Environment Waikato Technical Report 2001/12

The Freshwater Macroinvertebrate Communities of the Waikato, Waihou and Waipa Rivers.

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Acknowledgements

Thanks to Fiona Nicol for her assistance in the field and laboratory, Chris McLay and David Speirs for their comments on the draft and Harrison & Grierson for their processing of the samples.

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Executive Summary

Invertebrate populations in aquatic macrophytes in the Waikato, Waihou and Waipa Rivers were examined to study longitudinal changes and differences between invertebrate communities in these rivers. Eight sites were sampled on the Waikato, five on the Waihou and three sites on the Waipa River. Both the Waikato and Waihou Rivers had an abundance of macrophyte beds, dominated by *Egeria densa* in the Waikato and *Elodea canadensis* in the Waihou River. The lack of macrophyte beds in the lower Waipa River restricted the comparability of the samples with the other two rivers, hence analyses of the data was carried out only on the Waikato and Waihou Rivers. Macrophyte samples were taken from the edge of the channel at each site: *Egeria densa* from the Waikato sites, and *Elodea canadensis* in the Waipa and Waihou River sites. A comparison of the invertebrate assemblages of both *E. densa* and *E. canadensis* in the Waihou (Te Aroha site) showed the high comparability of the invertebrate communities of these two macrophyte species.

The Waikato, Waihou and Waipa Rivers showed moderate diversity in species sampled – 35, 40 and 34 taxa respectively. The relatively low numbers of mayflies and stoneflies observed in the samples was attributed to the high water temperatures at that time of year (summer). The Waikato River showed a general decline in species number, MCI and QMCI scores moving downstream. Taxonomic composition showed a wide range of dominant taxa groups with no clear transition moving downstream. The Waihou River, however, showed a decrease in the total number of invertebrates and number of taxa – no clear trend was seen in MCI/QMCI scores moving downstream. Taxonomic composition in the Waihou River was similar between the different sites with some increases in the dominance of molluscs and a decrease in the dominance of dipteran taxa at the lower sites. The Waipa River showed a decline in the MCI scores moving downstream, the other indices showed a strong decline at the Pirongia site.

The taxonomic composition of the invertebrate communities showed a wide variance in the Waikato River, whereas the communities in the Waihou were much more closely related. MCI, QMCI and taxa numbers were significantly higher in the Waihou River when compared to the Waikato River. The Waipa River showed strong dominance by molluscs in the upper two sites with a more varied community structure at the Pirongia site.

The decreasing MCI and QMCI scores on the Waikato River were attributed to the decline of water quality moving downstream. The high variance in invertebrate community composition in the Waikato River was attributed to the hydro-regulation of the flow regimes of the river.

1 Introduction

Freshwater macroinvertebrates are currently being used by a number of Regional Councils and Crown Research Institutes to monitor the state and health of the stream environments around New Zealand. Macroinvertebrates are good indicators of the state of streams and rivers because of their sedentary habitats, relatively long lifecycles and ease of sampling. Macroinvertebrate communities are affected over relatively long time periods, so that they are better indicators of condition than one off sampling of water quality parameters.

Most of the work carried out on macroinvertebrate communities in New Zealand has focused primarily on wadable streams where technology and ease of sampling makes monitoring a cost effective and proven option. Monitoring of macroinvertebrate communities in the large rivers is less common (Hynes, 1989), with some national monitoring work currently being undertaken by the National Institute of Water and Atmospheric Research (Scarsbrook *et al.*, 2000).

Environment Waikato has carried out routine water quality sampling on ten sites on the Waikato River. However, very little work has been conducted to date to examine the state of the macroinvertebrate communities along the river. Environment Waikato has funded some qualitative assessments of the aquatic plant and animal assemblages at various cross sections of the Waikato River (Coffey, 1997). This work has focused mainly on the hydro-lakes along the Waikato River. Similarly, there has been little work carried out on the macroinvertebrate communities of the Waihou and Waipa Rivers. Both of these rivers are routinely monitored as part of the water quality monitoring programme but very little biological work has been undertaken on these rivers (Barrier, 1994). This survey of the Waikato, Waipa and Waihou Rivers will start to address this information gap.

There is a stark contrast between the habitat available for macroinvertebrates in small cobbly streams compared to that of large rivers.
New Zealand streams and rivers have proven vulnerable to invasion by species such as *Egeria densa* and *Elodea canadensis* (Wells *et al.*, 1997). The Waikato River is no exception to this and large monospecific stands of *Egeria* were noted at all of the sites. Similarly, the Waipa and Waihou Rivers had large stands of exotic macrophytes present.

The overall aim of this study was to benchmark the macroinvertebrate communities in the Waikato, Waipa and Waihou Rivers. More specifically, the objectives were to:

1. Examine changes in community structure along the river length
2. Establish whether different community structures exist in different river systems.

2 Study Sites

Sites were chosen using 1:50000 topographical maps to identify readily accessible and evenly distributed sites on the Waikato, Waipa and Waihou Rivers. Eight sites were chosen on the Waikato River, five sites on the Waihou and three sites on the Waipa River (Figure 1). The eight sites on the Waikato River correspond closely with the current Environment Waikato water quality monitoring sites, allowing a comparison of results. Only three site assessments were completed on the Waipa River due to the lack of suitable macrophyte assemblages at the lower sites.

All of the sites were generally similar in morphology – the channel bottom was generally devoid of any vegetation and was composed of unstable, fine sediments.

The channel edges were observed to be the key habitat for biota, often with large stands of rooted macrophytes present. These macrophytes were mainly limited in distribution by flow and suitable substrate, restricting them to the margins of the channels and the shallower littoral zones.

Water quality parameters for the three rivers (Table 1) show increasing turbidity, phosphorus and nitrogen levels moving downstream. The Waipa River was the most turbid river as recorded at the Pirongia-Ngutunui road bridge.

Table 1: Water quality parameters for the Waikato, Waihou and Waipa Rivers from the Environment Waikato Water Quality Monitoring programme sites (5 year median).

	Turbidity (NTU)	Total Phosphorus(gm^3)	Total Nitrogen(gm^3)
Location	5 Yr Median	5 Yr Median	5 Yr Median
Waikato River @ Taupo Control Gates	0.3	0.005	0.07
Waikato River @ Ohaaki Bridge	0.6	0.011	0.10
Waikato River @ Ohakuri Tailrace Bridge	0.9	0.019	0.16
Waikato River @ Whakamaru Tailrace	1.1	0.021	0.19
Waikato River @ Waipapa Tailrace	1.2	0.025	0.26
Waikato River @ Horotiu Bridge	2.7	0.043	0.43
Waikato River @ Huntly-Tainui Bridge	5.3	0.059	0.55
Waikato River @ Tuakau Bridge	8.6	0.066	0.60
Waihou River @ Whites Rd	0.5	0.083	0.59
Waihou River @ Okauia	3.5	0.099	1.2
Waipa River @ Mangaokewa Rd	2.1	0.024	0.5
Waipa River @ Pirongia-Ngutunui Rd Br	10.3	0.062	0.86

2.1 Waikato River

Eight sites were surveyed on the Waikato River (Figure 1), starting with the Wallace Road site below Huka falls and running through to the lowest site at Tuakau. Each site was in a flowing section of the river – often located at intermediate positions between two hydrodams. The Waikato River was the largest of the rivers sampled and has a significantly higher discharge than the Waihou and Waipa rivers. *Egeria densa* was the most common and abundant macrophyte in the river and was strongly dominant at all of the sites surveyed. This species was often the only one that was observed at most of the sites, forming large monospecific stands.

2.2 Waihou River

Five sites were surveyed on the Waihou River (Figure 1), starting at Okoroire as the uppermost site down to the lowest site at Paeroa. The Waihou River was distinct from the Waikato with respect to regulation – there are no current dams on the Waihou and therefore the flow characteristics at each site were more consistent. There are a number of water abstractions from the Waihou River - mainly for irrigation purposes.

The Waihou River had a surprising lack of *Egeria densa* which was only present at the Te Aroha site. *Elodea canadensis* was common to all of the sites surveyed and was the dominant macrophyte, forming large, monospecific stands on the margins of the river. The river also contained a number of other macrophyte species that were often present and in significant numbers e.g., *Potomogeton crispus*.

2.3 Waipa River

Three sites were surveyed on the Waipa River. The Waipa River is similar to the Waihou with a lack of hydro-regulation but is much more turbid than the other two rivers (Table 1). The high turbidity could account for the apparent lack of aquatic macrophytes in this river. In the upper part of the Waipa River (upstream of Otorohanga) the water clarity was relatively high in comparison to the reaches of the lower Waipa (Table 1). There was some difficulty in finding suitable stands of *Elodea canadensis* (for comparison with the other rivers) as *Potomogeton crispus* often dominated the macrophyte beds at many of the sites. The paucity of suitable plants for sampling at the lower two sites (Otorohanga and Pirongia) renders the results questionable in comparison to the other sites sampled.

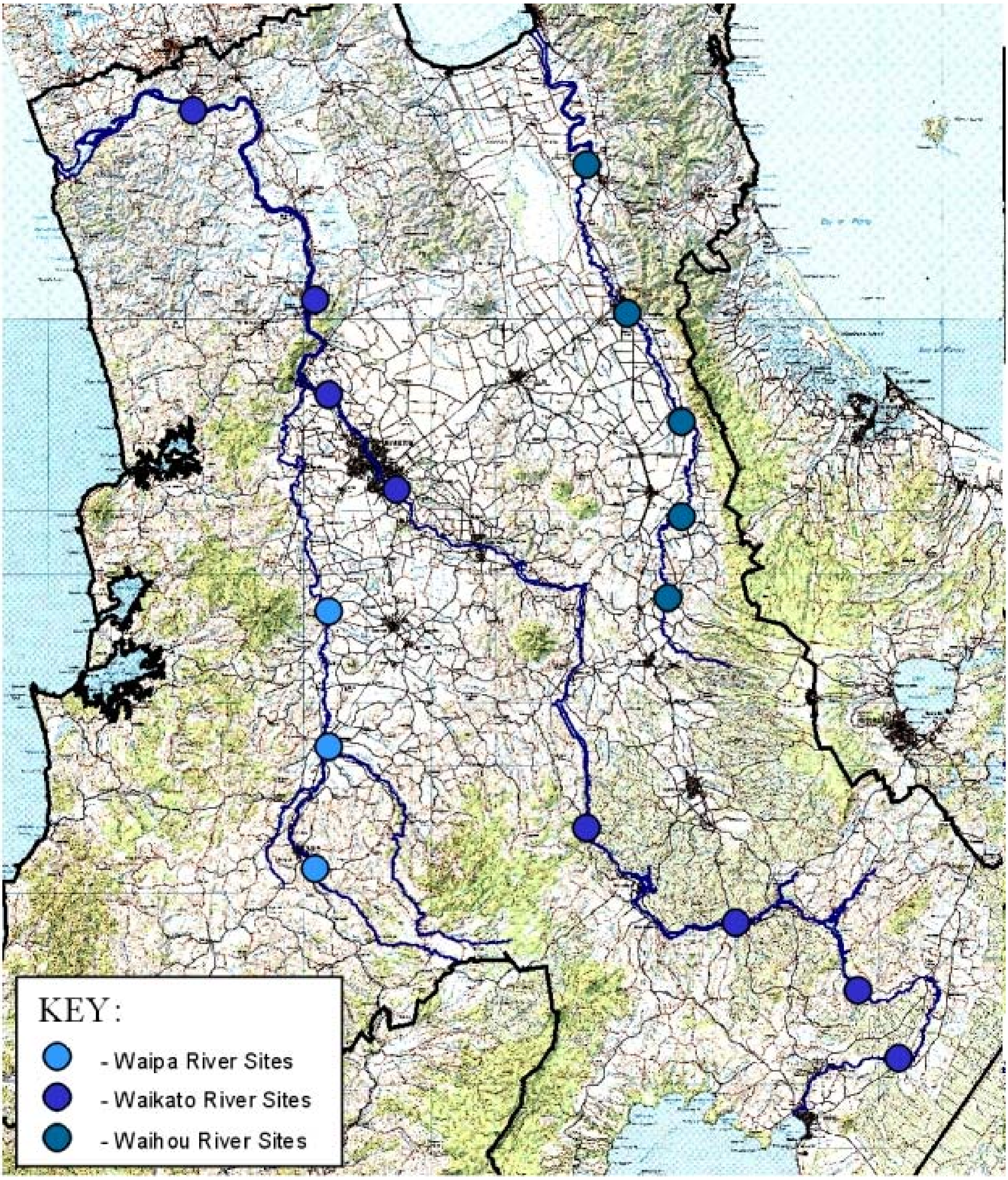


Figure 1: Study sites on the Waikato, Waihou and Waipa Rivers.

3 Methods

3.1 Invertebrate Collection

Samples were collected from flowing sections of each of the rivers – this was particularly relevant for the Waikato River where large sections of the river are composed of hydro lakes and hence resemble more lacustrine conditions. Samples were collected from the edge of the channel where macrophytes were minimally affected by fluctuations in flow as a result of daily variations in river level due to the hydrodam controls. Sampling of the macrophytes in the channel edge enabled a consistent methodology to be applied at all of the sampling sites.

Ideally the invertebrate samples of would have been taken from one macrophyte species – this proved impossible to complete due to the lack of some species, hence two target species were chosen: *Egeria densa* and *Elodea canadensis*. These species were chosen as they were abundant, similar in morphology and common in all the rivers surveyed. *Egeria densa* was common to all of the sites on the Waikato River and so was sampled at all of the eight sites. The Waihou and Waipa rivers on the other hand, had a scarcity of *Egeria densa* but commonly included *Elodea canadensis*. All of the Waihou River and Waipa River samples were composed of *Elodea*. A comparison of the macroinvertebrate assemblages found in these two plant species was made at the Te Aroha site on the Waihou River, where samples of both plant species were taken.

Four samples (approx. 200 grams) of macrophytes (*Egeria/Elodea*) were collected by snorkelling using a triangular frame hand net (300×300×300mm) with a 200µm mesh. Plant fragments were washed in a bucket of water and sorted by eye to remove any invertebrates still clinging to the vegetation. Plants were then wet weighed after sorting using a spring balance. The bucket of water and invertebrates were then passed through the collection net and transferred to a sample container and preserved in 70% alcohol. Invertebrate species were then identified in the lab to Macroinvertebrate Community Index (MCI) level (Stark, 1998). This sample collection method was following a technique designed by NIWA Hamilton scientists for the surveying of invertebrates in large rivers (Quinn, 1997).

3.2 Statistical Analysis

A variety of individual metrics was used to assess the relative health of the invertebrate communities at each site. Total number of invertebrates, species number and Quantitative Macroinvertebrate Community Index (QMCI) were assessed for each site and standardised against the wet weight of plant material for consistency. The Macroinvertebrate Community Index (MCI) was also assessed for each site although results were not standardised against the wet weight, as this index is reliant on presence/absence data.

Both the QMCI and MCI are indicators of organic pollution. In order to calculate a score for a site, individual taxon are assigned a sensitivity score ranging from 1 to 10 – a higher score indicative of higher sensitivity to pollution. The scores are then summed and transformed to an overall assessment of the condition of the site – the MCI based on presence/absence data and the QMCI (Stark, 1985) based on quantitative data. A two sample T-test was also performed on the indice data between the Waikato and Waihou Rivers, to test whether there were any significant differences ($P<0.05$) in the scores.

Species were also reduced to broad taxonomic groups for the assessment of relative abundances of the taxa groups at each site. A Detrended Correspondance Analysis or DECORANA was also applied to abundance data (standardised by sample weight) using PCORD (McCune, 1991), to examine the invertebrate community composition between sites on the Waihou and Waikato Rivers. DECORANA plots sites into 3D space on the basis of taxonomic composition, and hence sites that are closely clustered have similar taxonomic composition.

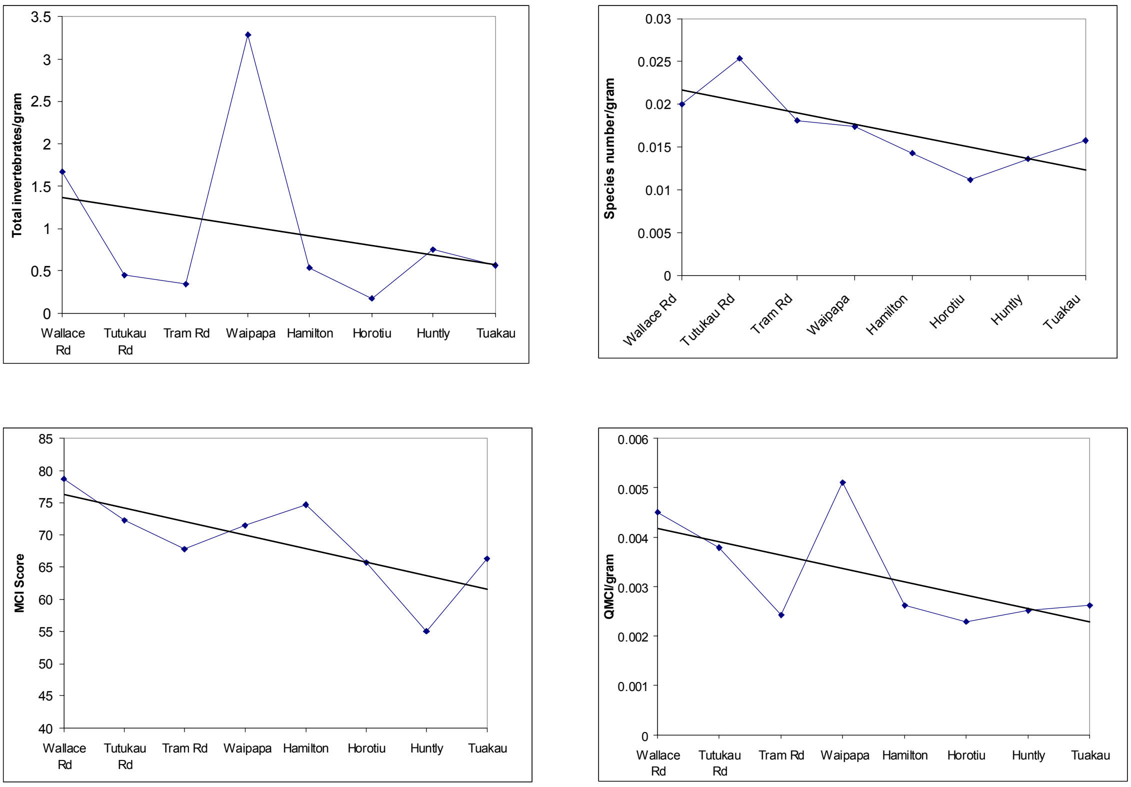
For each of the sites on the Waikato River there was a corresponding water quality site where a variety of measures are regularly made (Table 1). Calculations were performed using Pearson correlation between the axis scores from the DECORANA and 5 year median water quality results for each site (Wilson & Smith, 2000).

4 Results

4.1 Waikato River

4.1.1 Invertebrate richness, species number and indices

The Waikato River showed a wide range in the total invertebrates at each site (Figure 2a), ranging by a factor of sixteen between the most to least abundant sites. The total number of species recorded from all sites was 35. Species number showed less variance and ranged by a factor of three. Species number, QMCI and MCI scores showed a general decline moving down the Waikato River. A notable exception to the trends moving downstream is the Waipapa site – showing unusually high numbers of invertebrates and QMCI scores. The main difference between the Waipapa site and the others is that the Waipapa site is below a dam and hence subject to higher flow fluctuations.



(a) (b)

(c) (d)

Figure 2: a) Total invertebrates, b) species number, c) QMCI and d) MCI for different sites on the Waikato River.

4.1.2 Relative Abundances

The Waikato River showed a wide range of dominant groups between sites. There appeared to be no real trends in the macroinvertebrate communities moving downstream – some sites within relatively close proximity showed strongly differing communities (Figure 3).

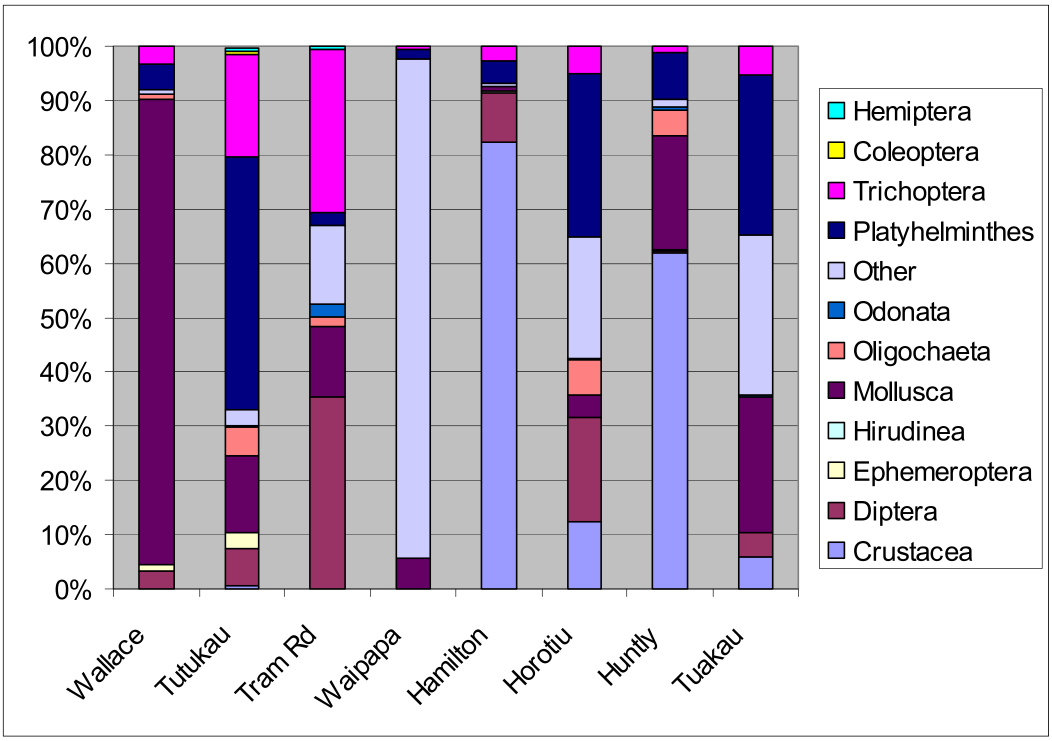
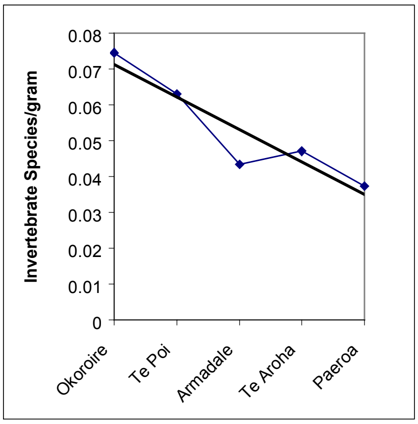


Figure 3: Relative abundances of major taxa groups for the sites on the Waikato River.

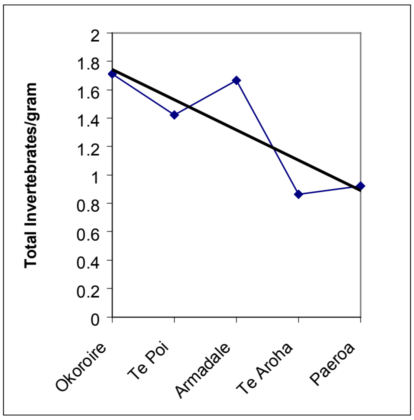
4.2 Waihou River

4.2.1 Invertebrate Richness, Species Number And Indices

Species number and total invertebrates ranged by a factor of two in the samples taken from the Waihou River (Figures 4a,b). The total number of species recorded from all of the sites was 40. Both the species number and total invertebrates showed a consistent decline in number moving downstream. MCI and QMCI scores, however, did not appear to change along the length of the river (Figures 5a,b).

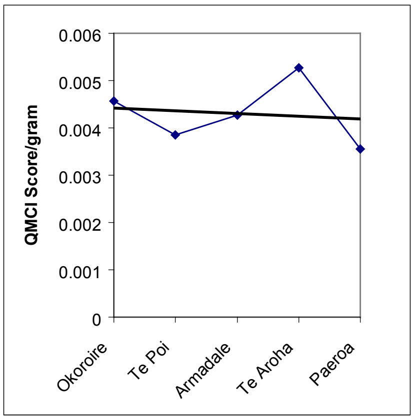


(a)

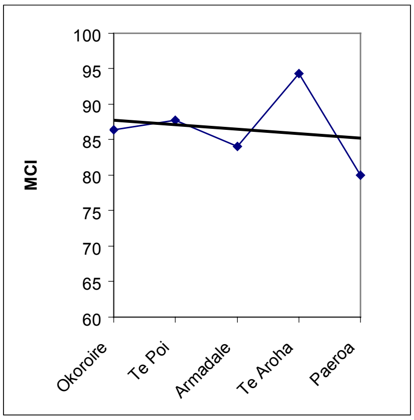


(b)

Figure 4: a) Invertebrate diversity and b) richness in the Waihou River sites.



(a)



(b)

Figure 5: a) QMCI and b) MCI for each site on the Waihou River.

4.2.2 Relative Abundances

All of the sites on the Waihou River showed a common core of taxa groups, namely: Molluscs, diptera and mayflies (Figure 6). Trichopterans were also present at all but the lowest site on the river (Paeroa). The composition of taxa at Okoroire was dominated by dipteran taxa – the most abundant being the chironomid *Tanytarsini*. Relative numbers of dipteran taxa decreased to the third site whereas numbers of molluscs increased. The Te Aroha site showed more mayflies than the other sites and this could be attributed to the greater diversity of habitat found at this site.

There is a strong similarity in taxonomic composition between the two Te Aroha samples taken – one for *Elodea canadensis* and *Egeria densa*. This suggests that the samples taken for each of the two-macrophyte species are comparable.

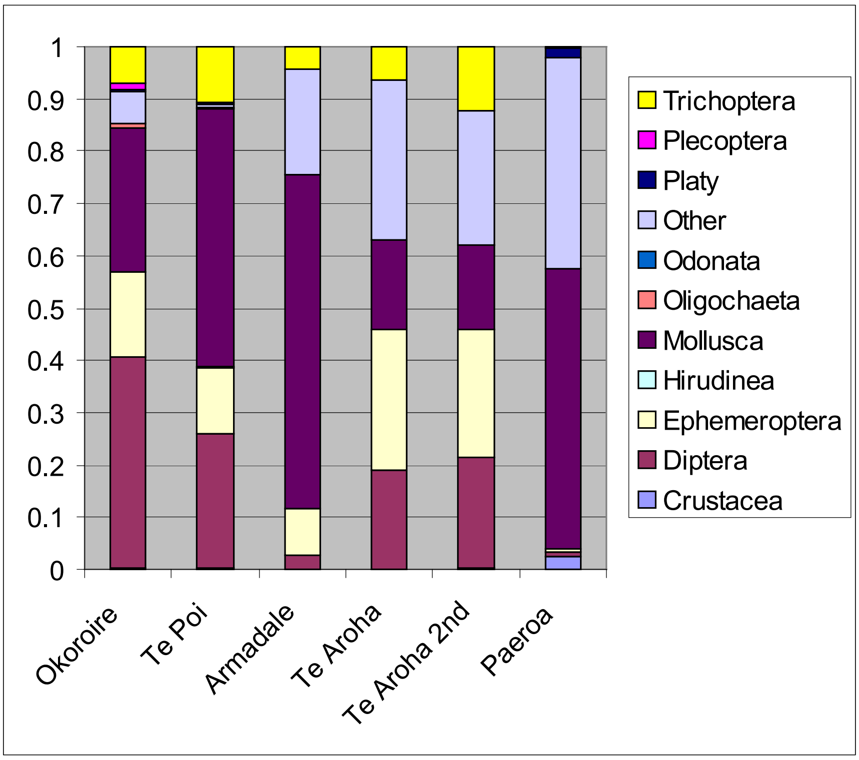
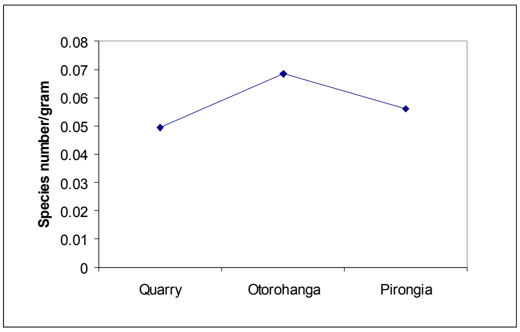


Figure 6: Relative abundances of major taxa groups for the Waihou River sampling sites.

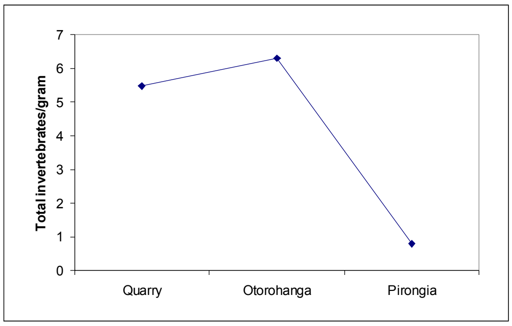
5 Waipa River

5.1.1 Invertebrate Richness, Species Number And Indices

Species number ranged by a factor of 1.5, total invertebrates by a factor of seven in the samples taken from the Waihou River (Figures 7a,b). The total number of species recorded from all of the sites was 34. The species number showed no real trend moving downstream, total number of invertebrates and QMCI scores (Figure 7c) however, showed a sharp decline at the Pirongia site. The MCI scores showed a steady decline moving downstream (Figure 7d). The Otorohanga site had the highest values for the species number, total invertebrates, and QMCI score.



(a)



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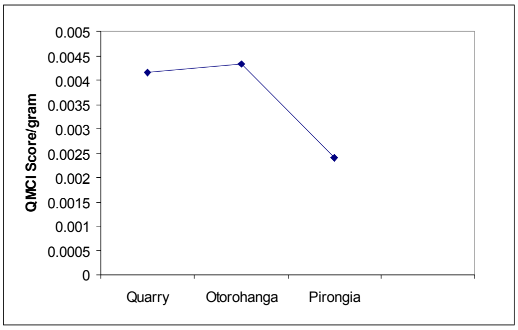

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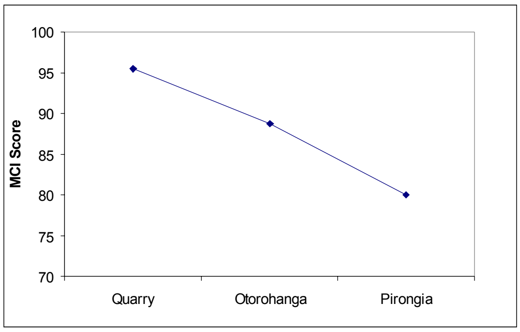

(d)

Figure 7: (a) Invertebrate diversity, (b) taxa richness, (c) QMCI and (d) MCI scores for the Waipa River.

5.1.2 Relative abundances

Both the Quarry and Otorohanga sites showed a strong dominance of molluscs (Figure 8) – namely Potamopyrgus in their samples. Trichopterans were the next most abundant group for both of these sites. The Pirongia site shows a much more varied taxonomic composition with crustaceans being the most dominant followed by dipterans.

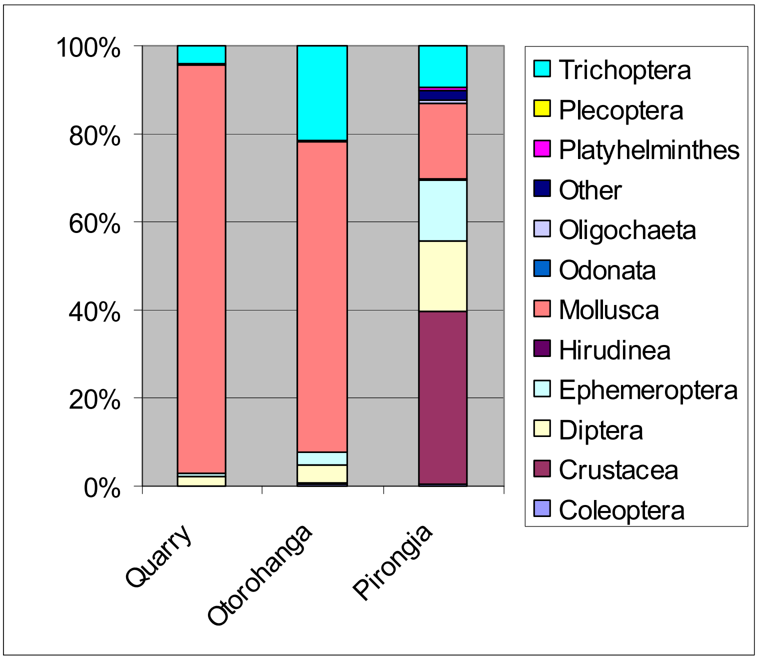

Figure 8: Relative abundances of major taxa groups for the Waipa River sampling sites.

6 Inter-River Comparison

The comparison between rivers focuses on the Waikato and Waihou Rivers and omits data on the Waipa River because of the lack of reliability of the data from this river.
The DECORANA of the river data (Figure 9) shows a tight grouping of the Waihou River sites, whereas the Waikato River sites show a wide scatter with the Waipapa site as the most distinct. Axis two is correlated with a number of water quality parameters (Table 2). The close proximity of the two Te Aroha sites on the DECORANA (each of a different macrophyte species) suggests that there was little difference in the invertebrate community composition between plant species – allowing a valid comparison to be made between the Waihou and Waikato River samples.

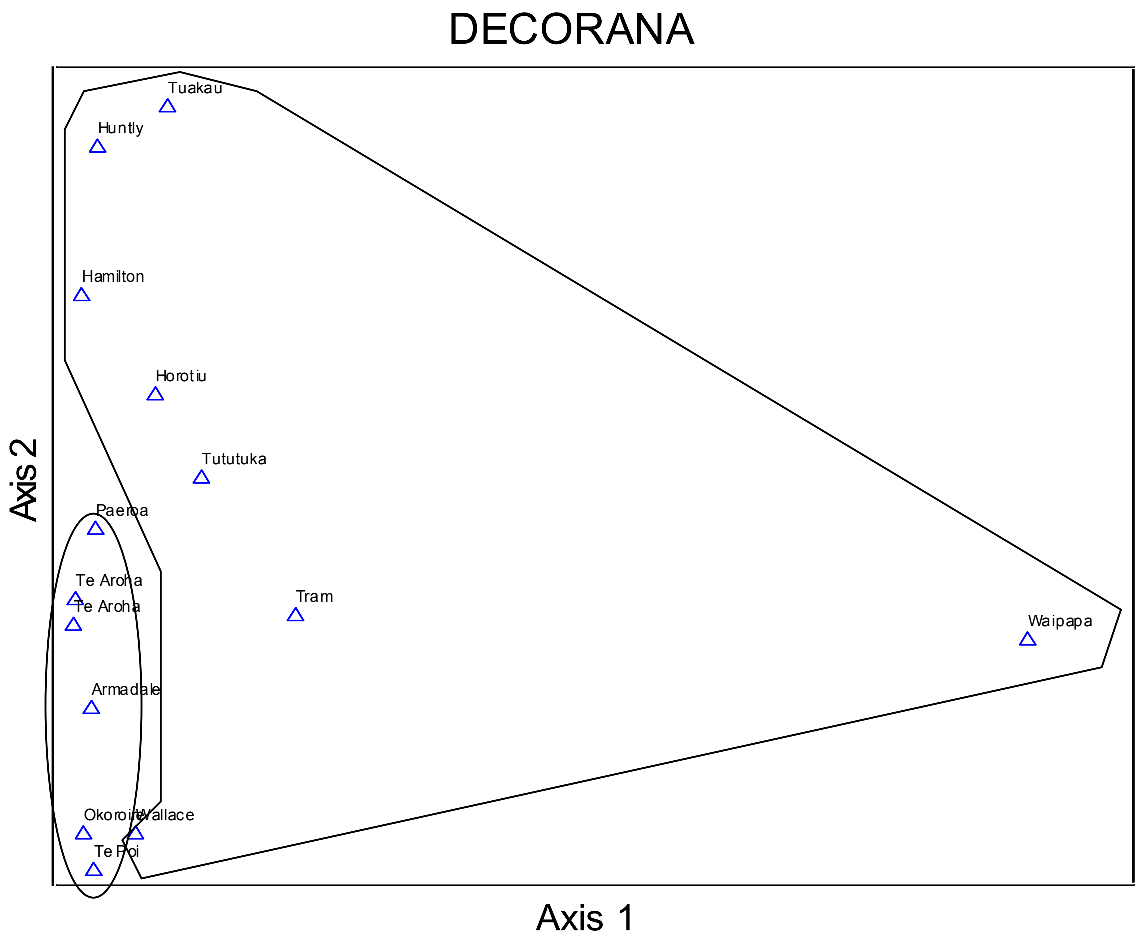

Figure 9: DECORANA showing two of the three axes of species abundance for the Waikato and Waihou Rivers.

Correlations were performed between the axis scores and water quality results for the Waikato River (Table 2) – axis two scores showed the highest correlation coefficients with total nitrogen, total phosphorus and turbidity. Axis one showed consistently low correlation coefficients for all parameters. The downstream shift in taxonomic composition is therefore most strongly correlated with the decline in water quality moving downriver.

Table 2: Pearson correlation values (r) between axis (DECORANA) scores and 5 year median water quality values for Waikato River sites.

	Conductivity	DO	Total N g/m3	Total P g/m3	Temperature	Turbidity
AXIS 1	0.26	0.47	-0.20	-0.21	0.12	-0.27
AXIS 2	0.36	-0.71	0.89	0.90	0.74	0.85
AXIS 3	0.81	-0.29	0.54	0.56	0.82	0.44

A comparison between the indice results for the Waikato and Waihou Rivers was also carried out:- QMCI and MCI scores were significantly higher in the Waihou River when compared with the Waikato River (P=0.0497 and P=0.0004 respectively). Total number of invertebrates (per gram) was not significantly different between the two rivers, and species number was significantly higher in the Waihou River (P= 0.0052).

7 Discussion

The Waikato, Waihou and Waipa Rivers showed moderate diversity in species sampled – 35, 40 and 34 taxa respectively, similar to the results from the National River Water Quality Network (Scarsbrook *et al.*, 2000). It is noted that the time of the survey (mid-summer) will have reduced the number of mayflies and stoneflies (particularly in the Waikato River), as the warmer water temperatures at this time of year excludes these species.

Species number declined in both the Waikato and Waihou rivers moving downstream and this is attributed to higher temperatures and declining water quality. The Waihou River showed stronger trends in the reduction of species number and total invertebrates moving downstream. MCI and QMCI scores showed some decline in the Waikato River but only showed a weak decrease in the Waihou. The MCI showed a clear decline in score moving downstream in the Waipa River.

Both the MCI and QMCI were designed for use in cobbly-bottomed streams on Mount Taranaki. The MCI and QMCI has only recently been used as indicators for large rivers (Scarsbrook *et al*., 2000). There is still some question as to whether these indices are appropriate indicators for use in large rivers compared to wadable streams. The relative increase or decrease of scores is still a useful measure, however, the absolute values and their meaning are yet to be determined.

The relative abundance of the taxonomic groups of the Waikato River varied widely and showed no consistent trend – the Waihou River, however showed more consistent composition and longitudinal changes. There was an overall shift observed in the community composition for both rivers moving downstream – the Waihou River samples showed more subtle changes in invertebrate composition when compared to the Waikato River, that showed more extreme changes in macroinvertebrate composition. The Waipa River communities in the upper sites differed from the other two rivers by having a strong dominance of molluscs, the Pirongia site however, showed a much more diverse community structure.

The large rivers surveyed showed very little habitat available for colonisation on the channel bottom. The vast majority of the channel bottoms were composed of silt or other unstable material – resulting in highly mobile substrates, unsuitable for colonisation by most macroinvertebrate species. Submerged rooted macrophytes in the littoral zone were common to all sites surveyed, and were the key habitat observed for macroinvertebrates. Other substrates suitable for colonisation were woody debris, snags and a variety of gravels in the littoral zone. The technique for invertebrate collection used in this study is a new one, and more study will be needed to determine the variability of species number and richness, and hence what weight of sample will be required to be representative.

A previous longitudinal study carried out on the Waikato River using artificial substrates (Davenport, 1981) found that the upper river sites (Huka falls, Ohakuri and Narrows) were dominated by chironomids, lower river sites (Horotiu, Ngaruawahia and Rangiriri) were dominated by *Potamopyrgus antipodarum*. The results from that survey show some differences with our results: none of the sites were dominated by chironomids in the current survey and there was no consistent dominance by any one taxon across the sites. *Paracalliope fluviatilus* was the only taxon that was dominant at more than one site (Hamilton and Huntly). The taxa lists show similar species collected, however, it is likely that the difference in sampling methodology influenced the relative abundance of these taxa.

The Waikato and Waihou Rivers showed similar numbers of invertebrates collected per gram of sample – even though there were two different species of macrophytes sampled. The results from the two species sampled at Te Aroha (*Egeria densa* and

Elodea canadensis) show a very similar invertebrate composition and hence strengthen the comparability of the two rivers samples. The Waihou River results show less organic pollution and higher numbers of invertebrate species than the Waikato River.

The Waikato River catchment is much larger than the Waihou and Waipa Rivers and it also has large portions of the catchment (particularly in the lower) that are composed of intensively used land. The Waipa River for example enters the Waikato River at Ngaruawahia and significantly influences the discharge and water quality of the river. The Waihou River has a large portion of its catchment in undeveloped land in the Coromandel and Kaimai Ranges, and the Mamaku Plateau. The larger size of the Waikato River could also influence the composition of the invertebrate fauna although habitats appeared to be similar between rivers. The increased level of development in the Waikato River could account for some of the differences observed between the two rivers. Studies on small rivers and streams in the Waikato Region has also shown a change in the invertebrate communities to a degraded state (Environment Waikato, 1998) in more developed catchments.

The hydro-regulation of the Waikato River could explain the highly variable taxonomic composition, high daily fluctuations in flow will cause disturbance to invertebrate communities affecting the availability and quality of habitat. Overseas studies have shown the importance of establishing natural flow regimes in rivers rather than just minimum flows (Benke, 2001, Molles *et al.*, 1998, Toth *et al.*, 1998). It will therefore be a challenge in the future to set criteria for the flow management of rivers that are heavily regulated, like the Waikato River. Further study therefore, on the effect of flow regimes in large rivers will need to be undertaken to improve our understanding of the biological processes in these systems.

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Appendix: River Data

Waikato River Raw Data

(standardised by kg total weight of sample)

	Wallace	Tututukau	Tram	Waipapa	Hamilton	Horotiu	Huntly	Tuakau
Acarina	5	8	4	1	1	1	1	1
Antipodochlora braueri	0	0	0	0	0	0	0	0
Aoteapsyche colonica	0	0	1	0	1	0	0	0
Ausella	0	0	0	0	0	0	0	0
Austroclima cf sepia	6	4	0	0	1	0	0	0
Austrosimulium longicorne	0	0	0	0	0	0	0	0
Berosus	0	0	0	0	0	0	0	0
Bryozoa - indet	0	1	7	1	0	0	3	109
Chironomus	0	0	0	0	0	0	1	0
Cladocera	0	0	10	2707	1	0	0	0
Coloburiscus humeralis	0	0	0	0	0	0	0	0
Copepoda	0	0	0	0	0	0	0	0
Corynoneura	0	0	0	0	0	0	0	0
Cura	81	209	9	59	22	52	65	166
Deleatidium unk	6	0	0	0	0	0	0	0
Dytiscidae (Liodessus)	0	0	0	0	0	0	0	0
Elmidae (Hydora nitida)	0	0	0	0	0	0	0	0
Eriopterini	0	0	0	0	0	0	0	0
Ferrisia	0	1	7	1	2	3	155	135
Glossiphonia	0	0	0	0	0	0	1	1
Gyraulus	0	37	0	0	0	0	0	0
Hudsonema aliena	0	0	0	0	0	0	0	0
Hudsonema amabilis	0	0	0	0	0	0	0	0
Hydra	0	0	16	302	1	0	0	0
Hydrobiosis juveniles	0	0	0	0	0	0	0	0
Hydrobiosis parumbripenis	0	0	0	0	0	0	0	0
Hygraula nitens	8	7	1	0	0	1	0	9
Latia neritoides	0	0	0	0	0	0	0	0
Lymnaea	2	4	0	4	0	0	0	0
Mauiulus luma	9	9	0	0	0	0	0	0
Microvelia macgregori	0	3	2	3	0	0	0	0
Muscidae	1	0	0	0	0	0	0	0
Nemertea - indet	0	4	6	2	1	34	6	48
Oligochaete - indet	13	23	6	0	0	11	35	0
Olinga	0	0	0	0	0	0	0	0
Orthocladiinae	24	29	113	2	7	0	0	5
Oxyethira albiceps	42	76	10	0	11	9	7	17
Paracalliope fluviatilis	0	0	0	0	444	22	466	31
Paratya curvirostris	0	0	0	0	0	0	0	4
Paroxyethira eatoni	0	0	0	0	0	0	1	4
Paroxyethira hendersoni	12	9	92	20	2	0	1	10
Physa acuta	34	7	21	41	2	2	4	3
Planorbarius	85	0	0	25	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0
Potamopyrgus antipodarum	1315	15	17	107	1	2	0	4

Pycnocentria evecta	0	0	0	0	1	0	0	0
Pycnocentrodes modestus	0	0	0	0	0	0	0	0
Rhabdocoels	0	0	0	0	0	2	0	0
Sigara arguta	0	0	0	0	0	0	0	0
Sphaerium	0	0	0	0	0	0	0	0
Tanaidacea	0	0	6	1	0	1	0	1
Tanytarsini	28	1	10	0	43	33	3	18
Tiphobiosis	0	0	0	0	0	0	0	0
Triplectides obsoletus	0	0	0	0	0	0	0	0
Xanthocnemis cf zealandica	0	1	9	8	0	1	5	2
Zelandoperla	0	0	0	0	0	0	0	0
Zelandobius furcillatus group	0	0	0	0	0	0	0	0
Zephlebia spectabilis	0	0	0	0	0	0	0	0
Zephlebia cf versicolor	0	0	0	0	0	0	0	0

Waihou River Raw Data
(standardised by kg total weight of sample):

	Okoroire	Te Poi	Armadale	Te Aroha	Te Aroha2nd	Paeroa
Acarina	1	2	0	0	0	1
Antipodochlora braueri	1	0	0	0	0	0
Aoteapsyche colonica	1	1	1	0	0	0
Austroclima cf sepia	48	39	138	261	174	3
Austrosimulium longicorne	35	3	36	115	58	2
Bryozoa - indet	0	2	0	0	1	0
Coloburiscus humeralis	2	4	0	0	0	0
Copepoda	0	0	0	0	0	70
Corynoneura	1	0	0	0	0	0
Cura	2	2	0	0	0	16
Dytiscidae (Liodessus)	0	2	0	0	0	0
Elmidae (Hydora nitida)	3	0	0	0	0	0
Ferrisia	5	1	7	0	0	54
Glossiphonia	1	0	0	0	0	0
Hudsoaliena	0	1	0	0	0	0
Hudsoamabilis	0	34	0	0	1	0
Hydra	2	1	0	0	0	2
Hydrobijuveniles	4	3	0	1	3	0
Hydrobiparumbripenis	2	2	1	1	0	0
Latia neritoides	1	0	28	0	0	3
Microvelia macgregori	0	1	0	0	0	0
Muscidae	0	3	0	0	0	0
Nemertea - indet	0	1	2	2	0	0
Oligochaete - indet	13	1	2	0	0	0
Orthocladiinae	64	98	10	131	80	6
Oxyethira albiceps	2	7	0	5	6	3
Paracalliope fluviatilis	103	2	332	425	220	299
Paratya curvirostris	0	0	0	2	3	23
Physa acuta	15	2	0	1	0	3
Polypedilum	0	0	0	0	1	0
Potamopyrgus antipodarum	450	698	1029	242	140	435
Pycnocentria evecta	102	82	67	76	85	0
Pycnocentrodes modestus	6	8	3	5	10	0
Sigara arguta	0	1	0	0	0	0
Sphaerium	0	0	0	0	0	1
Tanytarsini	590	262	2	19	41	1
Triplectides obsoletus	3	16	0	3	1	0
Xanthocnemis cf zealandica	0	4	0	0	0	0
Zelandobius furcillatus group	22	0	1	0	1	0
Zephlebia cf versicolor	227	137	8	114	36	3

Waipa Raw Data

(standardised by kg total weight of sample):

	Quarry	Pirongia	Otorohanga
Acarina	0	2	4
Aoteapsyche colonica	0	13	1
Austronella	2	113	162
Austrosimulium longicorne	77	34	57
Berosus	0	0	1
Cura	9	5	11
Elmidae (Hydora nitida)	8	4	32
Eriopterini	1	0	0
Ferrisia	1	0	0
Glossiphonia	0	1	0
Hudsonema amabilis	16	0	151
Hydrobiosis juveniles	0	0	8
Hydrobiosis parumbripenis	0	0	4
Hygraula nitens	1	1	0
Microvelia macgregori	1	0	0
Nemertea – indet	2	15	5
Oligochaete - indet	0	5	4
Olinga	2	0	0
Orthocladiinae	38	87	153
Oxyethira albiceps	9	39	5
Paracalliope fluviatilis	0	317	20
Physa acuta	0	0	4
Polypedilum	1	0	1
Potamopyrgus antipodarum	5074	140	4438
Pycnocentria evecta	91	11	1079
Pycnocentrodes modestus	12	2	64
Tanytarsini	2	9	22
Tiphobiosis	0	2	0
Triplectides obsoletus	97	10	40
Xanthocnemis cf zealandica	0	0	4
Zelandoperla	0	0	1
Zelandobius furcillatus group	5	0	0
Zephlebia spec	7	0	0
Zephlebia cf versicolor	15	0	28

Table Of Sample Weights

	Weight (g)
Waikato River	
Wallace Rd	850
Tutukau Rd	750
Tram Rd	1050
Waipapa	920
Hamilton	1120
Horotiu	1250
Huntly	1100
Tuakau	1140
Waihou River	
Okoroire	940
Te Poi	1000
Armadale	900
Te Aroha	1000
Paeroa	1100
Waipa River	
Quarry	950
Pirongia	930
Otorohanga	1050