EFFECTS OF LAND USE AND POINT SOURCE DISCHARGES ON MACROINVERTEBRATE AND PERIPHYTON COMMUNITIES OF THE TARANAKI RING PLAIN.

A.G. Wells
2000

A thesis submitted in partial fulfilment of the requirements for the Degree of Master of Science at Massey University.

ABSTRACT

Macroinvertebrate and periphyton communities were sampled from February 1998 to May 1998 in 83 stream and river sites throughout the Taranaki Ring Plain, New Zealand. Generally as streams descend the mountain, the catchment moves along a continuum ranging from pristine headwater streams with a high proportion of catchment in native forest, through to lowland streams with a high proportion of pasture catchment, draining intensive agricultural and industrial practices which put pressure on water resources. Ordination of sites indicated that the environmental continuum on the Ring Plain corresponds to a gradient of taxa along Axis 1 from clean water mayfly, caddisfly and stonefly taxa (i.e., *Deleatidium* spp., *Coloburiscus*) that prefer headwater streams, through to nutrient tolerant taxa (i.e. *Oxyethira, Nemertea, Potomoprygus*) that prefer lowland streams. This was emphasised by the positive correlation of Axis 1 with altitude and percent native forest and negative correlation with conductivity, chlorophyll a, temperature and BOD (Biological Oxygen Demand). A decline in invertebrate richness (number of taxa, Margarlef's index), and an increase in periphyton richness (number of taxa) and biomass (chlorophyll a) also occurred with distance downstream on the Ring Plain.

Data collected in my study were compared to earlier studies (Taranaki Catchment Commission 1982, 1984; Stark 1982; Hirsch 1958) to examine longer term temporal changes in macroinvertebrate communities. Significant differences in MCI and the SQMCI were found between my study and studies in the 1980's and 1958, as well as differences in percent EPT and the number of taxa between my study and 1980's studies. The decline in biotic indices in my study was also accompanied by a decrease in the abundance of mayfly and sensitive caddisfly taxa (i.e., *Deleatidium* spp., *Coloburiscus*) and an increase in the abundance of Diptera and the more tolerant caddisfly taxa (i.e. *Oxyethira*, *Tanytarsini*), since 1980's studies. Although invertebrate communities in my study that used to be below dairy factories and septic tank discharges were similar to the invertebrate communities in the 1980's

studies, there was a general improvement since the 1958 study. This recovery was reflected in the smaller negative differences in MCI values between sites directly upstream and downstream of discharge points within my study compared to the 1958 study. Temporal changes in water quality were mostly attributed to the intensification of agricultural practices, point source discharges from dairy factories and industry, changes in the flow regime and sand movement.

CONTENTS

GENERAL INTRODUCTION

Since human colonisation of New Zealand, two thirds of the almost complete forest cover has been removed, with about half this occurring in the last 150 years since European colonisation (Pullar and McLeod 1992). The impacts of land use on the health of New Zealand's water has been described by the Minister for the Environment as the most significant environmental issue facing the nation (Upton 1994). Productive land use such as agriculture has been shown to affect many of the characteristics of New Zealand's streams, including flows (Dons 1987; Fahey and Rowe 1992) nutrient and sediment concentrations (Smith et al. 1993), physical habitat (Williamson et al. 1992) and invertebrates (Quinn and Hickey 1990a; Harding and Winterbourn 1995; Townsend et al. 1997).

There have been many changes in attitudes to the assessment of water quality. The concern for ecological values has led to the emphasis on aquatic biota to assess conditions more directly (Norris and Norris 1995). The Resource Management Act (1991) also emphasizes the need for monitoring in order to meet the requirements of the Act (Berry 1995). This requires that discharges to receiving waters do not cause any "significant adverse effects on aquatic life" (sections 70 (regional plans) and 107 (resource consents)). There are advantages to studying the distribution of benthic invertebrates on a routine basis in this respect, they act as integrators of the physical and chemical characteristics of the water and provide a continuous record of environmental quality. The biota is also sensitive to intermittent pollution, which may be missed by chemical or physical surveillance. They are also capable of predicting the synergistic influences of combinations of chemicals on the environment at an early stage (Roper 1985).

Despite the importance and widespread use of stream macroinvertebrate communities for environmental monitoring and impact assessment, few studies have reported on long-term variation in community parameters (Townsend et al. 1987, 1989; Weatherley and Ormerod 1990). Few studies have also examined the interaction of point source discharges and land use on biological communities, rather they have focused on impacts from a combination of diffuse and point source discharges (Maasdam and Smith 1994, Quinn and Hickey 1990a, Harding and

Winterbourn 1995). The objective of this study was to examine the effects of land use and point source discharges on the invertebrate and periphyton communities of the Taranaki Ring Plain, and to reveal whether water quality has changed significantly since surveys by the Taranaki Catchment Commission (1984, 1982), Stark (1982), and Hirsch (1958). This involved a survey of the biological and physicochemical measures of 83 stream sites scattered on the Taranaki Ring Plain. Subsequently, 49 of these sites were compared to studies in the early 1980's, whilst 12 of these sites were compared to studies in 1958.