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A Review of Recent University Research on Te Waihora/Lake Ellesmere and its Catchment

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Review Structure

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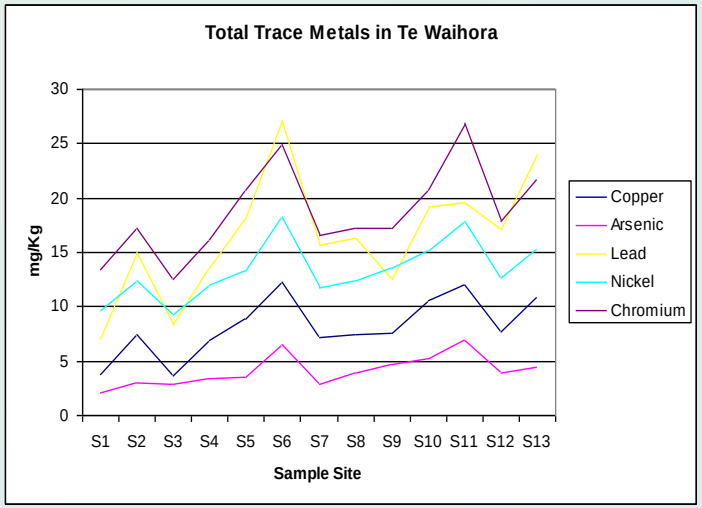
Contamination and Remediation

Sediment Contamination by Trace Elements

Peter Joynt
UC Summer Scholarship, 2010/11

(Supervisors: Jenny Webster-Brown & Sally Gaw)

- Trace elements tested: Fe, Mn, V, Cr, Ni, Cu, Zn, As, Cd and Pb
- Potential sources: catchment geology, fertilizers, building materials, agrichemicals
- All below guidelines for benthic aquatic life (ANZECC, 2000)



Using Native Species to Intercept Contaminants that Threaten Lake Ellesmere

Jason Hahner & **Hannah Franklin**
LU MSc thesis *LU PhD thesis*
Dept Ecology and Soil Science

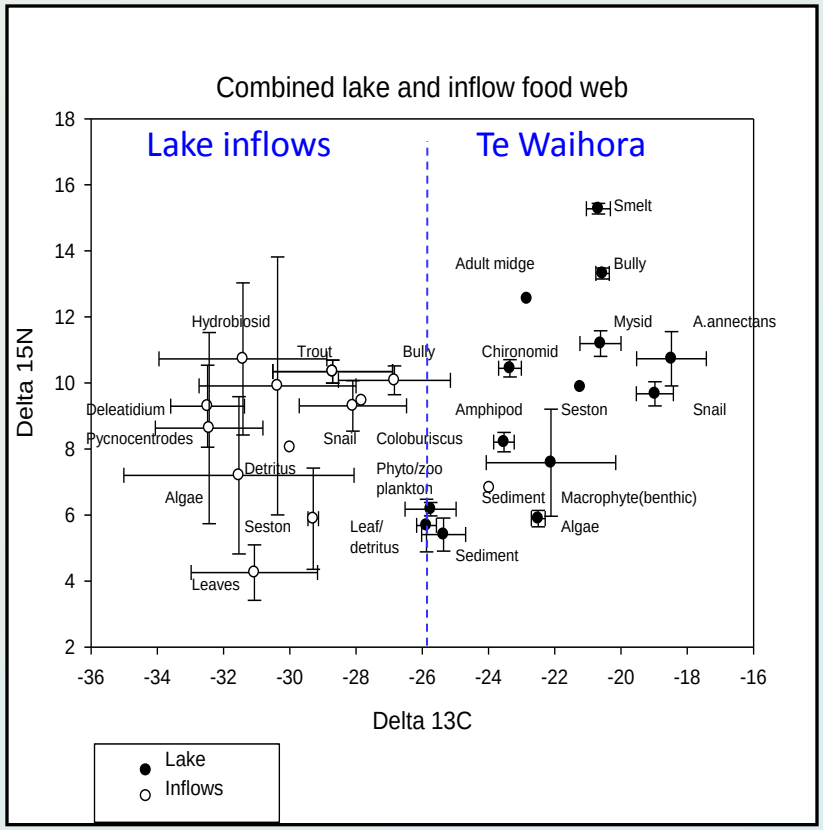
(Supervisors: Nick Dickinson & Brett Robinson)

- Using strategic native plantings and soil amendments on Canterbury farms to intercept nutrients and contaminants
- Plants increase biodiversity & provide wind shelter
- Some species may be used a fodder supplements to improve trace element nutrition

Ecology

Benthic Ecology and Food Web Dynamics of Te Waihora

Hannah Wood
UC MSc thesis, FERG, 2008
(Supervisor: Jon Harding)



- A broad-scale seasonal and spatial survey of benthic invertebrates and food webs for the lake and surrounding inflows
- The lake & inflows have very different food webs that show distinct isotopic signatures
- Species don't seem to move much between these two systems

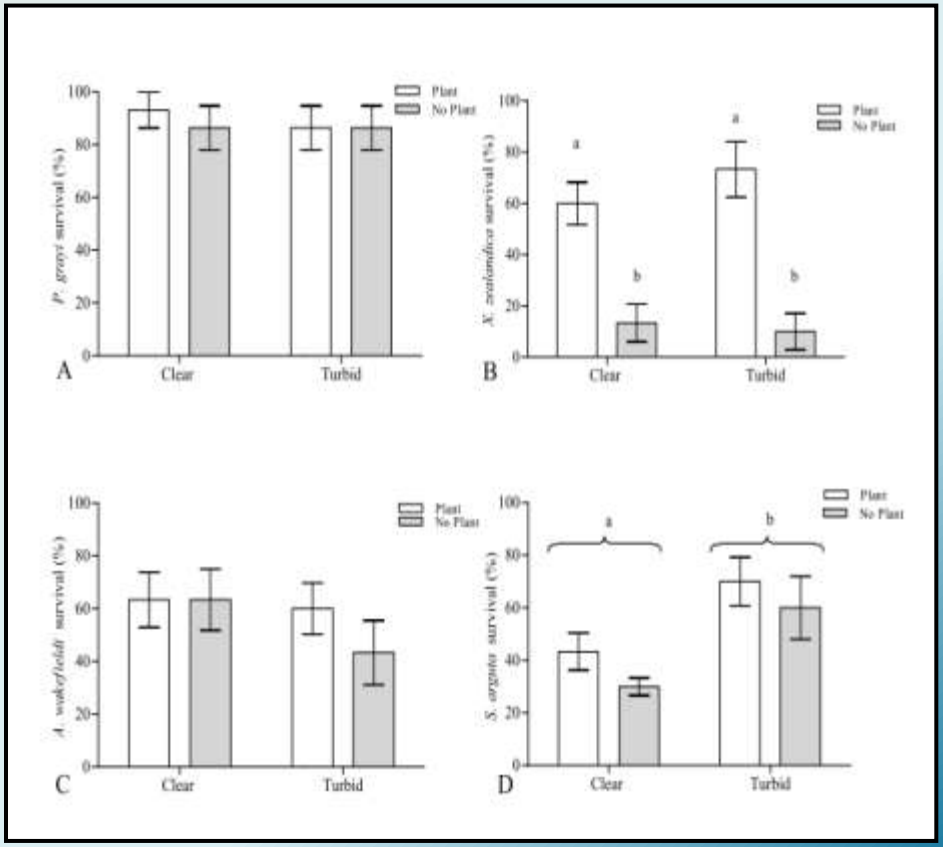
Wood & Harding (2007)

Response of Benthic Invertebrate Fauna to Fluctuating Lake Levels and Salinity in L Ellesmere/Te Waihora

Taryn Wilks
UC MSc thesis, FERG (2010)

(Supervisor: Jon Harding)

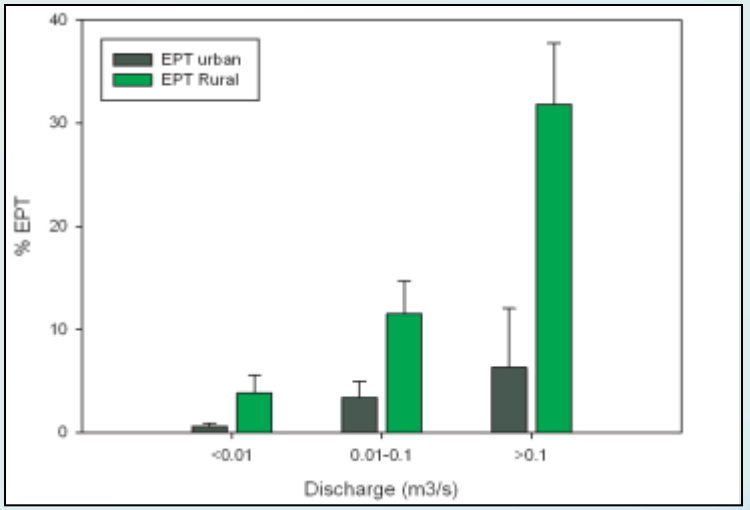
- Invertebrate species diversity highest in upper littoral zone (less dominated by crustacea) and changes seasonally
- There are few invertebrate predators, due to lack of cover (macrophytes) and high turbidity
- Experimental testing with bullies showed turbidity had little effect (except with backswimmers).
- Plants helped damselflies survive fish predation



Riparian Management and Invertebrate Health

Michelle Greenwood
UC PhD (2007) and Post Doc

(Supervisors: Jon Harding & Angus McIntosh)



- Riparian management is inconsistent across the Ellesmere catchment
- Invertebrate communities are severely impacted, limited by stream velocity and sediments (larger streams in better shape).

Greenwood et al. *Journal of Applied Ecology* (*in press*)

Nutrient / Algal Growth Relationships

General

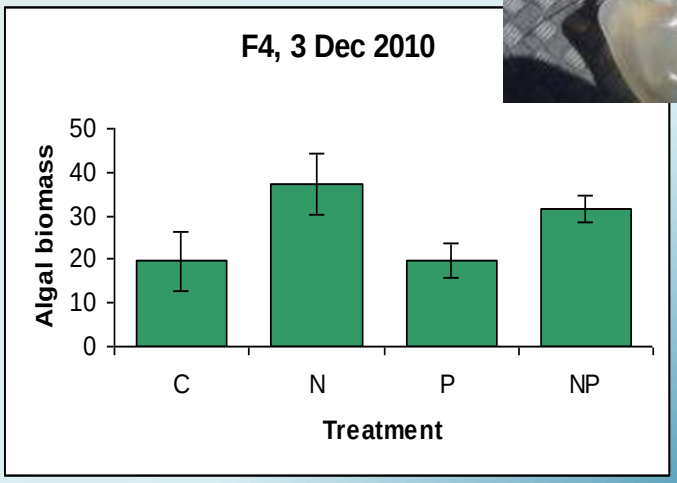
- High levels of nitrate in plains in Ellesmere tributaries (P –limited). Streams are highly productive, with rapid macrophyte growth and productivity controlled by riparian shading
- Banks Peninsular tributaries are N-limited (e.g. Kaituna River)

Bloom formation and nutrient limitation in Te Wairewa/Lake Forsyth

Theresa Burrell
UC MSc thesis, FERG (2011)

(Supervisor: Angus McIntosh)

- Microcosms spiked with N, P, or both (N+P) and deployed on lake
- Results indicate that algal growth in lake is N-limited.

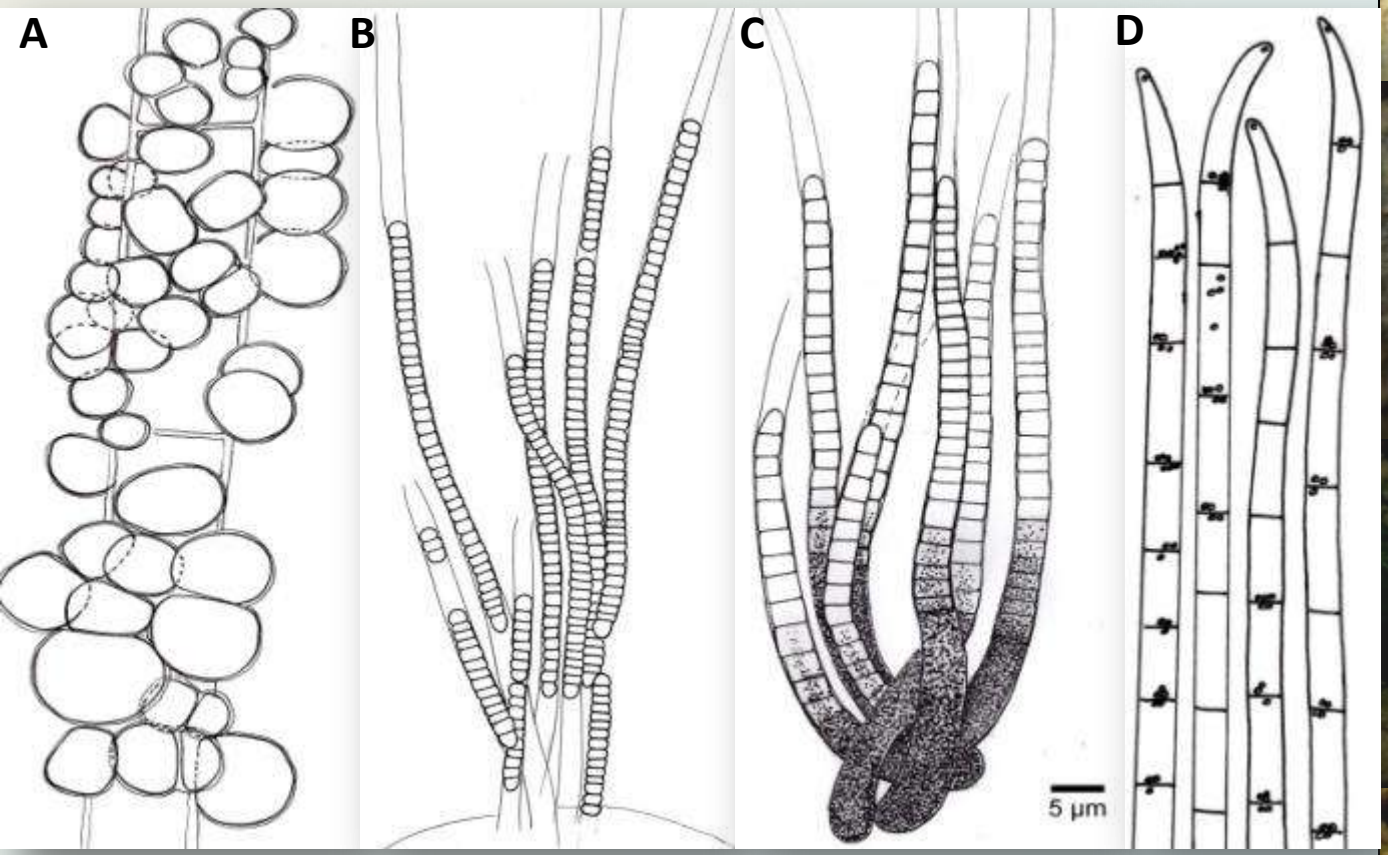


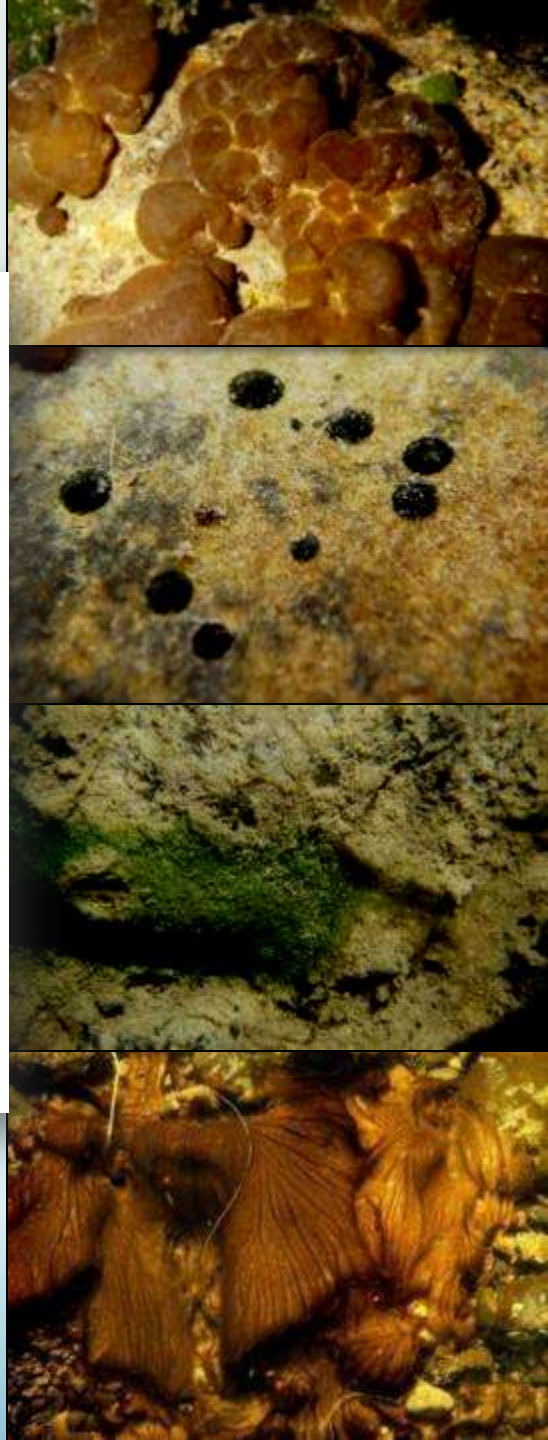
Taxonomic and ecological studies on Cyanobacteria in the Kaituna River catchment, Banks Peninsula

Faradina Merican
UC School of Biological Sciences

(Supervisor: Paul Broady)

- 44 morphospecies in visible mats, crusts and gelatinous colonies in the one river system.
- 22 of these are new records for New Zealand – maybe toxic morphotypes
- Epilithic crusts are ubiquitous but crust component and diversity differs greatly between upstream and downstream sites.
- Rare and poorly known morphotypes occur upstream where the catchment = native vegetation
- Increased cover of potentially toxic oscillatorialean mats recorded downstream of intense dairy farming activity
- Dominance phenomena downstream suggest proliferation by tolerant species in a more unstable/disturbed environment





Newly recorded morphotypes, A. *Xenococcus* sp., B. *Heteroleibleinia fontana*, C. *Homoeothrix gracilis,* D. *Geitlerinema ionicum*

Periphyton proliferation and cyanotoxin production

Francine Smith
UC PhD thesis, Dept of Chemistry (completion 2012)

(Supervisor: Sally Gaw)

- Some cyanobacteria produce toxins
- Dog poisonings, human health issues (drinking water or recreational contact)
- Some mat-forming *Phormidium* strains produce neuro-toxins
- Research into environmental factors promoting distribution and toxin production

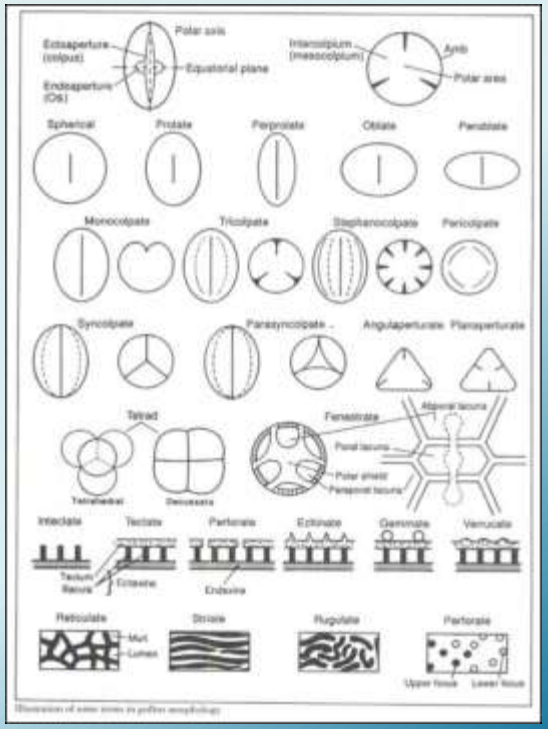
Lake History

The Environmental History of Te Waihora – Lake Ellesmere

Stephen Kitto
UC MSc Geological Sciences, 2010

(Supervisors: Maree Hemmingson, James Shulmeister and Catherine Reid)

- Sediment cores: sediment characteristics, Pb isotopes, palynology and diatom analysis
- Freshwater lake created 7500 yrs ago
- Waimakariri River avulsions led to break through to sea and brackish water
- Closed again to form current nutrient rich lake
- Human management of lake level and impacts of land use evident since 1960s



Holocene record of human induced and natural environmental change in Lake Forsyth (Te Wairewa)

Craig Woodward & Jamie Shulmeister
UC Geological Sciences MSc, 2005 & J Paleolimnoloy paper

Evolution of Kaitorete Spit

Jane Soons and Jamie Shulmeister, S Holt (1997, Marine Geology paper)
UC Geological Sciences

Geoarchaeology adjacent to Waihora

Kari Bassett and David Nobes
UC Geological Sciences

Hydrology

A Review of Permanent Opening Structure for the Drainage of Lake Ellesmere, Te Waihora

Mark Beattie

BE (Hons) Research Project, CNRE, 2005

(Supervisor: Tom Cochrane)

- 3 options for a permanent opening considered (and costed); siphon over Kaitorete spit, lock at Taumutu, culvert through Taumutu beach
- Current mechanical opening found to be most feasible and economical

Management

Benefits of riparian planting: a case study of lowland streams in the Lake Ellesmere catchment

Katie Collins
LU Master of Resource Studies thesis (2011)

(Supervisors: Crile Doscher & Hamish Rennie)

Understanding the spread of riparian restoration in the Te Waihora/Lake Ellesmere catchment

Aminath Nazra
LU Master of Applied Science (Envt Mgt) dissertation (2011)

(Supervisor: Hamish Rennie)

Environmental Education and Environmental Monitoring: Exploring the Interface

Franke Sharpe
LU Master Applied Science (Env. Mgt) dissertation (2009)

(Supervisor: Hamish Rennie)

Time, Events, Attitudes and People: A Study of the Environmental Attitudes of Lake Ellesmere Communities from 1900 – 2000

Golda Varrona
LU PhD Thesis (on going)

(Supervisors: Kevin Moore, Gary Steel & Hamish Rennie)

Fig 1a - Drain with summer weed growth

Fig 1b - Same drain as in fig 1a in autumn after weed removal

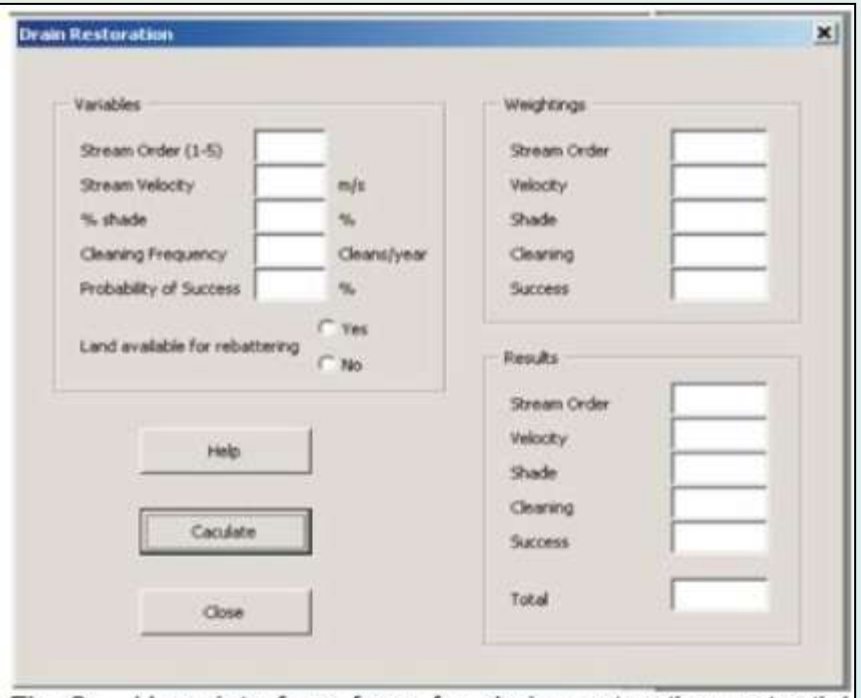


Fig 2 - User interface form for drain restoration potential calculator

Rural Drain Management - Decision Analysis for Better Practice

David Taylor

ENNR 425 NRE Project, CNRE, 2005

(Supervisor: Ash O'Sullivan)

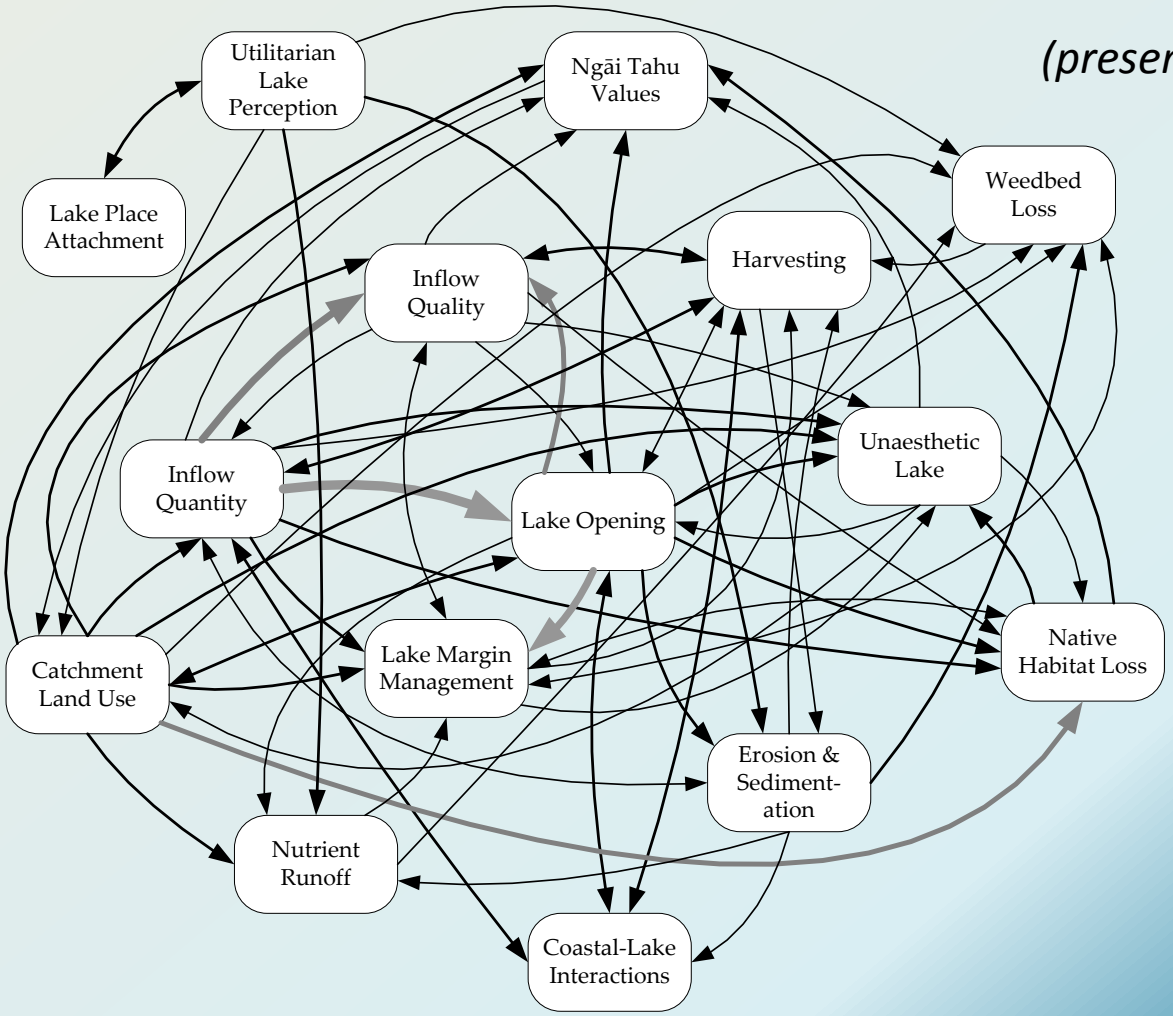
- Weed management
- Is riparian planting the long term solution? Or rebattering?
- Visual BASIC programme to asses restoration potential of a drain reach and recommend appropriate techniques
- Validated against 10 sites in Halswell area

PLOVER: Planning Openings and Values for Ellesmere's Resilience

John (Fritz) Raffensberger
UC Department of Management

Model commissioned by ECan in 2009

(presented at 2009 LLS)



Sample scenario: Careful opening times can improve eel & flounder migration.

	Baseline	Scenario	% change
Lake depth, mm	841	858	2%
Opening cost	-$124,106	-$129,747	5%
# of openings	3.8	3.9	3%
Lake area, h	19,554	19,667	1%
Volume, million m^3	308	312	1%
Dissolved oxygen	11.0	11.0	0%
Salinity, parts/000	6.8	6.7	-1%
Nodularia algae risk	2.7	2.3	-14%
Turbidity, NTU	87.6	86.8	-1%
Sprouting ruppia, h	398.8%	437.5%	10%
Eel recruitment & migration	$360,000	$908,239	152%
Flounder recruitment	$200,000	$291,003	46%
Duck hunting, opening day depth	838	739	-12%
Wader habitat, h	255	270	6%
Waders, population	4,348.3	4,575.7	5%
Farm covered	-129,978	-144,869	11%
Total $000	$305,917	$924,625	202%

Visualising the Impact of Opening Regimes on Te Waihora/Lake Ellesmere

Bernard Otinpong
LU PhD Thesis, Department of Applied Computing, ongoing

(Supervisors: Alan McKinnon, Stuart Charters)

Visualisation Program

Stakeholders of

Te Waihora/Lake Ellesmere

Inter act

Does this improve shared understanding?

Stakeholder organizations will be contacted for the study. If you are a farmer, fisher or lake settler and want to be part of the study, please contact: Bernard at **(03) 3252811 ext.8785, Mobile: 021 138 90, bernard.otinpong@lincolnuni.ac.nz**

A Post-Classical Economics Approach to Ecosystem Management

Edward Hearnshaw
LU PhD thesis (on going)
(Supervisors : Ross Cullen and Ken Hughey)

- Economic evaluation to identify cost-effective management actions for ecosystem management
- Novel ECOPY index devised to reflect the status or health of ecosystems (viewed as complex adaptive systems)
- Ecosystem health defined as a function of utility through ecosystem services, subject to preserving the integrity of the adaptive cycle
- Informed intuition methodology developed for adaptive co-management
  - Fuzzy cognitive mapping for transcribing the mental models of experts (*i.e*. resource co-managers) into a shared common knowledge
  - Scenario analysis for future outcome determination
- Empirical demonstration of the abductive process of research

Hearnshaw, EJS, Cullen, R, Hughey, KFD, Morison, K. (2007). A process of economic evaluation by abductive logic for ecosystem management. 51st AARES Annual Conference, Queenstown February 14-16.

Breaking New Ground: Re-inventing Māori Role in Te Waihora /Lake Ellesmere's Governance

Ali Memon and Nick Kirk

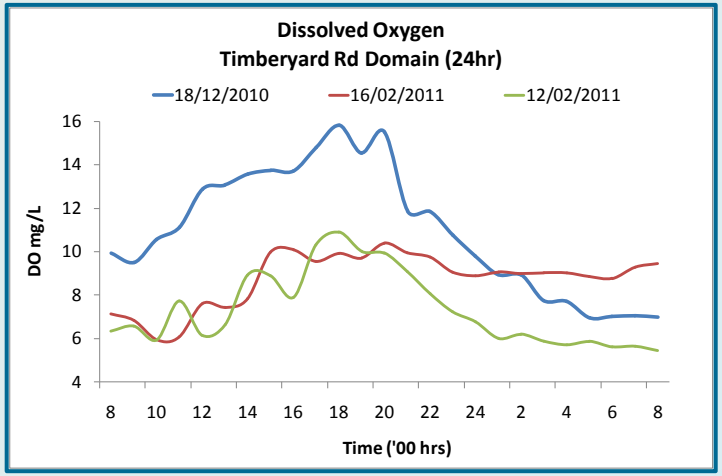
LU Department of Environmental Management

- Research examines recent initiatives to enhance Māori role in water governance in Aotearoa/New Zealand
- Based on a case of the recently reinvented governance arrangements for Te Waihora/Lake Ellesmere in the Canterbury region.
- Argue that three factors: property rights, globalisation and the regulatory planning environment for management both enable and constrain indigenous peoples to govern natural resources within a post-colonial society such as New Zealand
- Te Waihora used as a case study.

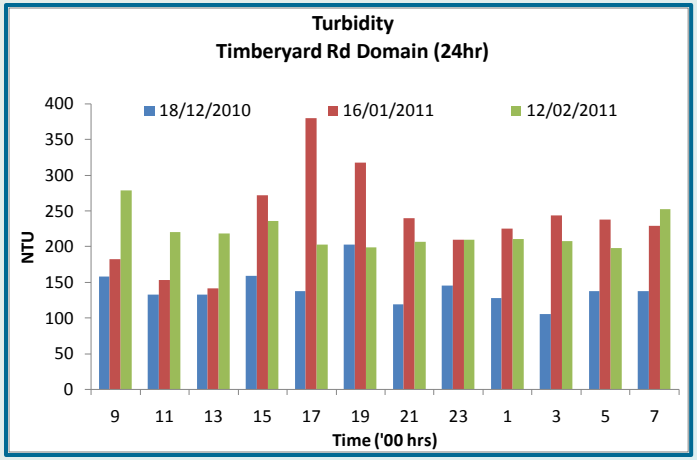
Water Quality

Diurnal Variation in Te Waihora Water Quality Parameters

Kelly Fisher
LU Summer Scholarship, Feb 2011
(Supervisor: Jenny Webster-Brown)

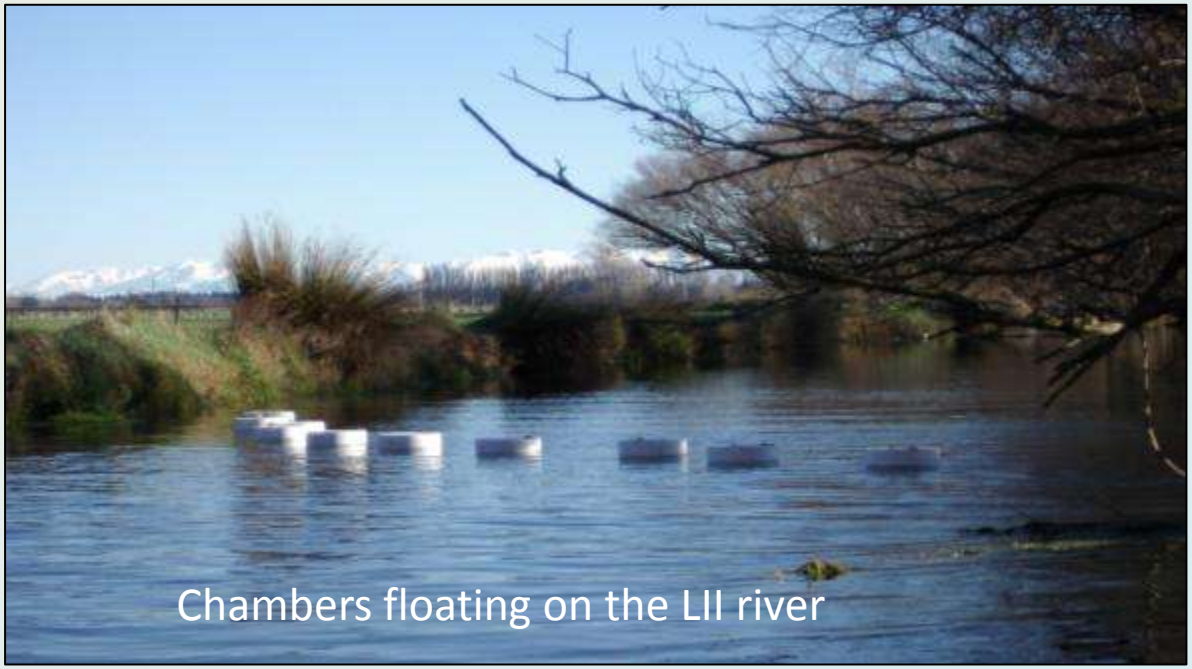


- DO, conductivity, pH, temperature, turbidity.
- 8 x12 hr profiles, and 3 x 24 hr profiles over 3 sites
- 2 depth profiles
- DO variation: min 5.44 mg/L (Timberyard at 8am) and max 20.3 mg/L (Kaituna at 6pm).



Flux of N_2O from the LII and Comparison with IPCC Defaults.

Tim Clough
LU Faculty of Agriculture and Life Science


Chambers floating on the LII river

Clough, T.J., Buckhought,L.E., Kelliher F.M. & and Sherlock R.R. (2007) Diurnal fluctuations of dissolved nitrous oxide (N_2O) concentrations and estimates of N_2O emissions from a spring-fed river: implications for IPCC methodology. Global Change Biology 13, 1016–1027.

Clough T.J., Bertram J.E., Sherlock R.R., Leonard R.L. and Nowicki B.L. (2006). Comparison of measured and EF5-r-derived N_2O fluxes from a spring-fed river. Global Change Biology 12, 352–363.

Measuring Source and Fate of Agricultural Nitrate: A dual-isotope approach

Naomi Wells
LU PhD thesis, Agriculture and Life Sciences

(Supervisor: Tim Clough, T Baisden and Rob Sherlock)

- Developing a stable isotope-based nitrate attenuation/ denitrification index
- Can be used to facilitate nitrate- accounting/ how much is coming from where/when.
- Includes work at Harts Creek

Future Research Plans …

- Lake Research Centre (NT/LU), including a potential field station
- Rivermouth classification and management
- Database development for tributary and lake water quality
- Phosphate release mechanisms in coastal and inland lakes (Sean Waters)
- Ongoing summer scholarships and thesis research to support restoration initiatives

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