THE EFFECT OF LAND USE ON BENTHIC COMMUNITIES IN HAWKES BAY STREAMS OF DIFFERING GEOLOGY.

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Science in Ecology
at Massey University

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Front page photograph: Pakuratahi Stream (2), Hawkes Bay. Taken 18 December 1996 by author.

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Errata Sheet

p. 9, line 18: should read: ...invertebrate **communities** and periphyton **biomass** through...

p. 10, line 5: should read: ...and periphyton **assemblages**, and to establish...

p. 10, line 7: should read: ...of periphyton **biomass** is also examined...

p. 17, line 9: should read: ...mesh) were **randomly** collected from...

p. 17, line 12: should read: ...mid channel within **riffles along** a 20m section...

p. 18, line 20: should read: ...and invertebrate data. **ANOVA calculations were conducted at the 0.05 level of significance, and** if necessary, data was log...

p. 19, insert after line 12: ***Community indices***

Two indices were used to assess species diversity.

These were:

1. Margalef's index (a simple measure of species richness) given by the formula:

$$D = (S - 1) / \ln N,$$

where S is the species number and N is the total number of individuals collected (Clifford and Stephenson 1975).

2. Berger Parker index (a simple measure of evenness, or dominance) given by:

$$D = N_{max} / N,$$

where N_{max} is the number of individuals in the most abundant species and N is the total number of individuals collected (Berger and Parker 1970).

Water quality was assessed by calculating the MCI (Macroinvertebrate Community Index) and QMCI (Quantitative Macroinvertebrate Community Index) (Stark 1985). An Ephemeroptera, Plecoptera, and Trichoptera (EPT) ratio was also calculated to assess water quality (Lenat 1988).

p. 21, line 1: omit: **'degrees of freedom,'**

p. 21, line 4: should read ...region. **The statistical level of significance for p-values is 0.05.**

p. 22, line 1: omit: **'4 replicate stone samples in'**

Figures on pp. 22, 24, 27, 29, 30, 31, & 32:

Bars equal the average site values, thus removing error bars for all exotic Pleistocene, logged limestone, & native limestone streams.

p. 23, line 1: should read: Total POM was **significantly** lower at...

pp. 24, 25, 27, & 29, line 1: omit: **'4 replicate Surber samples in'**

pp. 30, 31, & 32, line 1: omit: **'4 replicate Surber samples collected in'**

p. 39, insert at line 1:

Berger, W. H.; Parker, F. L. 1970: Diversity of planktonic Foraminifera in deep sea sediments. *Science 168*: 1345-1347.

p. 39, insert after line 14:

Clifford, H. T.; Stephenson, W. 1975: An introduction to numerical classification, Academic Press, London.

p. 42, insert after line 17:

Lenat, D. R. 1988: Water quality assessment of streams using a qualitative collection method for benthic invertebrates. *Journal of the North American benthological society 7*: 222-233.

p. 44, insert at line 1:

Stark, J. D. 1985: A macroinvertebrate community index of water quality for stony streams. *Water and soil miscellaneous publication 87*: 53p.

p. 64, line 14: should read: ...of land-use, **and in general geology appeared to be a more important determinant of macroinvertebrate community structure and periphyton biomass than did land use.**

ABSTRACT

ABSTRACT

Benthic macroinvertebrate and periphyton communities of streams draining four different land use types within four distinct geological types were sampled between December 1996 and January 1997. Catchment land use comprised either standing mature or logged exotic forest, native forest, or hill country pasture. The geological types of these catchments were either Mesozoic sandstone-greywacke, Pleistocene-greywacke, Tertiary mudstone, or limestone in origin. Pastoral stream invertebrate community structure was significantly different from that found in forested streams, with no clear distinction separating communities from standing exotic, logged exotic, and native forest sites. Pastoral communities were dominated by dipterans and trichopterans, while in contrast, macroinvertebrate communities in streams draining sandstone-greywacke catchments were dominated by ephemeropterans and plecopterans, showing a clear influence of catchment geology on benthic macroinvertebrate communities. This sandstone-greywacke effect appeared to be independent of land use. Periphyton biomass was greatest in pastoral and exotic sites, particularly those draining limestone catchments. High nutrient and conductivity levels, both of which are characteristic of limestone streams, appeared to override the effect of light restrictions on periphyton growth in exotic forest sites. Overall, both geology and land use played major roles in determining the structure of stream benthic communities, with factors such as altitude and stream temperature also important influences on these communities.

In November and December 1997, nutrient, shade, and disturbance effects were examined in periphyton communities colonising artificial substrates. These substrates were left in the 8 forested Hawkes Bay streams for 28 days with disturbance treatment substrates being physically abraded every 7 days. Nutrients (N + P) were added to nutrient treatment substrates and polythene cloth was used to create an artificially shaded environment for shade treatment substrates. Light availability and percentage canopy cover had the greatest effect upon periphyton, with light limitation being exhibited in closed canopy systems. Nutrient supply was also a factor determining periphyton biomass at both open and closed sites, although only up to a limit. Physical disturbance successfully removed organic matter from substrates as well as reducing chlorophyll *a* levels at open sites, however light and nutrient levels were more important determinants of chlorophyll *a* concentrations.

In summary, both land use and geology play a considerable role in influencing both macroinvertebrate community structure and periphyton biomass. The geological influence was mediated through direct effects on nutrient inputs into the stream (as measured by conductivity), as well as by the indirect influence upon stream water temperatures. The influence of land use on benthic communities is predominantly as a result of shade levels created by vegetation types and enrichment levels derived from agriculturally influenced land. These results are of particular importance when comparing or analysing results from studies involving different land use types, particularly when these land uses cover a range of altitudes or are found in more than one geological type.