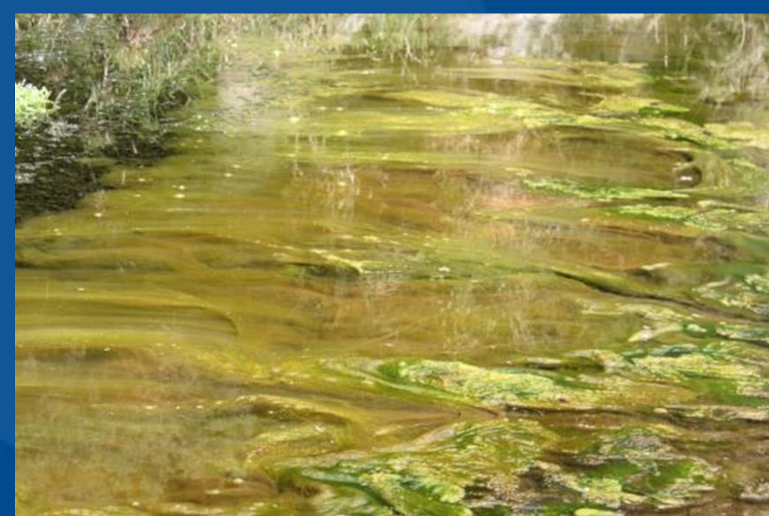
Why can't I see the forest for the cows?

Arboreal solutions for New Zealand's water quality crisis

Professor Russell Death

Innovative River Solutions Massey University

Selywn River, Canterbury



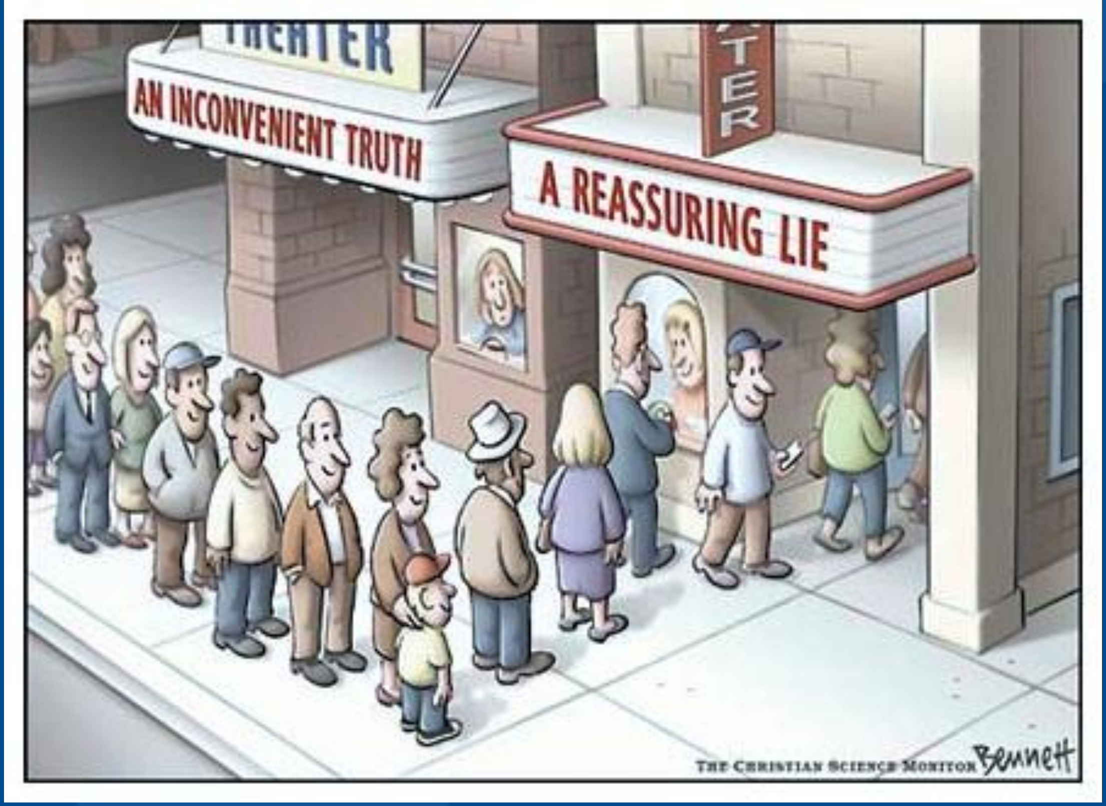
Kahuterawa Stream, Manawatu

Its not easy giving public talks as a river ecologist ☹

Highest percentage of endangered freshwater fish species in the world ☹

Most polluted river in the Western world ☹

Giving water (from National Parks) to bottling companies to sell :-(



No monitoring of any endangered freshwater invertebrates ☹

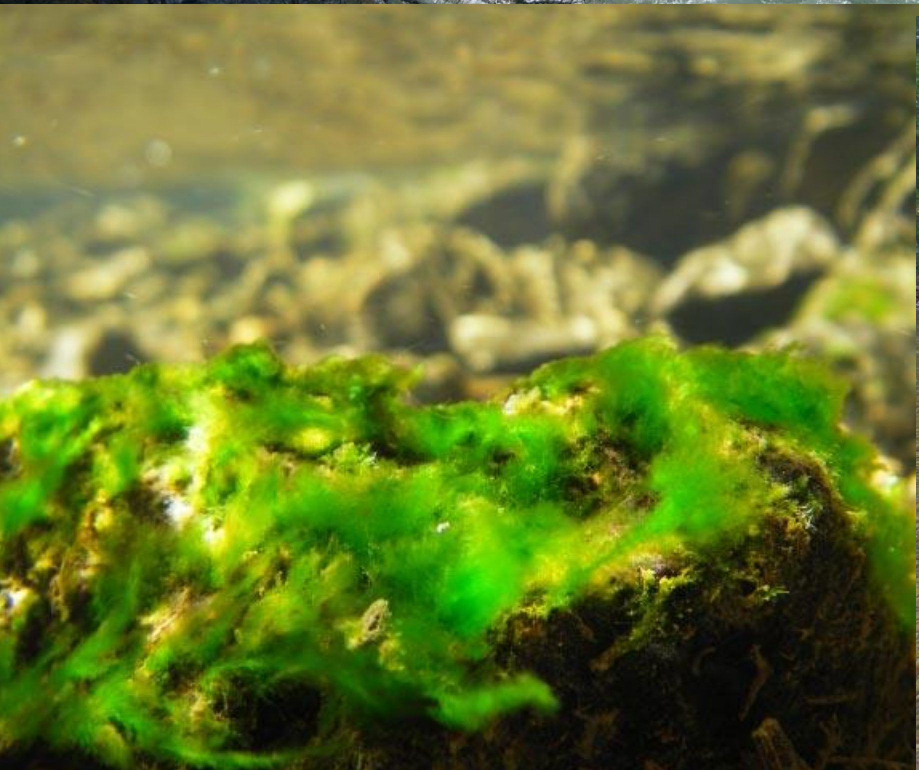
Increasing nitrate levels in our waterways ☹

Highest level of some waterborne diseases in the world ☹

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

THE ENGINE OF THE NEW NEW ZEALAND



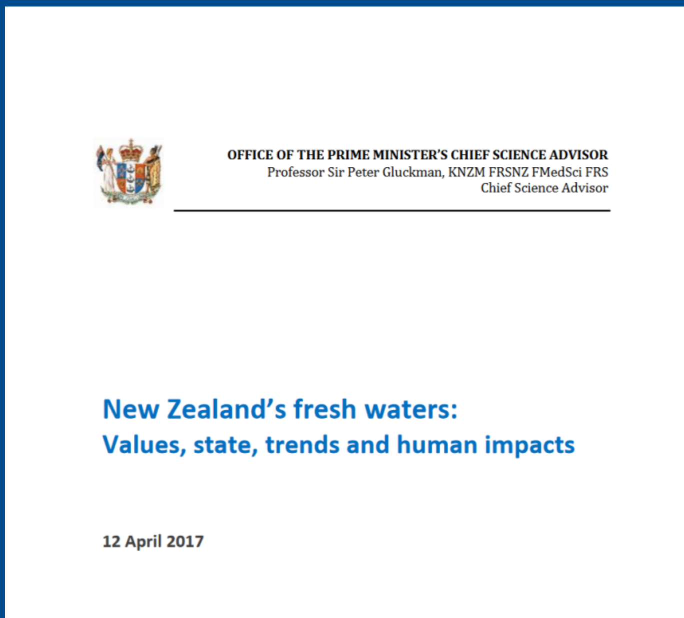



MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Unprecedented public concern about our waterways – even an election issue

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Three reports this year already say – water quality is “declining”



Not to mention 20 + years of science research

Hydrol. Earth Syst. Sci., 21, 1149–1171, 2017
www.hydrol-earth-syst-sci.net/21/1149/2017/
doi:10.5194/hess-21-1149-2017

Hydrology and Earth System Sciences

River water quality changes in New Zealand over 26 years: response to land use intensity

Jason P. Julian[1,5], Kirsten M. de Beurs[2,5], Braden Owsley[2,5], Robert J. Davies-Colley[3], and Anne-Gaelle E. Ausseil[4]

[1]Department of Geography, Texas State University, San Marcos, TX, USA
[2]Department of Geography and Environmental Sustainability, The University of Oklahoma, Norman, OK, USA
[3]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[4]Landcare Research, Palmerston North, New Zealand
[5]Landscape & Land Use Change Institute (LLUCI), University of Oklahoma and Texas State University, Oklahoma, Texas, USA

Correspondence to: Jason P. Julian (jason.julian@txstate.edu)

Received: 25 June 2016 – Discussion started: 21 July 2016
Revised: 22 January 2017 – Accepted: 25 January 2017 – Published: 23 February 2017

Abstract. Relationships between land use and water quality are complex with interdependencies, feedbacks, and legacy effects. Most river water quality studies have assessed catchment land use as areal coverage, but here, we hypothesize and test whether land use *intensity* – the inputs (fertilizer, livestock) and activities (vegetation removal) of land use – is a better predictor of environmental impact. We use New Zealand (NZ) as a case study because it has had one of the highest rates of agricultural land intensification globally over recent decades. We interpreted water quality state and trends for the 26 years from 1989 to 2014 in the National Rivers Water Quality Network (NRWQN) – consisting of 77 sites on 35 mostly large river systems. To characterize land use intensity, we analyzed spatial and temporal changes in livestock density and land disturbance (i.e., bare soil resulting from vegetation loss by either grazing or forest harvesting) at the catchment scale, as well as fertilizer inputs at the national scale. Using simple multivariate statistical analyses across the 77 catchments, we found that median visual water clarity was best predicted inversely by areal coverage of intensively managed pastures. The primary predictor for all four nutrient variables (TN, NO_x, TP, DRP), however, was cattle density, with plantation forest coverage as the secondary predictor variable. While land disturbance was not itself a strong predictor of water quality, it did help explain outliers of land use–water quality relationships. From 1990 to 2014, visual clarity significantly improved in 35 out of 77 (34/77) catchments, which we attribute mainly to increased dairy cattle exclusion from rivers (despite dairy expansion) and the considerable decrease in sheep numbers across the NZ landscape, from 58 million sheep in 1990 to 31 million in 2012. Nutrient concentrations increased in many of NZ's rivers with dissolved oxidized nitrogen significantly increasing in 27/77 catchments, which we largely attribute to increased cattle density and legacy nutrients that have built up on intensively managed grasslands and plantation forests since the 1950s and are slowly leaking to the rivers. Despite recent improvements in water quality for some NZ rivers, these legacy nutrients and continued agricultural intensification are expected to pose broad-scale environmental problems for decades to come.

1 Introduction

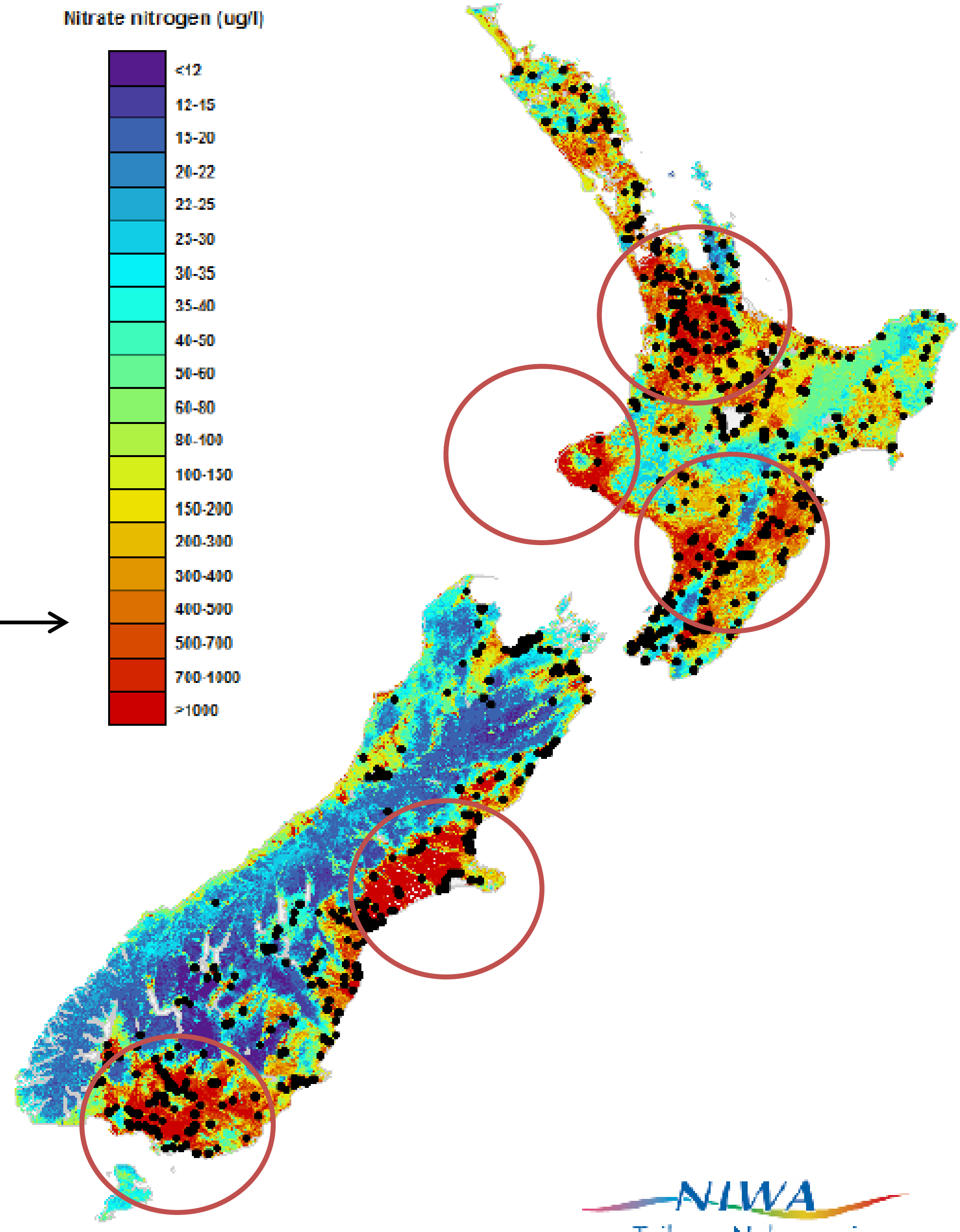
River water quality reflects multiple activities and processes within its catchment, including geomorphic processes, vegetation characteristics, climate, and anthropogenic land uses (Brierley, 2010). Relationships between water quality and these catchment characteristics are not straightforward because all of these factors interact over both space and time. For example, if intensive livestock grazing occurs on steep slopes, surface runoff and consequently river turbidity is expected to be greater than if grazing occurs on flatter areas; in other respects, if fertilizers are heavily applied to sandy soils with high drainage density, rivers will likely become

Published by Copernicus Publications on behalf of the European Geosciences Union.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Is water quality declining in New Zealand?

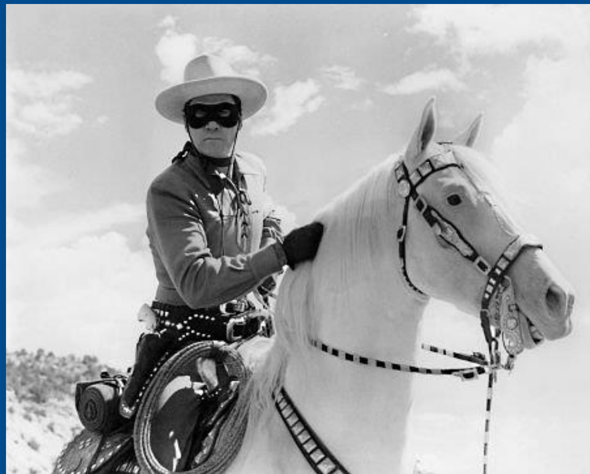
ANZECC trigger level



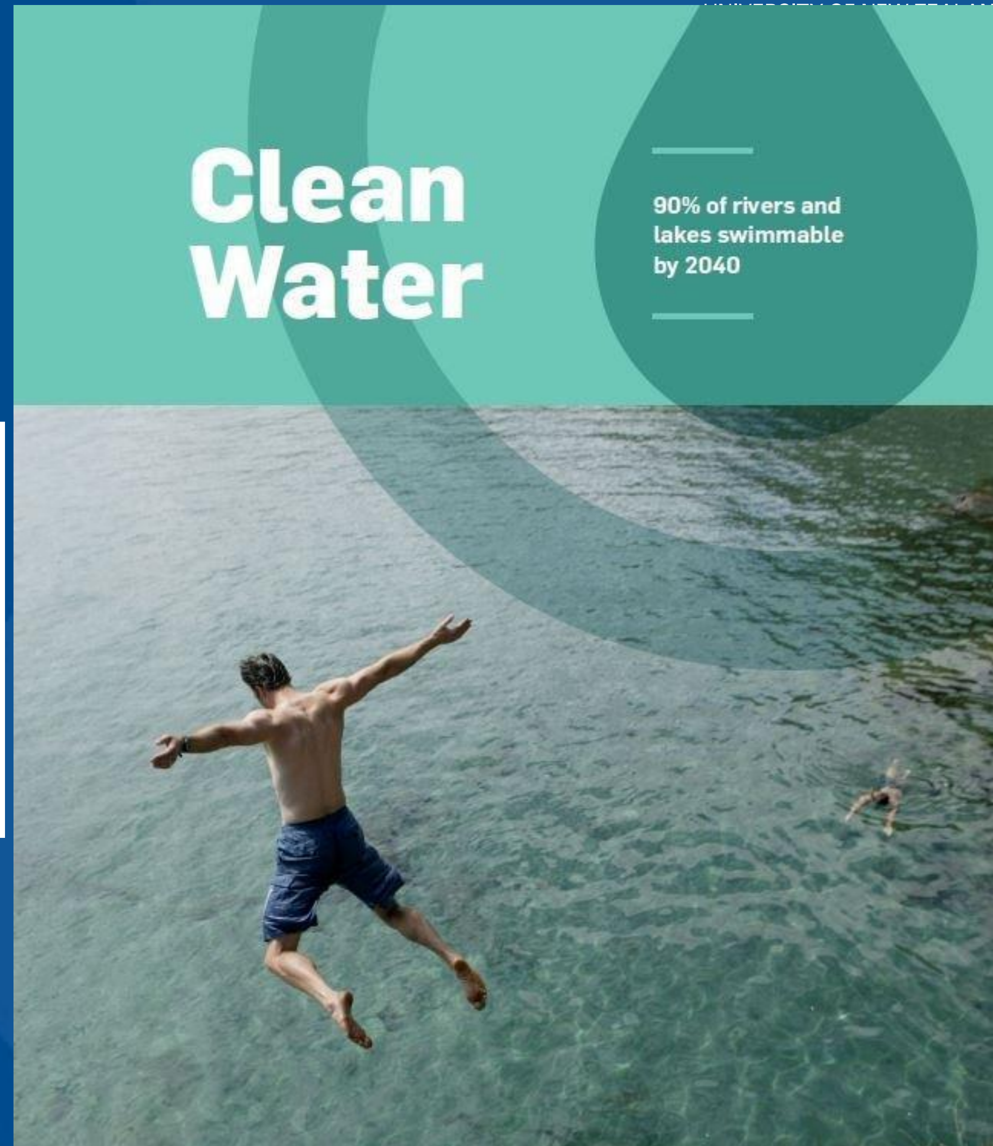
Nitrate

2017 MfE report
Nitrate:
Worse = 55%
Improve = 28%
DRP:
Worse = 25%
Improve = 42%

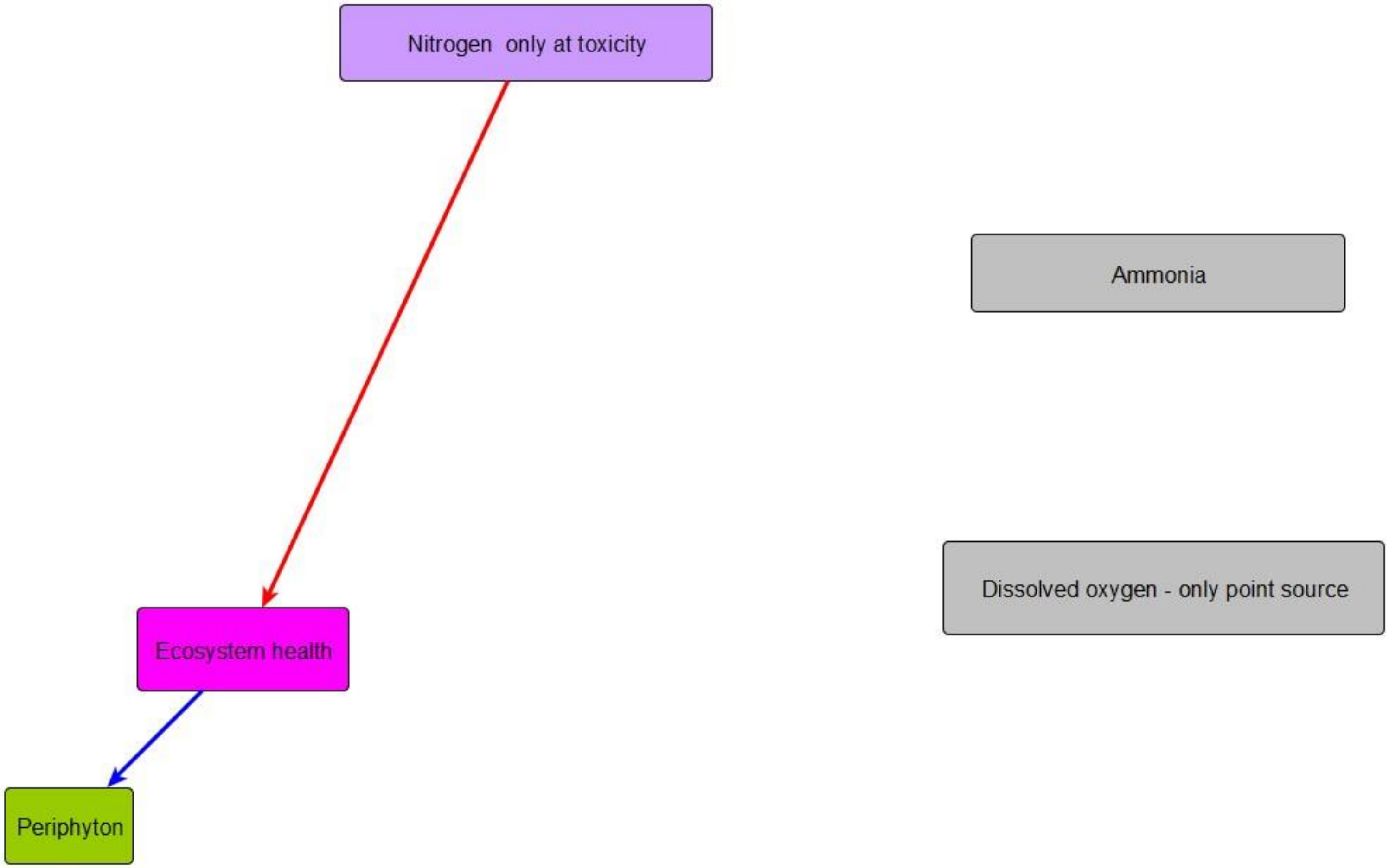
MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA



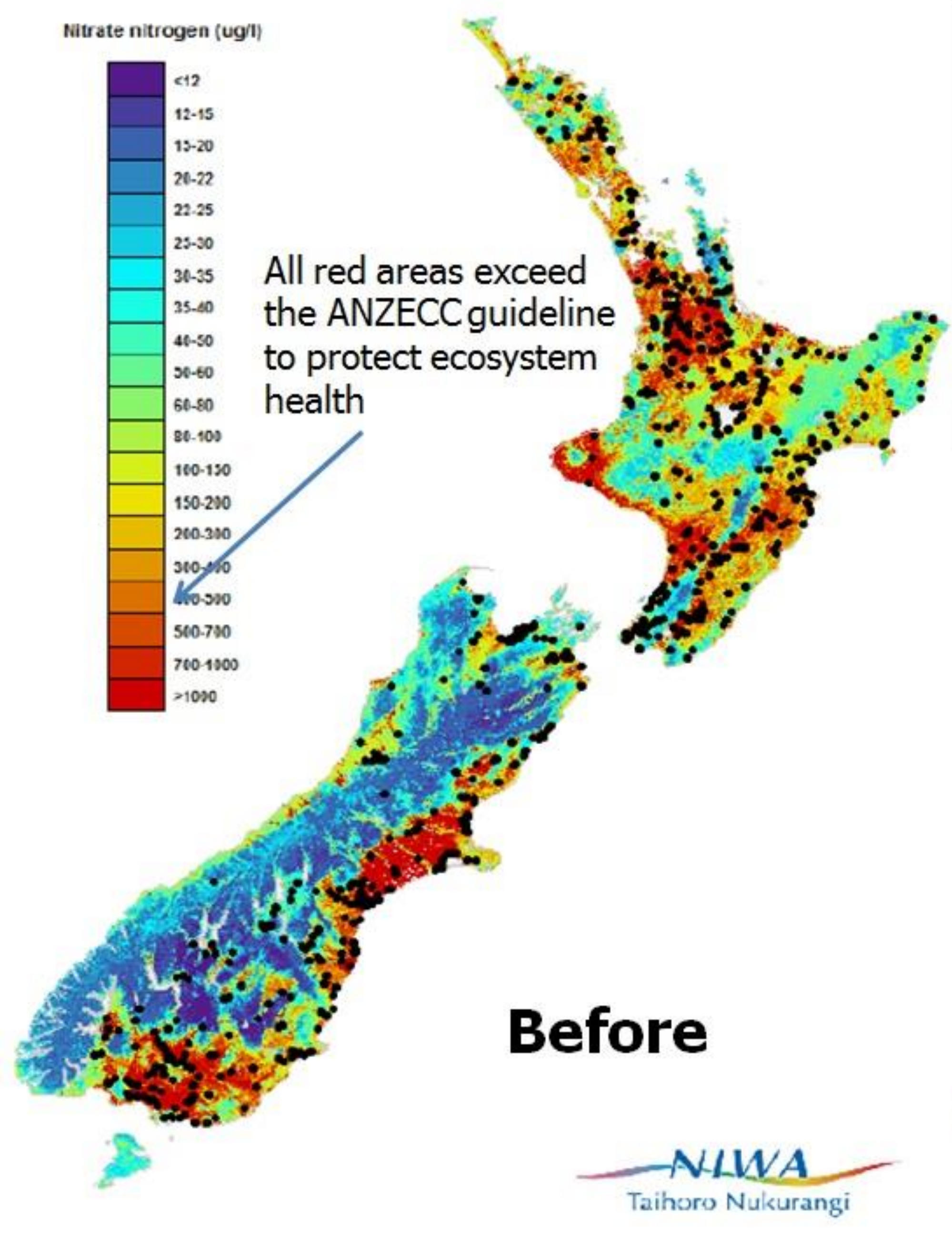
Just as dirty as before Water reforms 2017

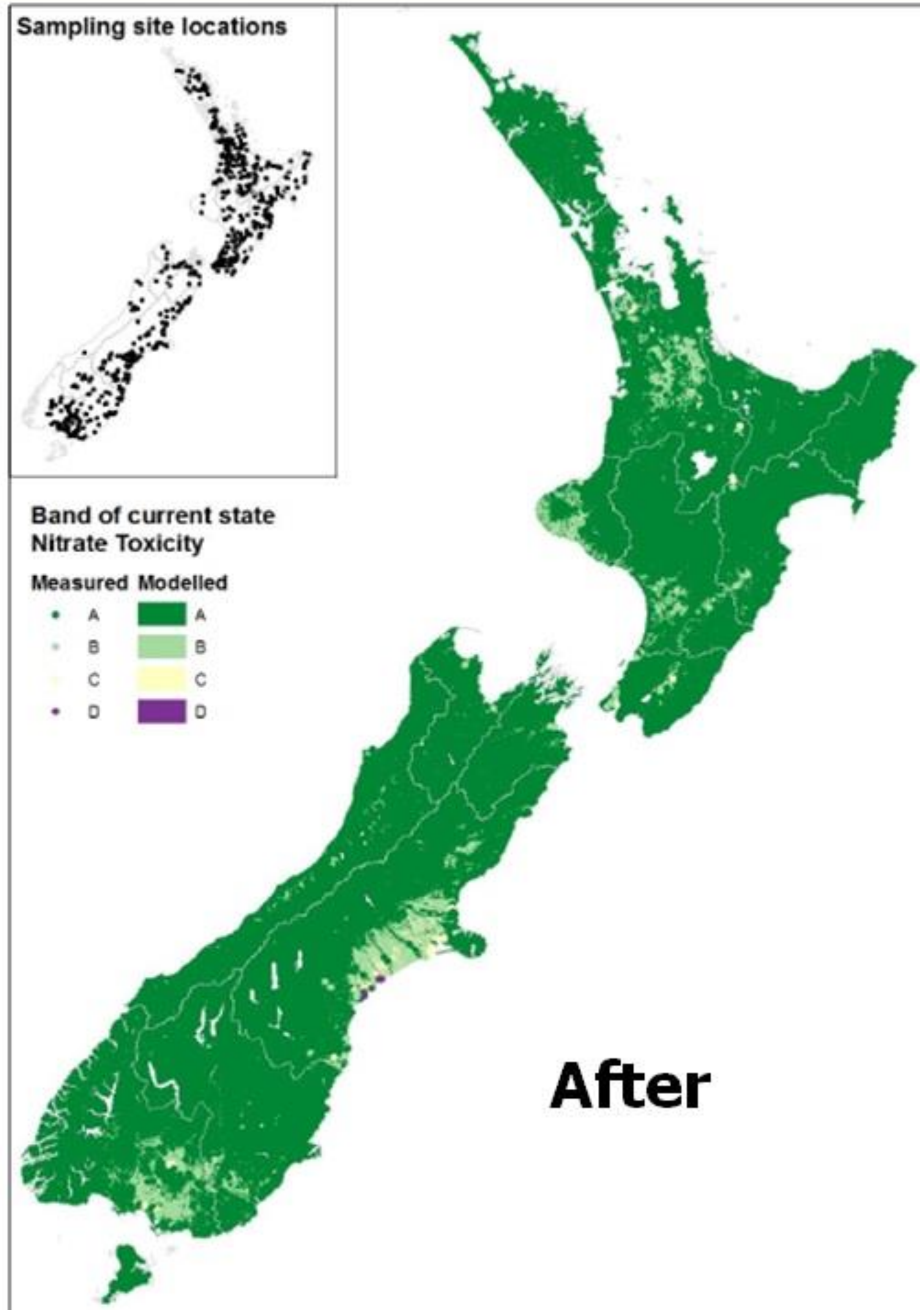


THE ENGINE OF THE NEW NEW ZEALAND


Nitrogen only at toxicity
Ammonia
Dissolved oxygen - only point source
Ecosystem health
Periphyton

“A fresh start for freshwater” NPS objectives 2014: (making the problem disappear)





Why is water quality bad?

~~"its complicated"~~

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

The main drivers of poor ecological health in New Zealand rivers?

1. Too many nutrients – nitrogen and phosphorus causing too much periphyton.
2. Too much sediment.

Agricultural industry solution

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND


DairyNZ

FARM
BUSINESS
ENVIRONMENT
FEED
PEOPLE
ANIMAL
MILKING
EVENTS
NEWS
ABOUT US
CONTACT US

High Low Search

DAIRY FARMERS SPEND OVER $1 BILLION ON THE ENVIRONMENT

HOME > NEWS > ALL NEWS >
DAIRY FARMERS SPEND OVER $1 BILLION ON THE ENVIRONMENT

SHARE THIS

Federated Farmers and DairyNZ have conducted a survey on New Zealand dairy farmers' environmental investments, revealing an estimated spend of over $1billion over the past five years.

ENVIRONMENTAL SPEND BY DAIRY FARMERS
$1 BILLION
OVER 5 YEARS

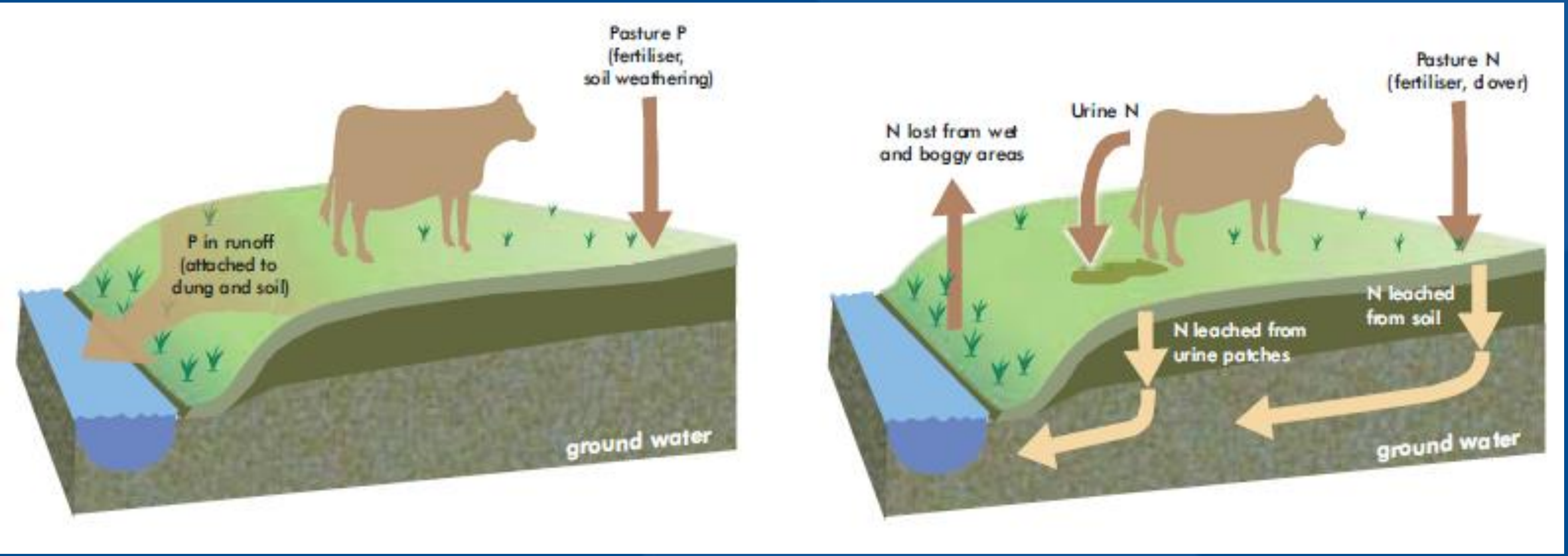
Five percent of the nation's dairy farmers responded to the survey and reported on the environmental initiatives they had invested in such as effluent management, stock exclusion, riparian planting, upgrading systems and investing in technology, retiring land and developing wetlands.

THE ENGINE
OF THE NEW
NEW ZEALAND

Sediment, Phosphorus, Pathogens

‘Easily’ mitigated with riparian fencing / planting.

Phosphorus Nitrogen



Phosphorus stopped by riparian planting and fencing streams

But up to 90% of nitrogen from cow urine leaches through soil.

Science solutions are simple

1. Reduce nitrogen = less cows
2. Increase water = less abstraction = less cows
3. Less fine sediment = less cows

Management solutions not so simple

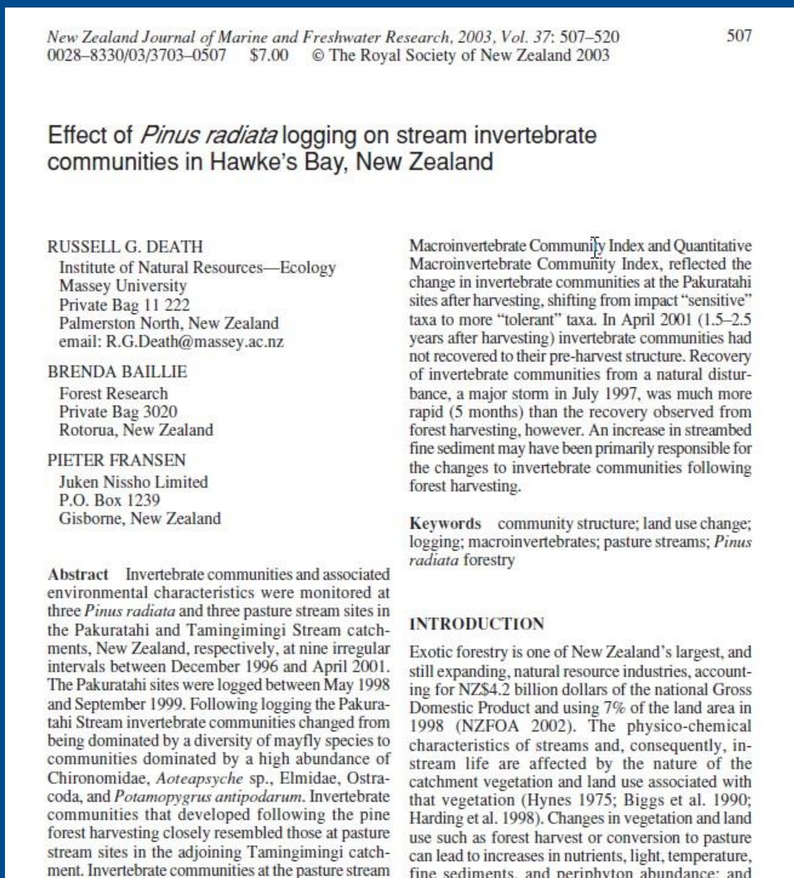
1. Less cows = less money ??
2. Less abstraction = irrigation

   = more cows

P.S. dams do not save rivers

And Forestry?

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND



New Zealand Journal of Marine and Freshwater Research, 2003, Vol. 37: 507–520 507
0028–8330/03/3703–0507 $7.00 © The Royal Society of New Zealand 2003

Effect of *Pinus radiata* logging on stream invertebrate communities in Hawke's Bay, New Zealand

RUSSELL G. DEATH
Institute of Natural Resources—Ecology
Massey University
Private Bag 11 222
Palmerston North, New Zealand
email: R.G.Death@massey.ac.nz

BRENDA BAILLIE
Forest Research
Private Bag 3020
Rotorua, New Zealand

PIETER FRANSEN
Juken Nissho Limited
P.O. Box 1239
Gisborne, New Zealand

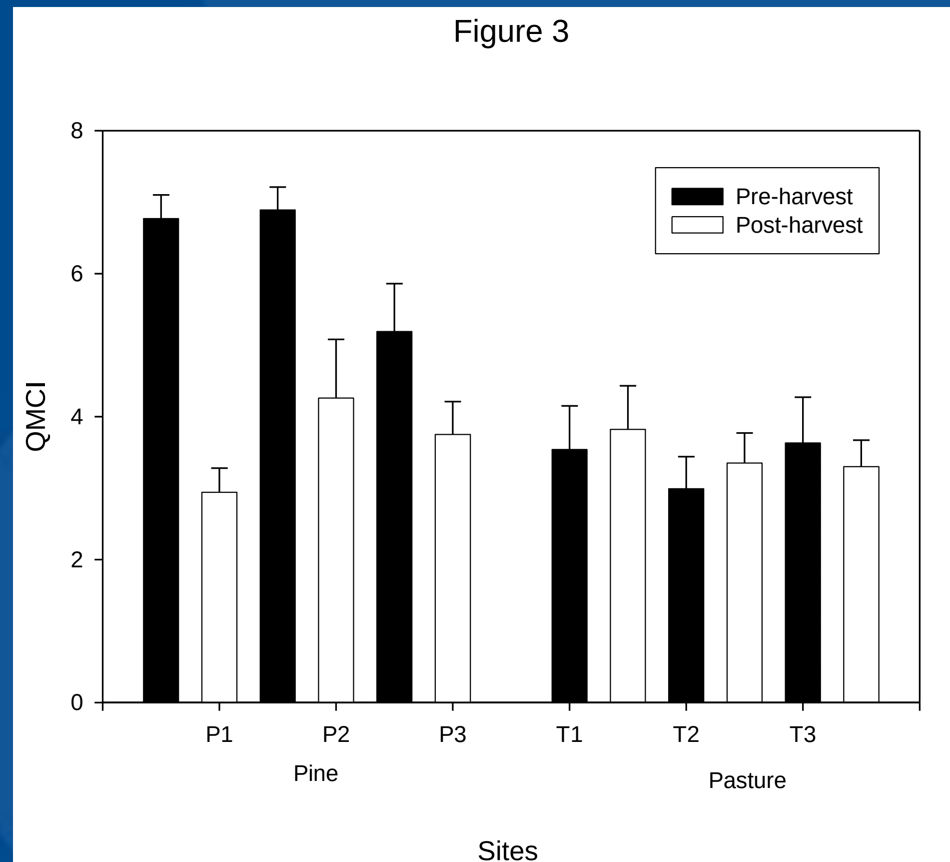
Abstract Invertebrate communities and associated environmental characteristics were monitored at three *Pinus radiata* and three pasture stream sites in the Pakuratahi and Tamingimingi Stream catchments, New Zealand, respectively, at nine irregular intervals between December 1996 and April 2001. The Pakuratahi sites were logged between May 1998 and September 1999. Following logging the Pakuratahi Stream invertebrate communities changed from being dominated by a diversity of mayfly species to communities dominated by a high abundance of Chironomidae, *Aoteapsyche* sp., Elmidae, Ostracoda, and *Potamopygrus antipodarum*. Invertebrate communities that developed following the pine forest harvesting closely resembled those at pasture stream sites in the adjoining Tamingimingi catchment. Invertebrate communities at the pasture stream

Macroinvertebrate Community Index and Quantitative Macroinvertebrate Community Index, reflected the change in invertebrate communities at the Pakuratahi sites after harvesting, shifting from impact "sensitive" taxa to more "tolerant" taxa. In April 2001 (1.5–2.5 years after harvesting) invertebrate communities had not recovered to their pre-harvest structure. Recovery of invertebrate communities from a natural disturbance, a major storm in July 1997, was much more rapid (5 months) than the recovery observed from forest harvesting, however. An increase in streambed fine sediment may have been primarily responsible for the changes to invertebrate communities following forest harvesting.

Keywords community structure; land use change; logging; macroinvertebrates; pasture streams; *Pinus radiata* forestry

INTRODUCTION

Exotic forestry is one of New Zealand's largest, and still expanding, natural resource industries, accounting for NZ$4.2 billion dollars of the national Gross Domestic Product and using 7% of the land area in 1998 (NZFOA 2002). The physico-chemical characteristics of streams and, consequently, in-stream life are affected by the nature of the catchment vegetation and land use associated with that vegetation (Hynes 1975; Biggs et al. 1990; Harding et al. 1998). Changes in vegetation and land use such as forest harvest or conversion to pasture can lead to increases in nutrients, light, temperature, fine sediments, and periphyton abundance; and



THE ENGINE OF THE NEW NEW ZEALAND

An alternative to more cows?

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Plant trees?

- Reduce nutrient loss from land.
- Reduce sediment loss – assuming you harvest responsibly.
- Improve waterway ecological health.
- Reduce green house gas emissions.
- Win/Win/Win environment / society / economy.

THE ENGINE OF THE NEW NEW ZEALAND

I’m not a tree hugger

But trees might be the solution !