A Review of Recent University Research on Te Waihora/Lake Ellesmere and its Catchment
Waterways Centre for Freshwater Management

A joint university focal point for improving knowledge-driven freshwater resource management through teaching and research
Review Structure

- Contamination and remediation
- Ecology
- History
- Hydrology
- Management
- Water Quality
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 as fodder supplements to improve trace element nutrition
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)
• 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 is inconsistent across the Ellesmere catchment.

Invertebrate communities are severely impacted, limited by stream velocity and sediments (larger streams in better shape).

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 oscillatoriaceous 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
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
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)
Rural Drain Management - Decision Analysis for Better Practice

David Taylor

ENNJR 425 NRE Project, CNRE, 2005

(Supervisor: Ash O’Sullivan)

• Weed management

• Is riparian planting the long term solution? Or rebattering?

• Visual BASIC programme to assess 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.

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

Stakeholders of Te Waihora/Lake Ellesmere 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

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 x 12 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).

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