cruentata*, *A. planulata*), and a stonefly (*Z. furcillatus*). However, these species are not considered of regional or national importance.

Overall, no species considered of national conservation importance, as listed by the Department of Conservation's 'New Zealand Threat Classification System lists – 2005 - Freshwater invertebrates' were encountered during the sampling period. Collier et al. (2000) noted that the *Z. nebulosa*, *E. zealandica* and *T. kleinpastei* had been recorded from three or fewer ecological regions. *Ecnomina zealandica* and *T. kleinpastei* are known from the Waikato Region (unpublished data and this study). New, southern-most distributional records were established for the caddisflies *Aoteapsyche* sp. X., and *T. kleinpastei*; and for the leptophlebiid mayflies *Z. nebulosa* and *Z. tuberculata*. *Zephlebia nebulosa* remains known from only two ecological regions. It is worthwhile to note that a single specimen of the mayfly *A. planulata* was collected at Site 1a, and although this species is considered widely distributed, its nymphs and adults are seldom caught (Towns & Peters, 1996; unpublished data). According to Towns &

Peters (1996) all the rarest New Zealand mayflies are Leptophlebiidae, and up to one-third of all species have restricted distributions.

The potentially new species of *Costachorema* was collected at Sites 2 and 3 along the mainstem of the Mokau River (one specimen was recorded from Site 3a, the more open of the tributaries). These specimens were only collected in the January samples. They appear very closely related to *C. xanthopterum* which was collected in large numbers at all main river sites during all sampling occasions. Further investigation (outside the scope of this study) is required to ascertain whether this is a species new to science.

4. Summary

The high productivity of the Mokau River and three of its tributaries along a 2.5 km reach was reflected in the very large numbers of adult EPT and diversity of species caught using a combination of UV light traps and Malaise nets. Nearly 60 species comprising nearly 40,000 individuals were collected during this study, markedly more species and numbers than ever recorded from a Waikato native forest stream, and Waikato urban and pasture streams during equivalent summer months.

The productivity of the Mokau River was further highlighted in that an order of magnitude more EPT were collected from the main river than its tributaries (despite the use of both trapping methods). The main river supported a very large population of adult aquatic insects with larvae exhibiting diverse functional feeding groups ranging from algal grazers and piercers, to filter feeders and predators, with over 36,000 caught during the study.

The importance of forested headwaters is highlighted in that nearly 95% of all EPT species recorded were collected within the three tributary sites using two collection methods, compared with 57% in the main river sites using only light traps. The main river sites yielded 65%, and the tributaries 92% of the total species caught by light trap alone. Of all the taxa present 43% were only collected within the tributaries. Collection methods may have contributed to the increased number of species at the tributary sites as Malaise nets were able to trap continuously over a 24 hr period. This enabled them to collect insects that exhibited diurnal activity (e.g., many mayflies) or those not attracted to UV light (some caddisflies and most stoneflies), whereas light trap catches represented a single night's sample over a few hours. It is possible that more species of EPT could have been collected by placing Malaise nets along side the Mokau River.

Some species were 'rarely-encountered' (R; 1-4 specimens per sample) in samples using coded abundance protocols but no species of special conservation significance were recorded. The ecological range was however, extended for four species. Specimens of a caddisfly potentially new to science were caught along the Mokau River and its lower tributary, but this will require further investigation to confirm its taxonomic status. Many species of EPT were restricted to one site (mainly tributaries), possibly a reflection of a species poor dispersal capabilities or a lack of connectivity between fragmented forest habitats.

5. References

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6. Appendices

Appendix 1: Adult Ephemeroptera, Plecoptera and Trichoptera (EPT) coded abundance data (trapping methods combined) from six sites sampled on the Mokau River (18 Nov 2006 to 16 Jan 2007). Rare (R) = 1–4, Common (C) = 5–19, Abundant (A) = 20–99, Very Abundant (VA) = 100–499, Very, Very Abundant (VVA) = 500+ individuals.

EPT taxa recorded	Site 1	Site 1a	Site 2	Site 2a	Site 3	Site 3
Trichoptera						
<i>Aoteapsyche catherinae</i>	VVA	C	VVA	C	VVA	A
<i>Aoteapsyche colonica</i>	A	C	VA		C	A
<i>Aoteapsyche raruraru</i>	VVA	A	VVA	C	VVA	A
<i>Aoteapsyche</i> sp. X	A		A		A	
<i>Costachorema xanthopterygum</i>	VA	R	VVA	R	VA	A
<i>Costachorema</i> n. sp.?			R		R	R
<i>Cryptobiosella hastata</i>		C				
<i>Ecnomina zealandica</i>		C				
<i>Edpercivalia thomasoni</i>		C				
<i>Helicopsyche albescens</i>	C				C	
<i>Helicopsyche zealandica</i>		A		C		
<i>Hudsonema alienum</i>						R
<i>Hudsonema amabile</i>		R	C		R	
<i>Hydrobiosella mixta</i>		VA		C		R
<i>Hydrobiosis budgei</i>	VA	R	VA	C	VA	A
<i>Hydrobiosis centralis</i>		C	R			C
<i>Hydrobiosis copis</i>	VA	R	VA	C	VA	A
<i>Hydrobiosis gollanis</i>		R		A		A
<i>Hydrobiosis parumbripennis</i>	R		R	R	R	R
<i>Hydrobiosis umbripennis</i>	A				A	R
<i>Neurochorema confusum</i>	A		A		VA	R
<i>Oecetis unicolor</i>	C	R	C			
<i>Oeconesus maori</i>		C		R		C
<i>Olinga feredayi</i>	R	VA	R	VA		C
<i>Orthopsyche fimbriata</i>		A		C		C
<i>Oxyethira albiceps</i>	VVA	C	VVA	R	VVA	VVA
<i>Paroxyethira hendersoni</i>	VVA	R	VA	C	VA	C
<i>Polyplectropus altera</i>	C	R	R	R	C	A
<i>Polyplectropus aurifusca</i>		R				R
<i>Polyplectropus impluvii</i>		A		R		C
<i>Pseudoeconesus bistirpis</i>		R	R	C		R
<i>Psilochorema donaldsoni</i>		R	C		R	R
<i>Psilochorema mimicum</i>		C		R		A
<i>Pycnocentria evecta</i>	A	R	A	R	R	R

EPT taxa recorded	Site 1	Site 1a	Site 2	Site 2a	Site 3	Site 3
<i>Pycnocentroides aeris</i>	VA	R	VA	R	A	C
<i>Pycnocentroides aureolus</i>	VVA	R	VA	R	VVA	C
<i>Pycnocentroides funerea</i>		VA		A		C
<i>Tiphobiosis cowiei</i>		R		R		
<i>Tiphobiosis kleinpastei</i>		R				R
<i>Tiphobiosis plicosta</i>				R		
<i>Tiphobiosis veniflex</i>	A	R	R	R	A	C
<i>Triplectides dolichos</i>	R	R				
<i>Triplectides obsoletus</i>		R	R	R	R	
<i>Zelandoptila moselyi</i>		R	C		C	R
Ephemeroptera						
<i>Acanthophlebia cruentata</i>						R
<i>Austroclima sepia</i>	VA	A		R	A	
<i>Austronella planulata</i>		R				
<i>Coloburiscus humeralis</i>		VA		A		A
<i>Deleatidium</i> sp.	C	C		C	VA	A
<i>Neozephlebia scita</i>	C	VA		A	A	A
<i>Zephlebia ?borealis</i>		C		R		R
<i>Zephlebia dentata</i>	C	A		VA		A
<i>Zephlebia nebulosa</i>		C				R
<i>Zephlebia tuberculata</i>	C					
<i>Zephlebia versicolor</i>		C		C		R
Plecoptera						
<i>Acroperla trivacuata</i>		A		A		A
<i>Spaniocerca zelandica</i>		A				C
<i>Zelandobius furcillatus</i>						R

Appendix 2: Total counts of adult Ephemeroptera, Trichoptera and Plecoptera (EPT) recorded from six sites sampled along the Mokau River (18 Nov 2006 to 16 Jan 2007).

EPT taxa recorded	Malaise nets			Light traps						Total
	Site 1a	Site 2a	Site 3a	Site 1	Site 1a	Site 2	Site 2a	Site 3	Site 3a	
Trichoptera										
<i>Aoteapsyche catherinae</i>			1	2450	12	1890	7	5429	34	9823
<i>Aoteapsyche colonica</i>	1		25	48	6	176		19	8	283
<i>Aoteapsyche raruraru</i>	4	2	11	2388	24	2512	8	3041	40	8030
<i>Aoteapsyche</i> sp. X				32		113		48		193
<i>Costachorema xanthopterygum</i>			14	155	1	1019	1	277	43	1510
<i>Costachorema</i> n. sp.?						2		4	1	7
<i>Cryptobiosella hastata</i>	5				4					9
<i>Ecnomina zealandica</i>	5									5
<i>Edpercivalia thomasoni</i>	2				5					7
<i>Helicopsyche albescens</i>				16				16		32
<i>Helicopsyche zealandica</i>	56	6			13					75
<i>Hudsonema alienum</i>									1	1
<i>Hudsonema amabile</i>					1	8		1		10
<i>Hydrobiosella mixta</i>	135	12	1		5		4		1	158
<i>Hydrobiosis budgei</i>	3	7	12	128	1	321	3	336	11	822
<i>Hydrobiosis centralis</i>	1		16		7	2			1	27
<i>Hydrobiosis copis</i>	1	6	58	132		289		281	6	773
<i>Hydrobiosis gollanis</i>	3	3	27		1		26		8	68
<i>Hydrobiosis parumbripennis</i>			3	3		3	1	2	1	13
<i>Hydrobiosis umbripennis</i>			1	33				49		83
<i>Neurochorema confusum</i>				64		89		163	1	317
<i>Oecetis unicolor</i>				16	2	8				26
<i>Oeconesus maori</i>	6	1	1		9		1		5	23

EPT taxa recorded	Malaise nets			Light traps						Total
	Site 1a	Site 2a	Site 3a	Site 1	Site 1a	Site 2	Site 2a	Site 3	Site 3a	
<i>Olinga feredayi</i>	23	26	5	2	84	1	109		5	255
<i>Orthopsyche fimbriata</i>	26	10	16		3		9		2	66
<i>Oxyethira albiceps</i>			34	2348	9	1749	1	3628	625	8394
<i>Paroxyethira hendersoni</i>				585	1	318	6	144	5	1059
<i>Polyplectropus altera</i>			17	16	2	1	3	16	8	63
<i>Polyplectropus aurifusca</i>	1		4							5
<i>Polyplectropus impluvii</i>	59	2	13		1		2			77
<i>Pseudoeconesus bistirpis</i>	2		1		2	4	5			14
<i>Psilochorema donaldsoni</i>					1	16		1	2	20
<i>Psilochorema mimicum</i>	2	1	39		7		3		6	58
<i>Pycnocentria evecta</i>			1	46	1	20	1	2	2	73
<i>Pycnocentroides aeris</i>				229	2	169	4	28	12	444
<i>Pycnocentroides aureolus</i>	1	1		2865		448	2	1483	11	4811
<i>Pycnocentroides funerea</i>	281	39	7		2		2			331
<i>Tiphobiosis cowiei</i>	1						3			4
<i>Tiphobiosis kleinpastei</i>	4		1							5
<i>Tiphobiosis plicosta</i>		2								2
<i>Tiphobiosis veniflex</i>				33	1	1	3	33	14	85
<i>Triplectides dolichos</i>				1	1					2
<i>Triplectides obsoletus</i>					3	1	1	1		6
<i>Zelandoptila moselyi</i>	1				1	8		16	1	27
<i>Acanthophlebia cruentata</i>									1	1
Ephemeroptera										
<i>Austroclima sepia</i>	71	2		160	2			64		299

EPT taxa recorded	Malaise nets			Light traps						Total
	Site 1a	Site 2a	Site 3a	Site 1	Site 1a	Site 2	Site 2a	Site 3	Site 3a	
<i>Austronella planulata</i>					1					1
<i>Coloburiscus humeralis</i>	97	29	67		10		4		5	212
<i>Deleatidium</i> sp.	7	9	59	6	3			192	8	284
<i>Neozephlebia scita</i>	144	91	41	16	3		3	33		331
<i>Zephlebia borealis?</i>	7		2				1			10
<i>Zephlebia dentata</i>	63	351	7	16	14		7		29	487
<i>Zephlebia nebulosa</i>	9		4							13
<i>Zephlebia tuberculata</i>				16						16
<i>Zephlebia versicolor</i>	11	16	3						1	31
Plecoptera										
<i>Acroperla trivacuata</i>	58	24	22							104
<i>Spaniocerca zelandica</i>	60		8						1	69
<i>Zelandobius furcillatus</i>			1							1
Total number	1150	640	522	11804	245	9168	220	15307	899	39955
Taxa richness	33	21	33	26	36	25	27	26	32	58